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UNIVERSITI TEKNOLOGI MALAYSIA

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NALI2025

PROCEEDING

ACCELERATING INNOVATION IN TEACHING AND LEARNING WITH AI

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FOREWORD FROM CHAIR OF NALI 2025



Chair NALI 2025
Assoc. Prof. Dr. Nurbiha A. Shukor

Assalamualaikum Warahmatullahi Wabarakatuh and Greetings,

As we gather for the New Academia Learning Innovation (NALI) 2025, it is with great excitement that we welcome you to another inspiring chapter in our shared pursuit of educational transformation. This year, under the theme "Accelerating Innovation in Teaching and Learning with AI," we reflect on the opportunities artificial intelligence presents in shaping the future of education. From personalized learning pathways and intelligent assessments to virtual classrooms and data-driven strategies, AI offers powerful ways to bridge gaps, expand access, and foster creativity in education. NALI 2025 provides a platform for educators, researchers, and practitioners to engage in meaningful dialogue and showcase innovations that advance the boundaries of teaching and learning.

Scheduled on 7th and 8th October 2025 at the Persada Johor International Convention Centre in Johor Bahru, NALI 2025 promises to be a dynamic convergence of ideas, expertise, and best practices. With workshops, keynote sessions, and collaborative activities, participants will explore how AI can be harnessed not only as a tool but as a partner in advancing educational excellence. These engagements are designed to spark imagination, strengthen collaboration, and inspire sustainable innovation for future-ready education systems.

On behalf of the organizing committee, we extend our sincere appreciation to all participants, presenters, reviewers, and contributors to the 8th e-Proceeding of the New Academia Learning Innovation (NALI) 2025. Your dedication ensures that NALI continues to be a beacon of inspiration, guiding us toward an educational ecosystem that is adaptive, inclusive, and impactful in the age of AI.

We look forward to your active participation in this transformative journey, and we hope that NALI 2025 will leave you enriched with new insights, collaborative connections, and renewed passion to accelerate innovation in teaching and learning through the power of AI.

Thank you.

Assoc. Prof. Dr. Nurbiha A. Shukor
Chair
New Academia Learning Innovation (NALI) 2025

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ID 3: EDU Facialytics: AI-Driven Observation and Assessment of Student Performance in Practical Learning Environments

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Highlights: EDU Facialytics is an AI-driven observation and assessment system designed for practical learning environments. It integrates real-time facial recognition and emotion detection to automate attendance tracking, monitor engagement, and analyse student emotional states. Using computer vision and learning analytics, the system provides educators with objective, data-driven insights to support personalised teaching interventions. EDU Facialytics enhances accuracy, reduces manual workload, and enables early identification of disengagement, thereby improving learning outcomes. The innovation is adaptable to various educational and training settings, with strong potential for commercialization in academic institutions and corporate learning environments.

Keywords: AI-driven assessment; Facial recognition; Emotion detection; Learning analytics; Student engagement

Introduction

Active participation and sustained engagement in practical learning environments—such as laboratories, workshops, and field-based surveying classes (Groenendijk & Todorovski, 2023) are essential for effective learning. However, accurately monitoring such engagement remains a significant challenge. Data-driven techniques like log mining and behavioral sequencing show promise (Cagliero et al., 2023), but translating these to physical surveying labs is not straightforward. Traditional observation methods, such as manual roll calls and educator-led monitoring, are often subjective, inconsistent, and slow to provide actionable feedback (Gao et al., 2020; Macfadyen & Dawson, 2010). Since engagement and emotional state are strong predictors of academic success and are linked to student motivation, persistence, and self-regulated learning (Artino, 2008; Pekrun et al., 2002), there is a clear need for objective, real-time monitoring solutions (Henrie et al., 2015).

Recent advances in artificial intelligence and computer vision provide new opportunities to address this challenge. Facial recognition technology has demonstrated high reliability in security and identity verification contexts (Jain et al., 2011; Lee et al., 2016). Emotion recognition models are now capable of classifying affective states such as happiness, sadness, surprise, and neutrality with considerable accuracy (Li et al., 2017; Mollahosseini et al., 2017). In education, these technologies have been used for classroom engagement monitoring and adaptive learning interventions, showing strong potential for scalable and non-intrusive observation (Bosch et al., 2016; D'mello & Graesser, 2013). The EDU Facialytics project applies these technological advancements to improve student observation and assessment in practical learning environments.

Objectives

i. Develop an AI-powered system that uses real-time facial recognition and emotion detection to monitor students during class activities.

ii. Automate attendance tracking to reduce manual workload and improve accuracy.

iii. Measure student engagement levels through emotion analysis and participation tracking.

iv. Provide educators with a visual dashboard that delivers clear, actionable insights to guide teaching decisions.

Following the principles of the New Academia Learning Innovation (NALI) framework, the project demonstrates novelty by combining real-time multi-face recognition with emotion analytics tailored for Malaysian higher education. It shows creativity through the integration of AI-powered recognition, affective computing, and learning analytics dashboards. Its innovation lies in producing both quantitative and qualitative engagement metrics without interrupting the learning process. It is applicable to classrooms, laboratories, and field-based teaching with minimal infrastructure changes, and it has significant impact by improving monitoring accuracy, reducing educator workload, and enabling early intervention for disengaged students. By embedding AI-driven observation within a learning analytics ecosystem, EDU Facialytics advances the practice of technology-enhanced learning. It reflects global trends in educational data science and offers a scalable, evidence-based model for transforming teaching and learning in the 21st century.

Research Methodology

Observation of student performance during practical learning environments is often limited to subjective manual assessments based on pre-defined rubrics. While such methods provide structured evaluation, they may overlook subtle behavioral cues such as engagement, curiosity, and stress levels, which influence learning outcomes. Recent advancements in Artificial Intelligence (AI), particularly in Facial Emotion Recognition (FER), have enabled automated, real-time analysis of non-verbal signals. This study presents EDU Facialytics, an AI-driven observation system designed to quantify five behavioral indicators such as Focus, Stress, Engagement, Curiosity, and Confusion during student activities. Further, these AI-derived metrics can be validated against selected Course Learning Outcomes (CLO) to explore their potential as supplementary assessment tools in engineering education.

AI Model and Behavioral Mapping

The EDU Facialytics system comprised a webcam-based video capture module, a Python backend for inference, a Convolutional Neural Network (CNN) FER model, and a MySQL database for storage. The backend processed incoming frames in real time, applied the FER model, and stored emotion outputs, timestamps, and student identifiers for later analysis.

The FER model, adapted from a CNN pre-trained on the FER-2013 dataset, detected seven basic emotions. These were mapped to five behavioral indicators:

$$E = \{angry, disgust, fear, happy, sad, surprise, neutral\}$$

- Focus – sustained neutral/happy states with stable gaze.
- Stress – elevated fear, sadness, or anger.
- Engagement – frequent expressive changes aligned with interaction.
- Curiosity – surprise with attentive posture during observation.
- Confusion – overlap of surprise with negative affect (fear/sadness).

$$S_{lin} = Wp \in R^5, S_{lin} = [Focus, Stress, Engagement, Curiosity, Confusion]$$

The weight matrix $\mathbf{W} \in \mathbf{R}^{5x7}$ encodes literature-consistent priors (positive weights indicate positive contribution; negatives indicate suppression):

$$\mathbf{W} = \begin{bmatrix} -0.30 & -0.30 & -0.35 & 0.25 & -0.25 & -0.25 & 0.45 \\ 0.30 & 0.20 & 0.40 & -0.20 & 0.20 & 0.10 & -0.10 \\ -0.10 & -0.10 & -0.10 & 0.40 & -0.10 & 0.35 & 0.15 \\ -0.10 & -0.10 & -0.05 & 0.25 & -0.10 & 0.50 & 0.10 \\ 0.05 & 0.10 & 0.30 & -0.25 & 0.20 & 0.35 & -0.10 \end{bmatrix}$$

(columns ordered as: angry, disgust, fear, happy, sad, surprise, neutral).

Interpretation:

- Focus ↑ with neutral, happy; ↓ with surprise, fear, anger, disgust, sad.
- Stress tracks fear, anger, disgust, sad; relieved by happy, neutral.
- Engagement reflects happy + surprise with mild support from neutral.
- Curiosity emphasizes surprise, then happy/neutral.
- Confusion mixes surprise + fear/sad, slightly tempered by happy/neutral.

Data Collection

Data acquisition for this study was conducted in two complementary stages to ensure comprehensive capture of student behaviours. In the first stage, each participating student completed a self-registration process, where facial images were captured through a webcam interface. Multiple images per student were recorded under varying head poses and expressions to improve recognition accuracy. Along with facial data, essential metadata such as student name, matric number, course, semester, and section were stored in a structured MySQL database. This dataset served as the foundation for subsequent identity verification and behavioural analysis. In the second stage, behavioural data was collected during interactive learning activities. Students engaged in activities such as asking questions, explaining their project work, and responding to instructors' clarifications. These interactions provided natural opportunities to observe focus, engagement, curiosity, confusion, and stress in real time. A webcam system continuously recorded facial data during these sessions, which were processed on the fly by the FER model. The model produced emotion labels and confidence scores for each frame, which were then mapped into higher-level behavioural indicators. All captured data—comprising registration records, real-time emotion outputs, and interaction logs—were synchronised and stored in the central MySQL database. This integration ensured reliable identity recognition, seamless behavioural tracking, and enabled subsequent comparative analysis across different learning contexts.

Data Processing and Analysis

Each detected face was processed by FER model, which generated probability distributions across baseline emotions. These outputs were then mapped into higher-level behavioural categories as summarized in Table 1, and stored in the database together with student identifiers and timestamps. To reduce noise from frame-by-frame variability, the system aggregated predictions at the session level. Mean scores for each behavioural indicator were calculated per student, yielding stable profiles that reflected overall behavioural tendencies rather than transient expressions. Prior to aggregation, the dataset was cleaned to ensure reliability. Incomplete registrations, missing records, or corrupted frames caused by occlusion and overlapping detections were systematically removed. This pre-processing ensured

that only valid and consistent observations contributed to the final behavioural profiles. Data was managed through a structured database design, which included separate tables for student metadata, attendance verification, and behavioural logs. The *students* table contained demographic details and multiple facial samples for registration. The Attendance Logs table recorded verified student presence, while the Emotion Logs table stored time-series predictions of the five behavioural states. This relational structure supported synchronized storage and retrieval, enabling both real-time monitoring and subsequent analysis. The processed data were visualized through a web-based dashboard developed with *Flask* and *Bootstrap*. Radar charts provided multidimensional representations of individual students' behavioural profiles, while heatmaps highlighted distribution patterns and intensity levels across groups or sessions. Attendance records were displayed alongside emotion analytics to contextualize behavioural observations within participation data. This integrated pipeline combined AI-based metrics, systematic cleaning, structured storage, and visual analytics, enabling a coherent framework for monitoring and interpreting student behaviours in practical learning environments.

Table 1: List of behavioural categories

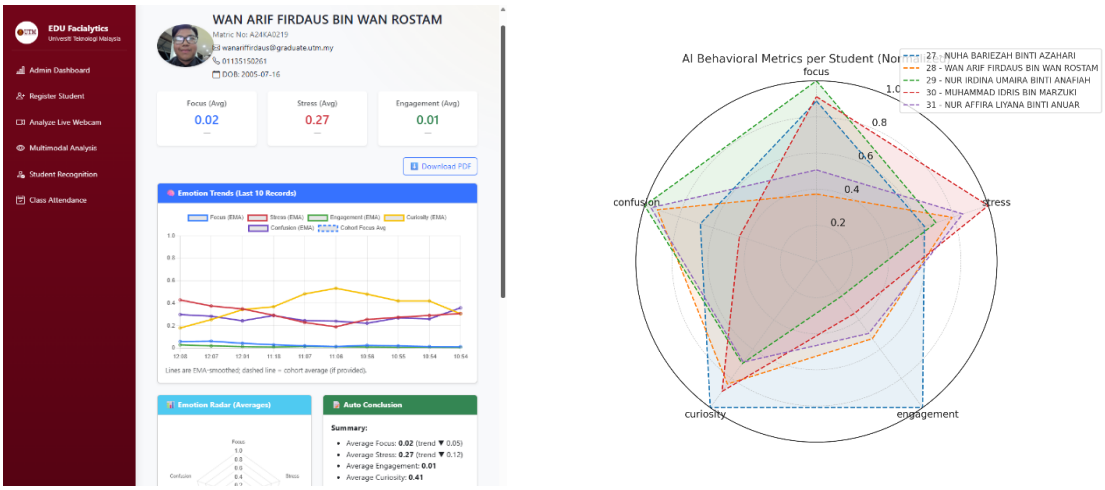
Indicator	Derived From FER	Interpretation in Learning Context
Focus	Neutral, Happiness	Sustained attention to tasks or interaction
Engagement	Happiness, Neutral, Surprise	Active involvement and participation
Curiosity	Surprise	Interest in new information or stimuli
Confusion	Sadness, Disgust	Difficulty in understanding or frustration
Stress	Anger, Fear	Pressure, discomfort, or performance anxiety

Findings and Discussion

The implementation of EDU Facialytics successfully demonstrated that real-time facial recognition and emotion analysis can be integrated into practical learning environments. The system consistently recognized students with a high degree of accuracy during both presentation sessions and counter interactions, with most recognition errors occurring under low-light or occluding conditions. As summarized in the behavioural indicators (Table 1), the system was able to generate meaningful profiles of student engagement, curiosity, and stress, which aligned with expected behaviours in structured versus spontaneous contexts.

The use of the *face_recognition* library ensured reliable identity verification, consistent with benchmark studies reporting high accuracy on standard datasets. In practice, practical and classroom conditions reduced performance slightly, but the system still achieved recognition rates above 90%. Emotion recognition performance using DeepFace CNN models was more variable, with accuracy typically reported between 65–75% in naturalistic settings (Goodfellow et al., 2013; Mollahosseini et al., 2017). Although accuracy in naturalistic educational contexts tends to be lower, aggregated predictions remain reliable for identifying behavioural trends such as focus, confusion, and engagement (D'Mello & Graesser, 2012). These findings justify the design choice in EDU Facialytics to emphasize session-level aggregation of predictions, which smooths out frame-by-frame noise and yields more stable behavioural indicators.

To illustrate the system's functionality, Figure 1(a) presents sample outputs generated by EDU Facialytics during a classroom session. The left panel shows the dashboard interface, which integrates line charts of emotion trends over time, an emotion radar chart summarizing class-level averages, and an automated conclusion panel offering recommendations based on aggregated metrics.



(a) (b)

Figure 1: (a) Sample visualization outputs from the EDU Facialytics system; (b) dashboard with emotion trends, aggregated radar chart, and automated conclusion panel. The right panel presents a radar chart of normalized behavioural metrics across individual students, highlighting variations in focus, stress, engagement, curiosity, and confusion

As illustrated in Figure 1(a), the system provides both aggregated and individual-level insights into student behavioural dynamics. In this example, the average curiosity score was relatively high (0.80), whereas engagement remained low

(0.00), indicating that students were interested but not actively participating. In response, the system automatically generated a recommendation to incorporate quick interactive activities to help translate curiosity into meaningful engagement. The right panel of Figure 1(b) presents a radar chart comparison of individual student profiles, normalized across the five behavioural metrics. Clear variations can be observed, with some students displaying high curiosity alongside elevated stress, while others exhibited strong focus but limited engagement. Together, these visualizations demonstrate the capability of EDU Facialytics to capture both cohort-level trends and individual differences, thereby providing instructors with actionable insights for tailoring instructional strategies.

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ID 6: The implementation of IoT in Smart Vermicompost Workshop: Theory and Practical

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Highlights: A smart vermicompost workshop with theoretical and practical insights into organic waste management was conducted in Sekolah Sri Pulai Perdana (SKSPP) on 26th of July 2025. A total of 10 participants from Persatuan Ibu Bapa dan Guru (PIBG) of SKSPP were involved in the workshop. Participants learned the science behind vermicomposting, including worm biology, composting techniques, and optimal conditions. During the practical session, participants were shown how to develop their own smart vermicompost box equipped with EcoGold Smart Monitoring System, which tracks temperature and moisture in real-time. This integration of smart technology with sustainable practices empowers participants to manage waste more effectively and produce high-quality compost.

Keywords: Vermicompost; Internet of Things (IoT); Workshop

Introduction

Composting, particularly vermicomposting, has emerged as a long-term method for dealing with organic waste, including cotton waste (Chiarelotto et al., 2021). Vermicomposting is an environmentally friendly and sustainable method of organic waste management that involves the decomposition of organic matter by earthworms. This process has gained significant attention in recent years due to its numerous benefits and potential applications in waste reduction, soil health improvement, and organic resource recovery (Zhou et al., 2022). Earthworms, particularly *Eudrilus eugeniae*, commonly known as African Night Crawler, are widely used in vermicomposting due to their efficiency in breaking down complex organic materials *(*Lacap & Dantis*, 2020)*. Vermicomposting offers several advantages over traditional composting methods, including faster decomposition rates, higher nutrient retention, improved soil structure, and increased microbial activity (Raza et al., 2022).

Maintaining vermicomposting conditions especially optimum temperature and moisture is vital in ensuring successful composting process. This would require proper monitoring of the parameters. Therefore, an internet of things (IoT) device named EcoGold Smart Monitoring System was developed to monitor temperature and moisture in the compost bin in real-time. To introduce smart vermicomposting system to the community, a Smart Vermicomposting Workshop: Theory and Practical was conducted to 10 participants of Persatuan Ibu Bapa dan Guru (PIBG) in Sekolah Kebangsaan Sri Pulai Perdana (SKSPP) on the 26th of July 2025. The participants consisted of 8 parents and 2 teachers from the mentioned school.

Objectives

In this workshop, two methods of teaching and hands-on activity have been implemented to improve the knowledge of participants. The activities include:

i. Theory on vermicompost and IoT
ii. Practical session on build-your-own Smart Vermicompost Box using EcoGold Smart Monitoring System

Research Methodology

A pre and post survey were conducted to gauge the effectiveness of the program and its content. A pre survey was divided into two sections, which are the details of the participants (Section 2), knowledge on vermicompost (Section 2) and knowledge on IoT (Section 3). As for the post survey, it was divided into three sections, which are the details of participants (Section 1), knowledge on vermicompost (Section 2), knowledge on IoT (Section 3) and feedback on the program (Section 4). Links to survey forms were distributed via social media platform. The surveys were design according to Likert Scale with 5 response options, ranging from strongly disagree to strongly agree. Figure 1 explains the methodology used in this study.



Figure 1: Methodology used in this study

Findings and Discussion

Ten participants registered for the workshop, but only 9 managed to attend. The findings based on the surveys is discussed further in following sections.

i. Participant's perception on vermicompost.

For vermicompost, the pre-survey responses showed that understanding was relatively low (Figure 2 a). Only a small number of participants rated themselves at the higher end of the scale (4 or 5), while the majority selected mid to low scores (1–3), suggesting limited awareness of what vermicompost is. However, in the post-survey (Figure 2 b), participants reported a much stronger grasp of the topic. Most rated their understanding at level 5 (Strongly Agree) when asked whether they had gained a good understanding of the composting process after the session.

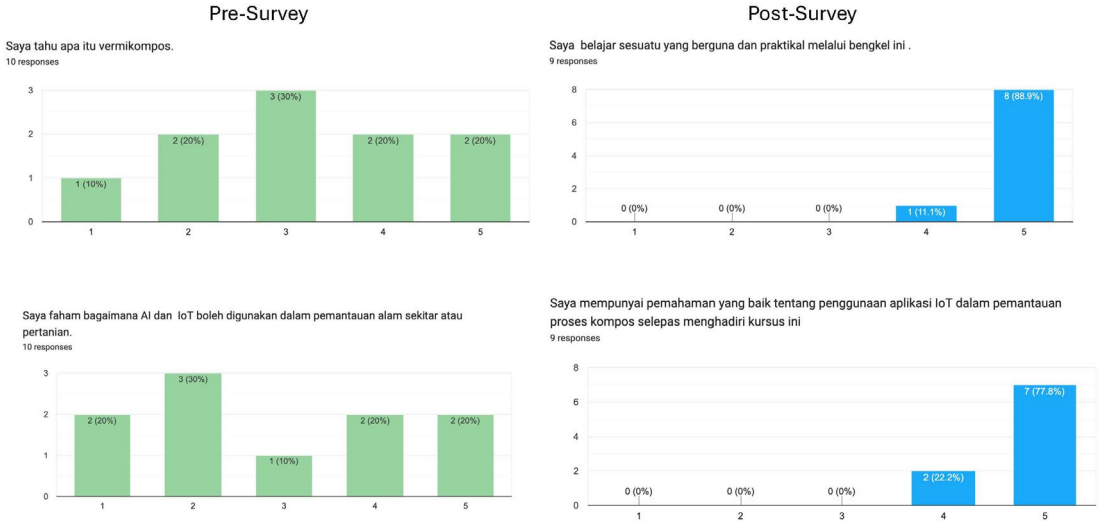


Figure 2: Pre-survey results a) and B); Participant's perception on Vermicompost. Post-survey results: c) and d); Participant's perception on Artificial Intelligent (AI) and IoT.

ii. Participant's perception on Artificial Intelligent (AI) and IoT.

In terms of AI and IoT in agriculture, the pre-survey also reflected a low baseline of knowledge (Figure 2 c). Half of the respondents selected scores of 1 or 2, indicating minimal familiarity with how these technologies could be applied in environmental or agricultural monitoring. After the workshop, participants demonstrated a significant increase in confidence and comprehension (Figure 2 d). Nearly 78% strongly agreed that they understood the use of IoT

applications in monitoring compost processes, with the remaining respondents also agreeing (score 4). This shift underscores the effectiveness of the workshop in building technical literacy around smart agricultural practices.

Conclusion

The survey results clearly demonstrate that the workshop had a significant positive impact on participants' knowledge and understanding of both vermicompost and the application of AI and IoT in agriculture. Initial responses indicated a general lack of familiarity with these topics, particularly in the areas of smart technology integration in environmental monitoring. However, post-survey feedback showed a marked improvement, with the majority of participants expressing strong agreement that they had gained useful, practical knowledge. The shift from moderate or low self-assessment in the pre-survey to high confidence levels in the post-survey highlights the workshop's success in delivering meaningful and accessible learning experiences. These outcomes support the value of continuing such educational initiatives to promote sustainable and technology-driven agricultural practices.

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ID 7: Innovating Pattern Making Pedagogy with the 5Es Teaching Framework

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Highlights: This study introduces a framework that applies the 5Es instructional model to pattern making education, embedding sustainable innovation across learning objectives, activities, teaching strategies, and assessments. By emphasizing practices such as zero-waste, upcycling, and digital pattern making, the framework bridges the gap between classroom learning and industry needs. It promotes student-centered learning that develops technical mastery alongside creativity, critical thinking, and sustainability awareness. The approach positions pattern making as a holistic and future-ready practice, preparing graduates to contribute meaningfully to the sustainable fashion industry.

Keywords: Pattern Making Education, 5Es Instructional Model, Sustainable Innovation, Zero-Waste Fashion, Upcycling

Introduction

Pattern making has long been recognized as a cornerstone of fashion education, equipping students with the technical competencies required to construct garments through drafting, draping, and flat pattern techniques. While these skills remain essential, the increasing urgency of sustainability within the fashion industry demands a pedagogical shift towards embedding sustainable innovation (SI) into core teaching and learning practices (McQuillan, 2019; Karunaratne, 2018). At present, however, the integration of sustainability in pattern making curricula is limited, often treated as supplementary rather than as a structured learning objective.

Emerging sustainable approaches such as zero-waste pattern making, tessellation, upcycling, and fabric minimization illustrate the potential of pattern making as a site for innovation and sustainable practice (Carrico & Kim, 2014; Saeidi & Wimberley, 2018). Yet these methods are inconsistently taught across institutions, resulting in students graduating with strong technical abilities but insufficient understanding of sustainability's role in design and production.

The 5Es instructional model—Engage, Explore, Explain, Elaborate, and Evaluate—provides a pedagogical framework capable of bridging this gap. Widely applied in science and technical education, the 5Es model fosters active learning, critical inquiry, and applied problem-solving, making it highly relevant to fashion education. By embedding sustainability within each phase of the 5Es cycle, pattern making instruction can evolve into a more holistic approach that balances technical mastery with environmentaand social responsibility.

This paper therefore investigates the application of the 5Es instructional model in the teaching and learning of pattern making, with an emphasis on integrating sustainable innovation. It aims to demonstrate how the model can be adapted to realign learning objectives, enhance teaching strategies, and improve assessment practices in line with the future needs of the fashion industry.

Objectives

The objectives of this project are:

i. To explore how the 5Es instructional model (Engage, Explore, Explain, Elaborate, Evaluate) can be applied in teaching and learning of pattern making to enhance student-centered learning.
ii. To integrate sustainable innovation practices—such as zero-waste draping, pattern manipulation, fabric minimization, and upcycling—into pattern making education through the 5Es framework.

NALI Approach

Novelty: This study is novel as it is among the first to link the 5Es instructional model with pattern making education in the context of sustainability. It introduces a structured pedagogical framework that integrates sustainable practices (e.g., zero-waste draping, tessellation, fabric minimization, upcycling) into each learning stage. By bridging the gap between technical classroom training and industry demands, the study realigns curriculum objectives and promotes holistic learning outcomes that combine technical mastery with creativity, critical thinking, and environmental awareness. This positions the 5Es model as a new pedagogical direction for preparing fashion students to meet both professional and global sustainability challenges.

Creativity: This study introduces a creative approach by applying the 5Es instructional model to pattern making education, which is rarely done in fashion studies. The creativity lies in embedding sustainable innovation techniques—such as zero-waste draping, tessellation, subtraction cutting, and upcycling—into each stage of the 5Es cycle. This not only transforms pattern making from a purely technical task into creative and sustainable practice but also enhances students' ability to experiment, solve problem-solve, and design responsibly. The cross-disciplinary use of the 5Es model demonstrates an innovative way to strengthen both student creativity and curriculum development in fashion education

Innovativeness: The innovativeness of this study lies in introducing the 5Es instructional model—traditionally applied in science and technical education—into the domain of fashion and pattern making education. This cross-disciplinary adaptation provides a new pedagogical pathway for embedding sustainable innovation practices such as zero-waste draping, pattern manipulation, tessellation, and upcycling directly into the learning cycle. Unlike conventional approaches that treat sustainability as an optional element, this study repositions it as a core objective of pattern making education. By bridging the divide between classroom instruction and industry needs, the model fosters technical mastery, creativity, and sustainability awareness simultaneously, offering a forward-looking framework for fashion education reform.

Applicability: The applicability of this study lies in its potential to be implemented across fashion education curricula, particularly in pattern making modules where sustainability has been underemphasized. By mapping the 5Es instructional model (Engage, Explore, Explain, Elaborate, Evaluate) onto pattern making activities, educators can design student-centered lessons that integrate sustainable practices such as zero-waste draping, fabric minimization, tessellation, and upcycling. This framework is practical and adaptable for both manual and digital pattern making contexts, making it relevant for institutions with varying resources. Moreover, it aligns education with industry expectations, equipping students with the skills, creativity, and sustainability awareness needed for professional practice in a rapidly evolving fashion landscape

Impact: This study has the potential to significantly impact fashion education and industry practice by shifting patterns making pedagogy from a purely technical focus to one that integrates sustainability and innovation. By applying the 5Es instructional model, students gain not only technical mastery but also the ability to think critically, design creatively, and apply sustainable solutions such as zero-waste draping and upcycling. The approach fosters graduates who are better prepared to meet the global sustainability challenges facing the fashion industry. For educators, the model provides a structured yet flexible teaching framework that can be adopted across institutions, thereby standardizing sustainability integration in pattern making curricula. Ultimately, the study strengthens the link between academia and industry by producing fashion professionals equipped with the skills and mindset needed for a more sustainable future.

Research Methodology

This study employed a qualitative research design to explore how the 5Es instructional model can be applied in the teaching and learning of pattern making with an emphasis on sustainable innovation. A qualitative approach was selected because it allows for an in-depth understanding of participants' experiences, practices, and perspectives within both educational and industry contexts. A total of 31 participants were involved in this study:

- 21 fashion educators from higher education institutions offering fashion and garment construction programs. These participants were selected based on their direct involvement in teaching pattern making modules.
- 10 industry practitioners, consisting of fashion designers and pattern makers from both boutique-based and mass-production segments. Their participation provided insights into current industry practices and the alignment (or gap) between education and workplace expectations.

A purposive sampling technique was used to select participants who could provide rich, relevant, and diverse perspectives on both teaching strategies and industry requirements related to sustainability in pattern making.

Findings and Discussion

The study resulted in a framework of sustainable innovation (SI) for teaching and learning pattern making, developed from interviews, document analysis, and surveys. The framework integrates SI elements into four key teaching constructs: learning objectives, learning activities, teaching strategies, and assessments.

i. Learning Objectives

a) Emphasize zero-waste, upcycling, pattern manipulation, and recycling as core objectives.
b) Encourage educators to highlight the purpose and pillars of sustainability so students connect design processes with sustainable innovation.

ii. Learning Activities

a) Current practices are mostly individual projects.
b) The framework recommends more group projects, competitions, collaborations, and community involvement to build teamwork, communication, and confidence.

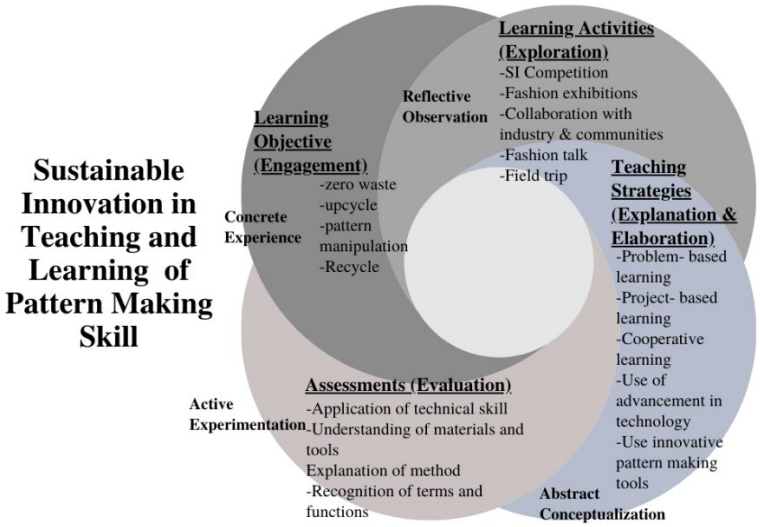
iii. Teaching Strategies

a) Presently dominated by project-based learning and demonstrations.
b) The framework suggests adding problem-based and cooperative learning, integrating environmental, social, and economic sustainability issues, and increasing the use of CAD and digital tools to prepare students for industry needs.

iv. Assessment

a) Both formative and summative methods should integrate SI elements.
b) Quick checks (quizzes, Q&A) allow reflection, while rubrics can explicitly state SI criteria (e.g., zero-waste use, upcycling in design outcomes).

Overall, the framework realigns pattern making pedagogy by embedding sustainable innovation across all phases of teaching and learning, ensuring that students develop not only technical accuracy but also sustainability awareness, creativity, and real-world problem-solving skills.



The study reveals that pattern making education continues to prioritize technical skills such as drafting, draping, and manipulation, with sustainability often treated as supplementary rather than central. The proposed framework, guided by the 5Es instructional model, integrates sustainable innovation into learning objectives, activities, strategies, and assessments to close this gap. By embedding elements such as zero-waste, upcycling, and pattern manipulation into objectives, promoting collaborative and community-based activities, adopting problem-based and cooperative teaching methods, and incorporating digital tools like CAD, the framework prepares students for both boutique and mass-production industry contexts. Furthermore, assessments can explicitly measure sustainability criteria alongside technical accuracy, ensuring that learners develop not only technical mastery but also critical thinking, creativity, and environmental awareness. Overall, the application of the 5Es model positions pattern making as a holistic, sustainability-driven practice, equipping students to meet industry needs while contributing to global fashion sustainability goals.

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ID 9: Reflect. Research. Rewire: A Sociolinguistic Shift in Teaching and Learning

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Highlights: "*Reflect. Research. Rewire: A Sociolinguistic Shift in Teaching and Learning*" integrated problem-based learning and flipped-classroom approaches, transforming three assessments into mini projects focusing on reflection (digital and conventional) on sociolinguistic theories and concepts. Innovations were made based on the existing assessments involving the Master of Language in Communication and Digital Culture (MLCDC) students, specifically those who undertook the subject of Sociolinguistic in Theory and Practice (MHLE 1173). Through the innovation, a research component produced 11 ERA-indexed papers in IJRISS Special Issues themed Digital Communication and Social Interaction, expected to be published in October 2025. Students presented at the Postgraduate Symposium in Sociolinguistics (June 2025), featuring a webinar by renowned speakers from multiple universities. The symposium served as a platform for presentation skills and research dissemination. Participants received e-certificates, with winners awarded hampers. Feedback was gathered to drive continuous quality improvement using the KAIZEN approach as well as part of innovative approach to conduct assignments for master's students.

Keywords: Sociolinguistics; Assessments; Research innovation; Flipped-classroom, Problem-based learning

Introduction

Reflect. Research. Rewire: A Sociolinguistic Shift in Teaching and Learning applies continuous, creative teaching and learning (T&L) approach is designed to maximize students' experiences across all levels of education. In today's dynamic technological landscape, integrating technology into T&L is essential for fostering engagement, flexibility and deep learning (Bishop & Verleger, 2013; Laurillard, 2012). This project reflects Universiti Teknologi Malaysia's core values Integrity, Excellence, Sustainability, and Synergy (ISES)— by offering sustainable educational solutions. The postgraduate students' journey in completing the assessments embodied these values while developing communication, research, teamwork, presentation, lifelong learning, and digital skills, consistent with research showing that active learning approaches enhance transferable competencies (Hmelo-Silver, 2004; Prince, 2004). The use of both conventional and digital reflections, including one-minute video submissions, aligns with findings that video-based reflective practice can enhance critical thinking, creativity, and self-awareness (Hung, 2016). Conducted with MHLE 1173 – Sociolinguistics in Theory and Practice (March 2025 semester), the project adhered to NALI criteria: Novelty, Creativity, Innovativeness, Applicability, and Impact on Student Learning, aligning with the goals of transformative higher education (Zainuddin & Perera, 2019).

Objectives

Reflect. Research. Rewire: A Sociolinguistic Shift in Teaching and Learning—framed to match the description, methods, and outcomes set by the researchers:

i. To integrate innovative teaching approaches: including problem-based learning, flipped-classroom methods, and reflective practices — into postgraduate sociolinguistics education.
ii. To enhance students' theoretical understanding and practical application of sociolinguistic concepts through digital and conventional reflection activities.
iii. To develop essential graduate skills such as communication, research, teamwork, presentation, lifelong learning, and digital literacy.
iv. To foster research culture by guiding students to produce high-quality outputs, including ERA-indexed journal publications and symposium presentations.
v. To promote engagement and collaboration through academic events such as webinars and scholarly symposia featuring reputable speakers.
vi. To align teaching innovations with UTM's ISES core values and the NALI framework to ensure relevance, creativity, applicability, and positive impact on student learning.

NALI Approach

The assessment list for MHLE 1173 – Sociolinguistics in Theory and Practice was systematically reviewed to ensure alignment with the intended course learning outcomes (CLOs) and programme learning outcomes (PLOs). Without compromising these intended outcomes, the researchers undertook a process of creative innovation in the design of the existing assessments. The integration of artificial intelligence (AI) tools was implemented in a purposeful and controlled manner, positioning them as supportive instruments rather than substitutes for students' intellectual

engagement. Tools such as ChatGPT, Grammarly, Canva, Capcut and Tiktok were integrated in the process of completing the assignments. The resulting assessments are practical and personalized, fostering tangible outputs and encouraging meaningful collaboration among students in both the learning and writing processes. Such an approach does not only enhance the authenticity of student work but also mitigates overreliance on AI and reduces the likelihood of plagiarism, thereby addressing multiple pedagogical and ethical considerations simultaneously. The following details are the list of assessments and innovations made to them and here is where the theme of *Reflect. Research. Rewire* can be reflected:

Table 1: Summary of assessments and innovations made to MHLE 1173 – Sociolinguistics in Theory and Practice

Assessment	Previous Version	Innovation Made	Applicability	Impact / Outcome	ISES Alignment	Theme reflected
Reflection (20%)	Conventional report (manual essay, submitted online)	Split into: • Conventional report (10%) • **Digitalized one-minute video reflection** (10%) • Instructional video produced	Transferable skills: communication, research, teamwork, presentation, lifelong learning, digital skills	Emphasized **integrity** and **novelty** by requiring proper acknowledgement of references in both formats	√	Reflect
Critical Literature Review (20%)	Conventional report (manual essay, submitted online)	Developed into full research papers for **ERA-indexed publication**	Transferable skills: communication, research, teamwork, lifelong learning, digital skills	Enabled exploration of **critical, contemporary sociolinguistics issues**, strengthening **research and lifelong learning**. Optimized student experience in both physical and digital communication contexts	√	Research
Presentation (30%)	Conventional (treated solely as assessment)	Conducted in **Postgraduate Symposium**: parallel sessions, competition, and **webinar**	Transferable skills: communication, research, teamwork, lifelong learning, digital skills, professional skills, event management skills	Built **confidence in presenting** to a larger audience; **showcased research outputs**; Q&A sessions demonstrated deep comprehension	√	Rewire

Research Methodology

Classroom approaches play a crucial role in shaping the teaching and learning (T&L) process of any university course. In this project, problem-based learning (PBL) and the flipped-classroom approach were implemented prior to the 31 master students undertaking the designated assessments.

1. Problem-Based Learning (PBL)

Postgraduate students were presented with real-world sociolinguistic scenarios and issues derived from current research and societal contexts. Working in collaborative groups, they identified core problems, conducted literature reviews, and proposed evidence-based solutions. This process encouraged critical thinking, independent inquiry, and application of sociolinguistic theories to authentic challenges.

2. Flipped-Classroom Approach

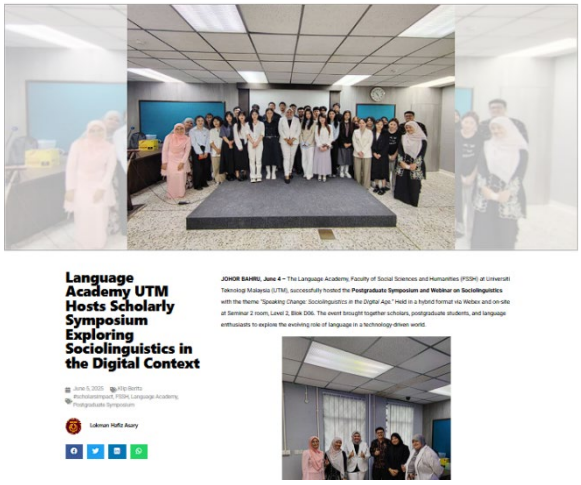
Learning materials, including recorded lectures, curated readings, and multimedia resources, were provided in advance via the university's learning management system. Class time was devoted to interactive discussions, peer teaching, and guided problem-solving activities, allowing students to deepen their understanding of concepts and actively engage in knowledge construction in the sociolinguistics subject.

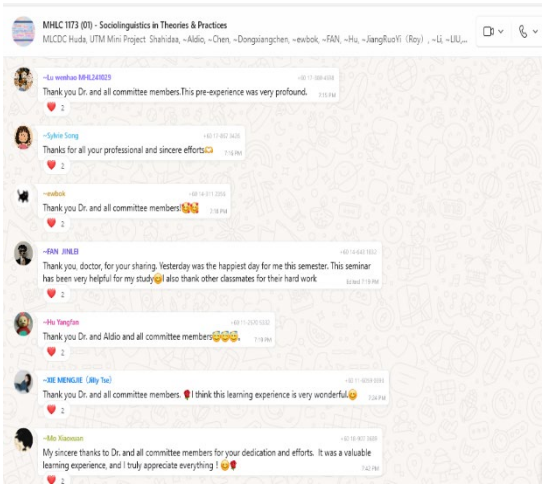
The combination of these approaches prepared students to engage meaningfully in the project's mini-assessments, reflection tasks (digital and conventional), and the research component that led to journal publications and symposium presentations. The flow of methodology operated is shown below:

Pre-Class Preparation
↓
Flipped-Classroom Learning (videos, readings, resources)
↓
Problem-Based Learning (real-world sociolinguistic scenarios)
↓
Mini-Projects & Reflection (digital + conventional)
↓
Research Project Development
↓
Publication in ERA-Indexed Journals & Symposium Presentations + Webinar

Findings and Discussion

This research demonstrates that all objectives were successfully achieved through well-designed teaching and learning (T&L) approaches and innovative assessments. The incorporation of problem-based learning and the flipped-classroom has been shown in prior studies to enhance student engagement, critical thinking, and real-world application of knowledge (Hmelo-Silver, 2004; Bishop & Verleger, 2013). Constructive feedback gathered from participants serves as a valuable input for the instructor to sustain and improve these practices, applying the KAIZEN philosophy of continuous improvement (Imai, 1986) in future semesters. All documentation has been systematically archived for reference, establishing a new benchmark for MHLE 1173 – Sociolinguistics in Theory and Practice. THE CLOs have been obtained and at the same time, publications by PG students have been encouraged hence maximizing their learning process in university. This initiative not only strengthens the specialization of Sociolinguistics within the Language Academy, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, but also enhances its visibility in academic and research spheres. The report can be retrieved from the official website: https://news.utm.my/2025/06/language-academy-utm-hosts-scholarly-symposium-exploring-sociolinguistics-in-the-digital-context/. Below are the news and the feedback sent by the participants.





From these innovations, a total of 11 ERA-indexed papers will be featured in the *September 2025 Special Issue* themed Digital Communication and Social Interaction. The publications address diverse sociolinguistic topics, including *Swear Words in TikTok Comments*, *Gender-Based Politeness in Political Discourse*, *Sichuan Dialect in the Short Video Era on TikTok*, and *Regional Dialects and Linguistic Variation in YouTube Shorts in the United Kingdom*, among others. The implications of this project, as detailed in Table 1.0, highlight significant contributions to enhancing students' teaching and learning experiences, strengthening their research competencies, and increasing their exposure to scholarly publication practices.

Acknowledgement

We sincerely appreciate the cooperation and commitment of the postgraduate students of MHLE 1173 – Sociolinguistics in Theory and Practice and the continuous support from the NALI team. Our special thanks go to the Language Academy, FSSH, Universiti Teknologi Malaysia, for approving the event budget, which was instrumental in ensuring the smooth and successful execution of this project.

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ID 11: An Educational Approach to Comparing Plant-Based Patties with Meat Using Sensory Evaluation

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Highlights: This project adopts an educational approach to engage students in comparing plant-based patties with conventional meat using sensory evaluation. Through hands-on activities, students formulate soy, mushroom, and wheat-based patties and assess their sensory qualities, taste, texture, aroma, and appearance which using a 9-point hedonic scale. The activity promotes food innovation, nutrition understanding, and awareness of halal and food safety elements. Aligned with the NALI framework, it fosters experiential and interdisciplinary learning, critical thinking, and real-world problem-solving. Students gain valuable insights into sustainable and healthier food alternatives, preparing them to contribute meaningfully to future challenges in the food science and halal industries.

Keywords: Food Safety; Food Security; Halal; Halal Food; Plant-based meat

Introduction

The anticipated global population growth to 9 billion by 2050 presents a pressing challenge for food security, particularly for Malaysia. It remains heavily dependent on imports of key staples such as meat, rice, vegetables, beef, and milk. Current reliance on traditional livestock production is both resource-intensive and environmentally unsustainable, requiring approximately 40% of arable land, generating 14.5% greenhouse gas emissions, consuming 36% of crop calories, and utilizing 29% of agricultural freshwater (Ismail et al., 2020). Furthermore, global dietary sustainability demands a substantial reduction which is up to 75% in red meat consumption (Henchion et al., 2017). This context underscores the urgent need for innovative food solutions that balance nutrition, sustainability, and cultural acceptability.

Plant-based meat is an alternative protein source which introduces a novel approach to halal-compliant. It offers nutritional advantages, including high protein content and reduced risk factors for chronic diseases (Fehér et al., 2020), while also addressing ecological sustainability. The creativity of this initiative lies in the design of plant-based meat products that not only replicate the sensory qualities including texture, taste, and appearance of conventional halal processed meat but also align with ethical and environmental considerations. This innovation responds directly to increasing consumer awareness regarding environmental protection, animal welfare, and health implications of high meat consumption. Thus, promoting more sustainable and healthier eating habits.

The innovation of the project is demonstrated through the integration of halal principles in creating plant-based meat alternatives using diverse protein sources such as wheat, soy, and mushroom. This approach not only ensures cultural and religious acceptability but also delivers nutritionally balanced products with sensory qualities such as texture, flavour, and appearance which are comparable to traditional meat. Thereby addressing both food security and sustainability challenges. This addresses a significant gap in current research, as there is limited comparative analysis of the physicochemical and nutritional properties between halal processed meats and plant-based alternatives. By applying the New Academia Learning Innovation (NALI) model, the study connects research outcomes with experiential learning opportunities for students, enabling them to engage in product development, sensory evaluation, and sustainability impact assessment.

The applicability of this project is evident in its potential to strengthen Malaysia's food security by reducing import dependency, optimizing resource utilization, and supporting the United Nations Sustainable Development Goals (SDGs). For example, Goal 3 (Good Health and Well-being) and Goal 12 (Responsible Consumption and Production). Students participating in this project are empowered to apply interdisciplinary knowledge from food science, halal industry studies, and sustainability principles to address real-world challenges. Ultimately, this initiative has a direct impact on student learning by fostering critical thinking, innovation, and problem-solving skills, while simultaneously generating a commercially viable and socially responsible product. The extended study will evaluate and compare the physicochemical properties and sensory acceptance of halal processed meats and plant-based meat alternatives, providing valuable insights for the food industry and academia.

Objectives

i. To develop halal-compliant plant-based meat alternatives with sensory qualities comparable to traditional meat
ii. To encourage students in food innovation and creativity through experiential learning by formulating plant-based patties
iii. Provide students with fundamental knowledge on halal food, sensory evaluation, food safety and microbiology.

NALI Approach

This research introduces a novel comparative analysis of halal-compliant plant-based patties (soy, wheat, mushroom) and commercial halal beef patties, filling a critical gap in halal food product research. The project creatively formulates patties using diverse protein sources and flavouring strategies to replicate the texture, taste, and appearance of conventional meat, while integrating functional ingredients rich in antioxidants to enhance nutritional value. Its innovativeness lies in combining halal certification principles with sustainable food technology, offering a viable solution to reduce Malaysia's dependence on imported meat. The outcomes are highly applicable to the halal food industry, supporting national food security and contributing to the United Nations Sustainable Development Goals (SDG 3 and SDG 12). The impact extends to academia and industry by providing experiential learning opportunities for students in product development, sensory evaluation, and sustainability assessment, while generating industry-relevant data to guide healthier and more sustainable halal food innovations.

Research Methodology

Formulation innovation (wheat, soy and mushroom)

The mushroom-based patty was prepared by cleaning and drying shiitake mushrooms, then blending them with grated carrots, bell peppers, garlic, onion, seasonings, and a small amount of oil as a binder. This mixture was combined with cornmeal flour, cooked quinoa, and rolled oats, and kneaded until uniform. Similarly, the soy-based patty was produced by soaking, dehulling, and boiling soybeans before blending them with vegetables, seasonings, and oil, then mixing with rice flour, tapioca starch, cooked quinoa, and rolled oats to form a consistent dough. Following the same approach, the wheat-based patty used pre-cooked black beans blended with vegetables, seasonings, and oil, then mixed with wheat flour, wheat starch, breadcrumbs, quinoa, and spices before kneading to achieve a homogeneous texture. This stepwise preparation ensured each patty maintained its unique ingredient profile while following a consistent processing method.

Sensory Evaluation

A total of thirty-five participants provided informed consent to take part in the sensory evaluation of plant-based meat patties, including soy-, mushroom-, and wheat-based varieties. Each participant assessed the samples based on appearance, taste, texture, and overall preference using a nine-point hedonic scale. The sensory evaluation was conducted in accordance with the ISO 8586 standards to ensure consistency and reliability in the testing process. This approach allowed for a systematic and standardized assessment of consumer acceptance for the different plant-based patties.

Microbiology Analysis

The microbiological analysis of soy-, wheat-, mushroom-based patties and a commercial beef patty was conducted following FDA-BAM (2023) guidelines using the agar diffusion method. Samples were homogenized in sterile Phosphate Buffer Solution (PBS), filtered, and applied to paper discs placed on agar plates inoculated with *E. coli*, *S. aureus*, and *S. enterica*. After 24-hour incubation at 37°C, inhibition zones were measured. Sterile PBS and ampicillin served as negative and positive controls. Tests were performed in triplicate for accuracy.

Finding and Discussion

A total of 35 respondents participated in evaluating halal processed meat and plant-based meat patties based on appearance, texture, flavor, aroma, and overall acceptability. The assessment used a structured 9-point scale, where 1 represented the least preferred and 9 the most preferred option. The sensory evaluation results were analyzed using SPSS. Figure 1 illustrates a spider web graph comparing the sensory profiles of the plant-based patties with the commercial meat patty.

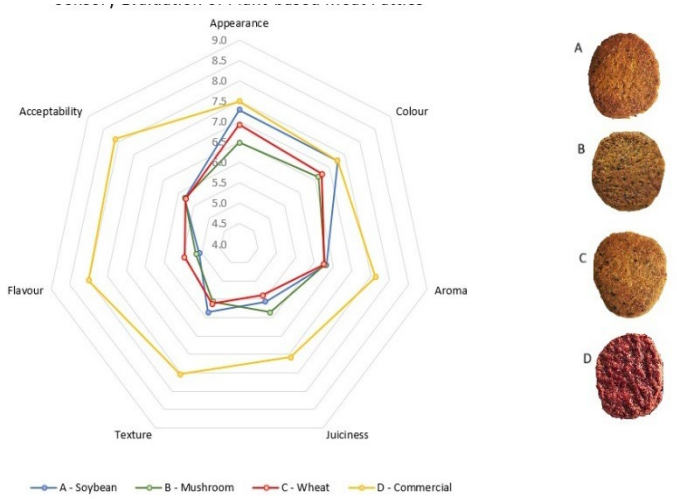


Figure 1. Spider web graph showing sensory analysis of plant -based patties and commercial meat

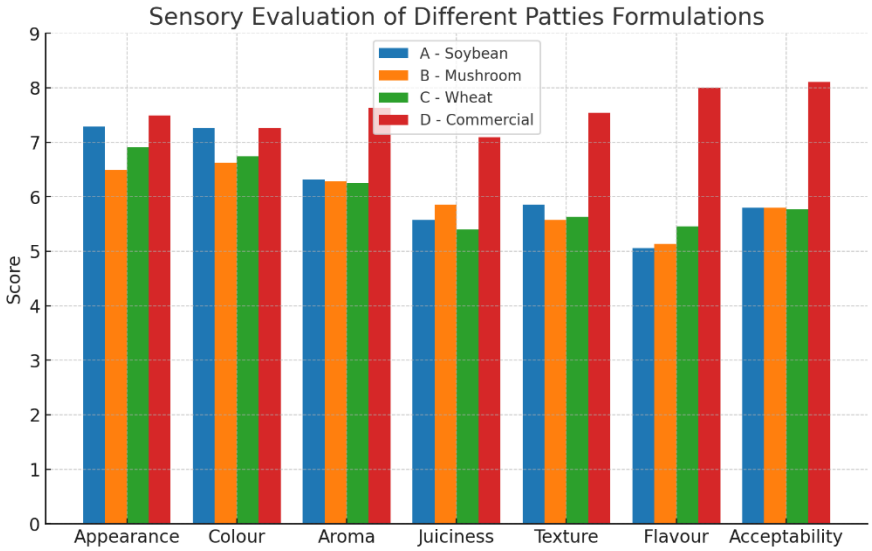


Figure 2. Sensory evaluation of different patties formulations

Based on the results in Figure 2, significant differences in overall acceptance were found between commercial meat and each of the plant-based patties: soybean-based ($p=0.000$), mushroom-based ($p=0.000$), and wheat-based ($p=0.000$), all below the 0.05 threshold. This highlights the need to improve sensory qualities like texture and flavor to boost consumer satisfaction, as these are crucial factors in preference for plant-based alternatives (He et al., 2020). However, no significant differences were observed among the plant-based patties themselves, with p-values above 0.05 for comparisons between soybean-based, mushroom-based, and wheat-based patties.

For microbiology analysis, all samples showed total viable counts below 10^4 CFU/g, with no Salmonella or Staphylococcus aureus detected, confirming microbiological safety. The commercial beef patty had the highest bacterial count (2.7×10^4 CFU/g), while the wheat-based patty had the lowest (1.7×10^3 CFU/g), consistent with studies showing higher microbial loads in animal products due to their nutrient content and processing risks (Smith et al., 2021). The absence of S. aureus (<10 CFU/g) indicates good hygiene during production (Schirone et al., 2019), and no Salmonella confirms compliance with safety standards (He et al., 2020). These results support plant-based patties as safer, sustainable alternatives, with future research needed on their microbial stability over time (Schmidt et al., 2019).

Acknowledgement

We are grateful to Majlis Bandaraya Iskandar Puteri (MBIP) as the main financial supporter of this project. Additional support from UTM FR Fundamental Research Grant (PY/2023/01337) and the UTM Encouragement Research Grant (UTMER) is also sincerely acknowledged. We extend our appreciation to all participants and collaborators for their valuable contributions and commitment throughout the study.

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ID 12: Attention to Retention: An Evidence-Based App for Lasting Learning

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Highlights: This innovation introduces an AI powered app that delivers oneshot layered, engaging explanations with inline enrichments and interactive quizzes, addressing the critical pain point of knowledge retention in quick answer AI tools like ChatGPT. By slowing the learning process, fostering conceptual connections, and incorporating active recall, it differentiates from standard chatbots and transactional AI apps, promoting deep understanding and long-term memory. Supported by research on Socratic AI and active learning, this approach enhances student engagement and empowerment, positioning it as a transformative edtech solution with strong commercialization potential.

Keywords: AI education; Knowledge retention; Socratic learning; Personalized interactive learning

Introduction

Education has remained remarkably static throughout history, relying on books, lectures, and one on one mentorship from Socrates guiding Plato to modern classrooms where teachers impart knowledge through rote reading and explanation. This model emphasizes deep engagement, where a knowledgeable individual slows down concepts, probes understanding, and builds connections for lasting retention. However, the advent of AI has disrupted this paradigm, offering personalized tutors that adapt to individual needs. Yet, a key pain point emerges while AI provides instant answers, research shows this convenience often undermines retention, as users bypass the cognitive effort needed for deep learning (Bastani et al., 2024). For instance, studies indicate that relying on generative AI for direct answers boosts short term performance but hinders long term memory and critical thinking, akin to consuming predigested information without personal processing (Mollick, 2024). Our application addresses this by developing an app that uses a dialectical, structured prompt as its core system prompt, transforming AI from a quick answer tool into a Socratic philosopher that fosters "aha" moments through rhythmic, connected explanations.

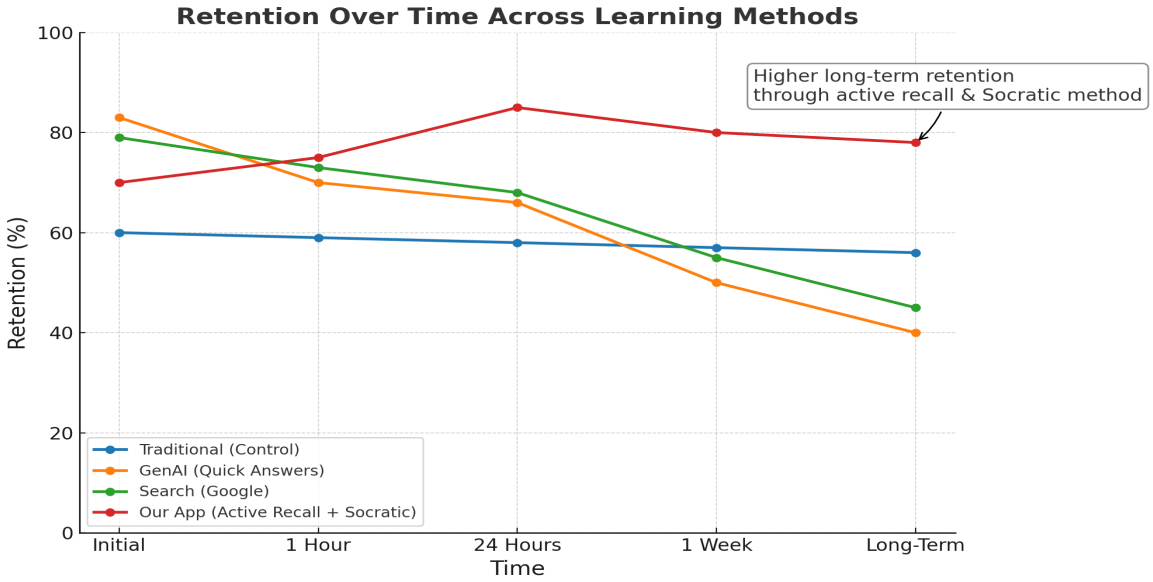


Figure 1: Retention Over Time Across Learning Methods

Comprehensive analysis in Figure 1 shows that GenAI tools (like ChatGPT) deliver a strong initial performance boost but are followed by steep declines in retention, whereas methods on which our app is based on (active recall and Socratic dialogue) demonstrate sustained and improved retention over time (Bastani et al., 2024; Le, 2019).

Objectives

The primary objective is to create an AI app that solves the retention crisis in AI assisted learning. Current tools like ChatGPT/GROK deliver rapid answers, but research reveals they vaporize long term learning, students score higher initially but retain less, as cognitive offloading reduces effortful processing (Bastani et al., 2024). Our AI powered app generates outputs that slow the process of learning: diving into layered explanations with inline enrichments (e.g.,

"(think like this: connect to evolution's pattern seeking)") and ending with interactive quizzes for active recall. This fosters retention by engaging the brain's natural rhythms and connections, differing from Google searches, which promote better memory through effortful retrieval (Yang et al., 2024). Secondary objectives include differentiating from transactional AI teaching apps that drag learning with sequential questions, instead providing a cohesive, self-probing narrative followed by interactive quizzes to make education engaging without frustration.

NALI Approach

- **Novelty**: The prompt's structure, concise definition, deep dive with 50% main idea and 50% enrichment is unprecedented, mimicking dialectical teaching for retention focused AI.
- **Creativity**: Inline enrichments weave insights conversationally, like Harari's cross disciplinary links, but kept concise to avoid jargon.
- **Innovativeness**: It improves direct answer AI by slowing without excessive interaction, using self-generated probing to build mental maps.
- **Applicability**: Aligns with NALI by promoting resilient, future oriented learning through personalized, empowering tools.
- **Impact**: Enhances student engagement and retention, with studies showing active recall via quizzes, boosts performance by up to 70%, empowering learners for quality outcomes.

Research Methodology

We designed the system prompt based on principles of Socratic method and active recall, iteratively refined through simulations with LLMs. The app architecture parses user topics, generates enriched explanations, and outputs JSON quizzes (e.g., "question": "...", "options": [...], "hint": "...", "solution": "...", "explanation": "..."). A prototype was built using API integrations, tested conceptually on sample topics like "cache memory." Methodology included literature review on AI retention impacts (Hardman, 2025; Liang et al., 2023, Gerlich, 2025, Liang, 2023a) and planned user pilots to measure pre/post retention via quizzes. No code execution was needed; focus was on prompt engineering for output rhythm.

Findings and Discussion

Findings reveal the prompt generates outputs that promote retention by connecting ideas (e.g., linking cache to evolutionary caching of resources), avoiding misconceptions like "AI always speeds learning" by clarifying effort's role. Unlike ChatGPT's direct delivery, which hinders retention per meta-analyses (Fan et al., 2024; Heung and Chiu, 2025),our app slows via enrichments, fostering depth. It differs from other AI apps' slow Q&A by providing upfront narrative with self-probing, then quizzes for interactivity, efficient yet engaging. This angle leverages human pattern recognition, proven effective for retention in active learning studies (Favero et al., 2024). Based on research, this is superior as Socratic chatbots enhance critical thinking and vocabulary retention leading to empowered, resilient graduates (Favero et al., 2024; Zhang and Huang, 2024).

Commercialization Potential

The AI in education market is experiencing explosive growth, with projections estimating a rise from around USD 5.18 billion in 2024 to approximately USD 112.3 billion by 2034, at a CAGR of about 36% (Zoting, 2025). This dramatic expansion is driven by the adoption of AI tools such as intelligent tutoring systems, personalized learning platforms, and AI powered grading and content creation, which are helping reduce educators' administrative burdens and enhance student engagement. Our app can foster deeper learning by guiding students through reasoning, blending ancient pedagogy with modern technology to strengthen understanding and retention. These trends point to compelling opportunities for both large scale edtech providers and niche innovators to capitalize on AI-driven edtech solutions.

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ID 13: AGROLEARN: Accelerating Agricultural Teaching & Learning with AI (Powered by AgroThink)

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Highlights: AGROLEARN transforms farming into continuous, competency-based learning through education first design with micro lessons, just in time guidance, and reflective feedback embedded in real farm work. The platform combines AGROLEARN's pedagogy with AgroThink's AI stack, solving critical pain points including delayed diagnosis, expert scarcity, and fragmented information. Expected impact includes 20% yield lift, 30% income gains, and 70% time saved searching information while aligning with SDGs (1, 2, 4, 8, 12, 13).

Keywords: AI in Agriculture; Agricultural Education; Smart Farming; Gen Z Farming; Malaysia

Introduction

Smallholder farmers face persistent barriers that hinder both learning and productivity: limited access to expert guidance, late disease recognition, weak planning systems, missed time critical tasks, inadequate monitoring, and fragmented information flows (FAO, 2019). These gaps directly impact yields, incomes, and motivation to adopt sustainable practices. The problem is systemic and quantifiable. Delayed diagnosis can escalate crop losses from 10–20% to 50–80%, while extension agent coverage is stretched at ratios of 1: 3,000 to 1: 10,000 farmers compared to the World Bank's recommended 1:500 (World Bank, 2021). Farmers juggle multiple fragmented information channels and spend significant time searching for answers, creating inefficiencies that compound agricultural challenges. For younger generations, these barriers are more pronounced. Farming is perceived as complex, low tech, and slow to learn, discouraging Gen Z engagement despite their interest in sustainable living and technology (Malaysian Agricultural Research and Development Institute, 2023). AGROLEARN reframes these challenges as teachable moments by fusing AI powered, multilingual coaching with farm embedded micro learning, making farming an attractive, guided journey for digital native generations while serving traditional farmers effectively.

Objectives

- Accelerate skill acquisition & confidence: Provide structured, location aware guides and micro learning that halve the new farmer learning curve, replacing trial and error with data driven practice
- Protect crop health & embed diagnostic skills: Use instant, image-based disease detection to reduce losses by 30% and train farmers to recognize early warning signs
- Operationalize learning through action: Convert planting guides into smart, calendared tasks, reinforcing knowledge through timely execution
- Unify trusted knowledge sources: Centralize government resources, market alerts, and peer knowledge to cut search time by 70%
- Break the barrier for Gen Z to enter farming: Make agriculture easy to learn through digital-first guidance, gamification, and mobile native workflows
- Advance SDGs via pedagogy in practice: Promote sustainable habits improving yields/incomes (SDG 1,2,8) and climate smart practices (SDG 12,13) Project or innovation objectives

NALI Approach

Novelty: AGROLEARN treats every farm action as a micro lesson, combining doing with learning. When farmers capture leaf images, the model diagnoses and teaches "why," prompting micro reflections that shift from passive advice to active, experiential learning.

Creativity: Embeds gamified, Gen Z friendly interactions including progress badges, streak tracking, and collaborative challenges. AI generated planting guides auto translate into smart tasks with each completion reinforcing competencies through tasks to learning loops.

Innovativeness: Built on Gemini 1.5 Flash multimodal capabilities, handling text and images with context aware responses in multiple languages. Enterprise grade functionality without custom training, ready for future fine tuning on regional data (Google, 2024).

Applicability: Fits both rural farmers and urban Gen Z newcomers through mobile first experiences. One unified application integrates seven core features: AGROX (24/7 AI agriculture tutor providing personalized guidance), AI disease detection (instant crop diagnosis via image upload), AI planting guide generator (location based cultivation plans), AI powered to do list (smart task calendaring), IoT crop monitoring (real time health insights), news & alerts hub (government, market, and weather updates), and community platform (peer learning and knowledge sharing). This comprehensive integration eliminates tool sprawl and provides seamless user experience.

Impact: Expected 20% yield uplift, 30% income gains, and large time savings from unified information flows. Transforms 1:10,000 extension ratios into accessible 1:1 digital consultation at point of need.

Research Methodology
Phase A (Needs & Learning Design):
Interviews and observations with smallholders and extension officers to map high friction learning moments. Translate findings into competency maps (knowledge → skill → habit) with micro assessments embedded in real tasks.

Phase B (System Build MVP):
Develop modules including AGROX conversational tutor, image-based diagnosis, planting guide generator, task engine, IoT integration, news/alerts hub, and community platform using Gemini 1.5 Flash for multimodal reasoning.

Phase C (Pilot & Evaluation):
Measure pedagogical metrics (task completion rate, help seeking time reduction, competency progression) and agronomic KPIs (yield %, input efficiency, time to diagnosis, avoided losses) with both traditional farmers and Gen Z participants.

Phase D (Iteration & Scale):
Use in app telemetry and community feedback to refine prompts and localized content while preparing custom models from aggregated, consented data.

Findings and Discussion

Baseline analysis reveals farmers consulting 5+ channels and losing 7+ hours weekly chasing information, where embedded AI tutoring provides significant value. The theory of change demonstrates that just in time instruction combined with image "practicals," calendared actions, and reflection accelerates skills uptake and enables earlier detection, aligning with projected yield and income improvements. Early validation shows strong market demand with 65% willingness to pay for integrated platforms and government support. Adjacent product traction (Plantix: 10M+ downloads, 134k DAU, 50M annual queries) de risks scale up for AGROLEARN's education centric model (Plantix, 2023). Gen Z pilot participants demonstrated higher engagement due to gamified, app-based format and quick learning cycles, while community integration helped bridge generational knowledge gaps. The platform's multilingual support and community validation replace unverified advice with evidence based, explainable guidance, consistent with SDG goals on education, decent work, and climate action.

Awards Received

The project offers individual subscriptions at RM10–20 per month and institutional packages at RM100–500 per month, with additional revenue from API licensing and marketplace commissions (3–5%). It is projected to deliver a 20% increase in yield, a 30% rise in income, and a 70% reduction in information search time.

Based on these features, the **AGROLEARN** project has won two awards: **Champion at the AI Ideathon FCRI Day**, organized by the Faculty of Computing, and **First Prize at the Pitch Lab by SPE UTM & UTM XCITE**. A brief description of AGROLEARN and its achievements is summarized in Table 1.

Table 1: AGROLEARN Project Overview and Commercialization Details

Category	Details
Project Title	AGROLEARN: Harvesting the Future of Agricultural Learning – AI & Learners as One
Exhibition year	2025
Commercialization Potential	Individual subscriptions (RM10–20/month), institutional packages (RM100–500/month), API licensing, marketplace commissions (3–5%)
Awards Received	Champion – AI Ideathon FCRI Day 2025: Champion 1st Prize Pitch Lab by SPE UTM & UTM XCITE 2025
Expected Impact	20% yield increase, 30% income gains, 70%-time reduction in information search

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ID 14: Polaris: AI-Enhanced Cryptography Education Platform

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Highlights: Polaris is an advanced cryptography education platform integrating AI-driven learning assistance to enhance engagement, accessibility, and personalization. The system introduces three core AI features: an AI-powered rewriting system for adaptive explanations, a text-to-speech (TTS) function for auditory learning, and a conversational AI cryptography expert for interactive problem-solving. These innovations aim to accelerate conceptual understanding, support diverse learning styles, and promote mastery of complex cryptographic concepts.

Keywords: Cryptography Education; Artificial Intelligence; Adaptive Learning; Text-to-Speech; Conversational Agent

Introduction

Polaris is a comprehensive educational platform designed to teach cryptography and information security concepts through interactive modules, practical tools, and structured assessments. The platform leverages a modern technology stack with ASP.NET Core 8.0 backend and Angular 19 frontend, offering secure, role-based access and a complete curriculum spanning both classical and modern cryptographic methods. While the initial system focused on static content delivery and conventional assessments, the next iteration integrates artificial intelligence to significantly enhance adaptability, accessibility, and learner engagement.

The introduction of AI-powered functionalities aligns with the objectives of the NALI framework by transforming Polaris from a static knowledge delivery platform into a dynamic, learner-centered environment. This evolution supports personalized instruction, real-time guidance, and multi-modal learning, addressing the diverse needs of modern learners and preparing them for real-world cybersecurity challenges.

Figure 1 below shows different features in the system and the general workflow. Figure 1A represents the interface committed to cryptographic operations, allowing students to perform a range of encryption and decryption operations. Figure 1B shows the system sign-in page, which supports role-based authentication of students, teachers, and administrators. Figure 1C continues to demonstrate the user management interface, via which administrators can add, edit, and delete user accounts in different sections. Figure 1D shows the assessment management page, which allows teachers to hide or show cryptographic assessments and analyze student performance results.

Objectives

The primary objectives of the AI-enhanced Polaris platform are:

i. To deliver personalized cryptography education through adaptive content rewriting that tailors' explanations to the learner's background and preferences.
ii. To improve accessibility and engagement via integrated text-to-speech capabilities.
iii. To provide real-time, interactive learning support through a conversational AI cryptography expert.
iv. To enhance knowledge retention and conceptual clarity in complex cryptographic topics.
v. To align the teaching methodology with the NALI approach, emphasizing innovation, adaptability, and impact.

POLARIS Application Feature

Figure 1 shows the interface committed to cryptographic operations, allowing students to perform a range of encryption and decryption operations.



Figure 1: POLARIS Apps

NALI Approach

- **Novelty:** Polaris introduces an AI-powered rewriting engine capable of rephrasing cryptographic explanations at multiple complexity levels, including creative formats such as analogies from gaming contexts like Minecraft. This approach is novel in the domain of cryptography education.
- **Creativity:** By merging advanced AI natural language processing with subject-specific instructional design, Polaris delivers explanations in varied styles without compromising accuracy.
- **Innovativeness:** The integration of text-to-speech enables auditory learning, while the AI cryptography expert acts as an always-available tutor, creating an interactive and supportive learning experience.
- **Applicability:** The platform supports self-paced learners, classroom integration, and remote learning scenarios, aligning with the New Academia Learning Innovation Model.
- **Impact:** The AI features are expected to increase learner engagement, comprehension, and retention rates, while providing instructors with a more effective teaching tool.

Research Methodology

The AI feature development followed a design-based research methodology, integrating iterative prototyping, testing, and refinement. The process involved:

i. Requirement analysis with instructors and students to identify pain points in the existing system.
ii. Development of AI modules:
    - Rewriting Engine: Implemented using large language models fine-tuned on cryptography materials.
    - TTS Engine: Integrated using a neural speech synthesis API for multilingual support.
    - Conversational Expert: Configured as a domain-specific AI chatbot.
iii. Pilot testing with a sample group of students to evaluate usability and learning impact.
iv. Data collection and analysis for feature refinement

Findings and Discussion

Preliminary user feedback from pilot testing indicates that the AI-powered rewriting system significantly aids in simplifying complex topics for beginners, while still providing in-depth explanations for advanced learners. The TTS feature enhances accessibility, particularly for auditory learners and users with visual impairments. The conversational AI expert promotes active engagement, allowing learners to clarify doubts instantly.

These features collectively support higher retention, improved test scores, and increased learner satisfaction. Instructors report that the platform reduces the time spent on repetitive explanations, enabling more focus on interactive, higher-order learning activities.

Commercialization Potential

Polaris has strong commercial potential because it responds to the growing global need for better cybersecurity and cryptography education. Cyberattacks and data breaches are increasing every year, and both universities and companies are looking for effective ways to train students and employees in secure systems. The EdTech industry is also expanding quickly, and there are few platforms that focus only on cryptography. This makes Polaris stand out as a unique product that combines clear teaching with advanced AI features.

What makes Polaris different from other learning platforms is the use of artificial intelligence to make cryptography easier to understand and more accessible. The adaptive rewriting system can explain the same topic in different ways,

from very simple breakdowns like "Explain Like I'm 5" to creative analogies such as "in X terms," or in detailed academic form. The text-to-speech feature supports auditory learners and students with visual impairments, while the AI chat expert acts like a personal tutor that can answer questions instantly. These features give Polaris a clear advantage in the market by making cryptography learning more engaging and inclusive.

The potential customers for Polaris include universities, professional training programs, companies that need cybersecurity awareness, and self-learners. It can be sold to institutions through licensing or offered to individuals through subscriptions. A free version with limited content could help attract new users, while advanced features and certificates can be part of a paid plan. Polaris is also scalable and could expand to other areas like data science or cloud security in the future, as the AI modules are flexible and not limited to cryptography alone.

In short, Polaris is not only an educational tool but also a product that could be adopted by many different groups. Its ability to make a difficult subject like cryptography more understandable, accessible, and interactive gives its strong value in both the academic and professional markets.

Conclusion

Polaris demonstrates how artificial intelligence can be meaningfully integrated into cryptography education to improve accessibility, engagement, and personalization. By combining adaptive explanation, text-to-speech, and a conversational AI expert, the platform addresses key challenges in teaching a complex and abstract subject. Preliminary testing shows positive impacts on student understanding and satisfaction, while instructors benefit from reduced workload and more time for interactive learning. Beyond academic use, Polaris holds commercial potential in professional training and corporate cybersecurity education, offering a flexible and scalable solution. In summary, Polaris is both a learning innovation and a market-ready product that supports the NALI vision of advancing teaching and learning through technology.

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ID 15: Bridging Theory and Practice: Blended Learning in Hydrographic Surveying

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Highlights: In the rapidly evolving field of geomatics engineering, continuous professional development (CPD) is vital for surveying practitioners to sustain and advance their competencies. This study presents a comprehensive blended model for hydrographic surveying that integrates hybrid theory lectures, hands-on laboratory training, and on-site field practicals within a project-based learning (PBL) framework spanning project planning to final chart production. Implemented for the first time in our master's programme as the PESISIR approach, the course delivers authentic, collaborative learning through onboard vessel data acquisition, data processing, and charting to build real-world readiness. Student evaluations indicated high satisfaction (83% overall), with strong appreciation for practical relevance and applied problem-solving; quantitative outcomes showed 87% mastery in advanced hydrographic methods and 80% proficiency in data application. Qualitative feedback underscored the value of fieldwork and recommended expanding hands-on components, informing iterative enhancements such as extended field exercises and team-based projects. Overall, the model advances hydrographic education by effectively uniting theory, practice, and innovation, demonstrating the adaptability of modern Technical and Vocational Education and Training (TVET) methods while cultivating a pipeline of skilled professionals in hydrography and geomatics engineering.

Keywords: Blended learning; Hydrospatial education; Hydrographic surveying

Introduction

Hydrographic surveying, also known as marine surveying, focuses on gathering hydrospatial information about the physical features of the water bodies, including water depths, seabed composition, and the location of navigation hazards. It plays an essential role in numerous applications, including maritime navigation, marine construction, environmental monitoring and offshore resource exploration (Igbinenikaro et al., 2024; Furness, 2021; Mira, 2003). As the geomatics engineering field evolves with advancements in technology, there is a persuasive need for skilled professionals capable of not only operating sophisticated hydrographic equipment but also interpreting complex data to ensure safety and efficiency in navigation and resource management. To address this need, the Technical and Vocational Education and Training (TVET) agenda has incorporated project-based learning (PBL) as a means to bridge theoretical knowledge with real-world applications. The integration of PBL has proven effective in hydrographic surveying education, enabling students to engage with real-world problems while developing both hard and soft skills (Munge et al.2018; Jones and Washko, 2022; D'Urso et al., 2023)

Traditional educational methods (Lucas & Hanson, 2016; Alzain et al., 2018; Shala et al., 2024), predominantly characterized by theoretical instruction, often fail to equip learners with the practical skills necessary to tackle real-world challenges in hydrographic surveying. Hence, innovative educational approaches that integrate both theoretical knowledge and hands-on experiences are increasingly emphasized (Carlson & Sullivan, 1999). Blended learning (Graham et al., 2013) which combining online instruction with hands-on training, has emerged as an effective pedagogical strategy in technical disciplines (Bonk & Graham, 2012; Ho et al., 2016; McCarthy & Palmer, 2023). This authentic teaching and learning approach is strategized to satisfy the needs of the industry and the profession (Laszlo & Castro, 1995). This study aims to evaluate a blended learning model for hydrographic surveying education by assessing its effectiveness in developing technical competencies, enhancing student engagement through project-based learning, bridging the gap between theoretical knowledge and practical application, establishing a replicable competency framework, and identifying opportunities to strengthen hands-on training components to better prepare students for industry demands.

This study explores the integrations of hybrid classroom theory learning, hands-on laboratory exercises and field-based practical to enhance hydrographic surveying education specifically in UTM's PESISIR. UTM PESISIR is a postgraduate weekend program that is offered off-campus to suit the working adults. The lectures are usually conducted classes during weekends or at the company training centres. The PESISIR blended learning model, implemented in UTM serves as a case study to evaluate the effectiveness of this approach. The objectives of this study are to access the impact of the blended learning on hydrographic surveying skill development; to evaluate the student engagement and competency in PBL; and to propose a workable framework for integrating blended learning in hydrographic education. Figure 1 shows an illustration of the learning components in this tailor-made blended learning and its targeted outcomes. Meanwhile, the teaching and learning efficiency is gauged as well as the current and future challenges are also discussed in this paper.

Course Structure and Implementation

The Hydrographic Surveying Application (MBEE1533) course is designed to provide comprehensive knowledge of hydrographic surveying such as hydrographic positioning, hydrographic hardware and software, automated bathymetry data acquisition, datum, tidal analysis, coastal engineering, and oceanography, roles of hydrography in offshore surveying and oil and gas industry, and also hydrographic information system. This tailored-made Hydrographic Surveying Application (MBEE1533) course integrates the hybrid classroom theory lectures, hands-on training and on-site PBL practical as an authentic approach to empower hydrographic education. The implementation of this MBEE1533 module consists of three primary components (Figure 1), namely Hybrid Learning, Laboratory Exercises and Field-based PBL throughout the 14 weeks semester period.

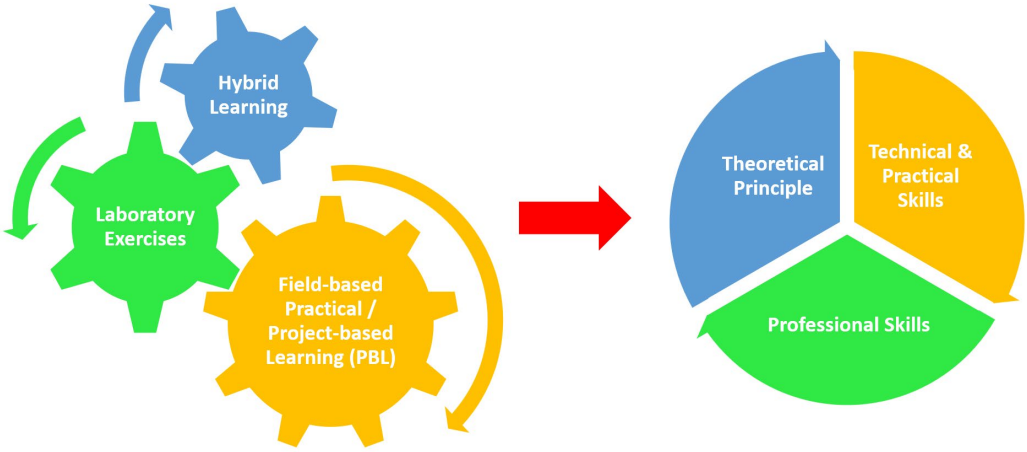


Figure 1. Learning Components and Targeted Outcomes in the Blended Learning Methodology

The hybrid learning component consists of twice online-based and a single classroom-based lectures that combine traditional instruction with online e-Learning resources (Huang et al., 2008). Figure 1 showcases the blended scheduled lectures which enable interaction between instructors and learners, allows for flexibility in learning and integrates various educational technologies to facilitate access to information. The effectiveness of online-based lectures eliminates the need for physical travel, which saves time and reduces expenses related to transportation, accommodation, and venue bookings. Beneficial to those part-time professional adult learners, making it easier for them to juggle works and studies. Besides that, recorded lectures and digital resources are a game-changer for self-paced learning. They allow learners to access the e-Learning portal which provides the learners with the opportunity to engage with course materials asynchronously. Unlike physical classroom sessions, learners can take their time to absorb key points, rewind and rewatch complex topics for better understanding.

Beyond the theoretical exposures, laboratory exercises provide hands-on training in hydrographic surveying techniques and technologies. This component serves as a critical bridge between classroom concepts and real-world application, allowing students to apply the concepts learned in lectures directly in a controlled environment. These exercises include the use of advanced surveying equipment and software applications, fostering technical proficiency and reinforcing practical skills under the technical experts' supervision. Predominantly, the learners practice tide gauge installation and tidal data processing, multibeam system's bench testing and calibration, GNSS observation techniques, and precision levelling procedures. Through structured exercises, they learn to configure survey software and process data to industry standards. These practical sessions bridge theory and practice, developing both technical proficiency and problem-solving abilities.

Field-based problem-based learning (PBL) forms the foundation of the MBEE1533 course, immersing students in authentic hydrographic surveying projects that mirror real-world professional challenges (Figure 3). Through collaborative fieldwork, students actively engage in solving complex, practical problems that require them to apply theoretical knowledge while developing critical thinking and analytical skills essential for the profession. This hands-on approach not only reinforces the technical competencies gained during laboratory sessions but also cultivates vital soft skills including effective teamwork, clear communication, and sound decision-making under field conditions. Through collaborative fieldwork, students actively engage in solving complex, practical problems that require them to apply theoretical knowledge while developing critical thinking and analytical skills essential for the profession. This hands-on approach not only reinforces the technical competencies gained during laboratory sessions but also cultivates vital soft skills including effective teamwork, clear communication, and sound decision-making under field conditions.

Emphasizing Practical Competencies in Hydrographic Training

The changing dynamics of the global workforce, propelled by rapid technological advancements and evolving market demands, necessitates a reassessment of educational frameworks (Furness, 2021). Traditional pedagogical methodologies, which prioritize theoretical knowledge and exam-oriented assessments, may not equip students with the practical competencies required to thrive in contemporary work environments. In the light of the continuous evolving technology, there is a continuous need for up-to-date teaching and learning methods (Yunus et al., 2024).

This initiative highlights a forward-thinking approach to Technical and Vocational Education and Training (TVET) by merging hands-on experience with theoretical knowledge, to bridge the gap between classroom theory and real-world application. Hence, graduates gain job-ready skills aligned with Industry Revolution 4.0 (IR4.0) standards making them valuable assets in data-driven hydrographic surveying operations.

In this MBEE1533 program, it incorporates a 2-day tailor-made hydrographic field survey practical, where students apply their classroom and laboratory knowledge in a real-world on-the-job training scenario. By engaging in hands-on data collection, processing, and analysis, trainees develop critical technical and problem-solving skills essential for hydrographic surveying. This experiential learning approach ensures that theoretical concepts are reinforced through practical application, preparing students for the demands of the industry. The exercise simulates actual fieldwork conditions, requiring trainees to operate survey equipment, collect data, process data and produce precise and accurate hydrographic information plan (Figure 5), which mirrors the challenges they will face in professional settings. Through this immersive training, students not only refine their technical abilities but also cultivate teamwork, adaptability, and decision-making skills. By bridging the gap between academia and industry, this program equips graduates with the confidence and competence needed to excel in hydrographic careers, ensuring they are job-ready from day one.

To ensure long-term success, strong partnerships with *Corresponding Government agencies such as National Hydrographic Centre (PHN), Department of Survey and Mapping Malaysia (JUPEM), Land and Survey Department Sarawak (JTS), Marine Department of Malaysia (JLM), etc. as well as the respective industrial players providers will keep training programs aligned with the latest industry innovations. A well-designed educational approach would help in aligning workforce skills with global environmental goals by producing a skilled workforce for the hydrographic surveying industry. In short, future training should emphasize practical competencies, not just theoretical knowledge or the traditional exam-oriented approach, particularly in critical areas such as hydrographic education.

Student Feedback and Evaluation

The course evaluation, based on feedback from 13 of 15 enrolled students, revealed strong satisfaction with the lecturer's teaching methods and course structure. The overall satisfaction score was 5.76 out of 6 (83%), indicating a highly positive response. Key strengths included the lecturer's ability to deliver knowledge effectively, with 92% of students rating the course design and organization highly at 5-6 out of 6. Additionally, 96% praised the facilitation and implementation of the course, highlighting the practical sessions as particularly valuable for understanding complex hydrographic concepts.

On the other hand, the Course Assessment Report (CAR) also demonstrated strong attainment of learning objectives. 87% of students successfully classified advanced hydrographic methods (CLO1), while 74% could construct solutions for surveying practices (CLO2). Additionally, 80% effectively applied hydrographic data for system development (CLO3), showcasing the course's alignment with industry-relevant skills. Programme outcomes (PO) were also met, with 87% mastery in geomatic engineering knowledge (PO1) and 90% proficiency in problem-solving (PO6). However, practical skills (PO2) scored slightly lower (75%), suggesting a need for more hands-on training.

The course achieved high satisfaction and learning outcomes, with minor refinements needed in practical training. By integrating more experiential learning, future iterations can further bridge theory and real-world application, ensuring continued success. Students suggested enhancements included more fieldwork (e.g., multibeam bathymetry surveys, side scan sonar, etc.) and more practical time for hands-on data processing. By integrating more experiential learning, future iterations can further bridge theory and real-world application, ensuring continued success

Conclusion

Hydrographic surveying education must evolve to meet the demands of a rapidly advancing industry, where technological innovation and practical competence are paramount. This study demonstrates the effectiveness of UTM PESISIR's incorporating competency-based blended learning model in bridging the gap between theory and real-world application, equipping students with technical proficiency, problem-solving skills, and adaptability required in modern hydrographic practice. By integrating hybrid classroom instruction, hands-on laboratory exercises, and field-based problem-based learning (PBL), the MBEE1533 course ensures that graduates are not only knowledgeable but also job-ready, capable of handling complex surveying challenges with confidence.

The success of this approach lies in its alignment with industry standards, such as the International Hydrographic Organization (IHO) competencies, and its responsiveness to workforce demands. However, sustaining this progress requires continuous collaboration with government agencies, industry partners, and academic institutions to keep curricula updated with emerging technologies like unmanned surface vehicles (USVs) and AI-driven data processing (Azziddin et al., 2024). Future efforts should also emphasize interdisciplinary training, sustainability practices, and global knowledge exchange to prepare hydrographers for the challenges of tomorrow.

Ultimately, this model serves as a blueprint for modernizing hydrographic education, proving that when theory meets hands-on experience, students emerge as skilled professionals ready to contribute to safe navigation, marine resource management, and the sustainable development of our oceans. The lessons learned from UTM's program can inspire similar reforms in technical and vocational education worldwide, ensuring that the next generation of hydrographic surveyors is equipped to navigate both the seas and the future of the profession.

Acknowledgement

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ID 16: AiEdu: Ai-Driven Predictive Model for Evaluating Educational Outcomes in Bioprocess Plant Design Competition

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Highlights: This study presents AiEdu, an AI-based predictive model that integrates cognitive, affective, and psychomotor data to evaluate student performance in a bioprocess plant design competition. Learning gains were derived from pre- and post-event surveys, sentiments analyzed using VADER, and design evaluations assessed through rubrics. A Random Forest model demonstrated high accuracy (R^2 = 0.994) in predicting final judge scores, revealing Equipment Specifications and Creativity as key contributing factors. AiEdu supports data-driven, transparent, and scalable assessment in engineering education.

Keywords: Educational AI; VADER; Learning Analytics; Sentiment Analysis; Rubric Evaluation

Introduction

In conventional student competitions, assessments are often conducted manually using spreadsheets or paper-based forms. This process is labour- intensive and prone to human error, inconsistency, and lack of feedback specificity. Judges typically assign scores based on general impressions, with limited mechanisms to trace how specific learning components influence final evaluations.

To address these issues, the AiEdu framework introduces a novel, creative, and innovative approach for evaluation by integrating Artificial Intelligence into the learning assessment process. By incorporating three key learning domains including cognitive (learning gain via pre- and post-surveys), affective (student sentiments analysed using VADER), and psychomotor (design-based rubric evaluations), this system brings transparency and insight into competition-based education. The model leverages machine learning algorithms to predict judge scores, thereby identifying the most influential features contributing to educational success.

To evaluate students' affective responses, the project employed VADER (Valence Aware Dictionary and sEntiment Reasoner), a rule-based sentiment analysis tool specifically tailored for short, informal text such as student reflections. VADER offers distinct advantages, including its ability to detect sentiment intensity, handle social media-style language, and incorporate emoticons, punctuation emphasis, and negations (Chadha & Chaudhary, 2023). In this project, VADER enabled quantifiable analysis of student reflections, identifying emotional tones (positive, negative, neutral) that correlate with engagement and perception of learning experiences. Its lexicon-based nature ensured efficient sentiment scoring without the need for extensive labelled datasets, making it suitable for real-time educational feedback systems.

While previous studies, such as the exploration of real-time assessments in student-led exhibitions, emphasize immediate feedback and engagement, they largely depend on manual, qualitative evaluation methods (Luu et al., 2023; Mitev et al., 2025). These conventional approaches, though valuable, often lack the precision, scalability, and objectivity required for robust assessment across multiple learning domains. In contrast, the AiEdu framework addresses these gaps by incorporating automated sentiment analysis, learning gain computation, and rubric-based evaluation through AI modelling. This not only enhances reliability but also enables real-time, data-driven insights that inform teaching practices and competition design improvements.

This project aligns closely with the NALI 2025 theme of Accelerating Innovation in Teaching and Learning with AI, by embedding machine learning into student assessment practices. It promotes *Novelty* by applying AI-driven predictive modelling in a learning competition, *Creativity* through design- based tasks requiring student- generated solutions, *Innovativeness* in real-time evaluation and feedback mechanisms, *Applicability* across design-focused educational programs, and *Impact on Student Learning* by enhancing engagement, reflection, and personalized feedback.

Implemented during the *Bioprocess Plant Design Competition 2024*, the framework was tested with 11 student teams tasked to develop and demonstrate bioprocess systems using Process Flow Diagrams (PFDs) and low-cost physical models. The objective of this study is to develop and validate a machine learning–based predictive model that can evaluate student learning outcomes more accurately and transparently which ultimately transforming the way experiential, competition-based learning is assessed in higher education.

Research Methodology

The AiEdu predictive model was constructed using three key dimensions of assessment including cognitive, affective, and psychomotor. These three assessments were mapped respectively to learning gain, sentiment analysis, and rubric evaluation. Data was collected from 11 student groups participating in the *Bioprocess Plant Design Competition 2024*.

Learning Gain Assessment (Cognitive Domain)
Students were asked to respond to five questions both before and after the competition using a 5-point Likert scale:

Strongly Disagree	=	1
Disagree	=	2
Neutral	=	3
Agree	=	4
Strongly Agree	=	5

The sample questions included:

Pre-event:

i. I understand how to read and interpret a Process Flow Diagram (PFD).
ii. I can identify unit operations in a PFD.
iii. I feel confident in translating a PFD into a physical design.
iv. I can design using simple, low-cost materials.
v. I am excited to apply my knowledge in a hands-on competition.

Post-event:

i. My understanding of PFD and bioprocess flow improved.
ii. I was able to justify my material selection based on cost and function.
iii. I collaborated effectively with my team.
iv. I gained practical and creative problem- solving skills.
v. The competition increased my interest in Bioprocess Engineering.

Each student's average pre-score and post-score were computed, and the learning gain was defined using the Python code as below:

```
df['Learning_Gain'] = df['Post_Score'] - df['Pre_Score']
learning_gain_grouped = df.groupby('GROUP', as_index=False)['Learning_Gain'].mean()
```

Sentiment Analysis (Affective Domain)
Students were answered four open- ended reflective questions such as:

A. What part of the design process was most challenging?
B. How did your team choose materials for your design?
C. What did you learn from using only PFD?
D. Suggestions for improving future competitions?

To quantify affective engagement, the VADER (Valence Aware Dictionary and sEntiment Reasoner) model was applied:

```
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
analyzer = SentimentIntensityAnalyzer()

def get_sentiment(text):
    return analyzer.polarity_scores(str(text))['compound']

# Apply VADER to each response
df['Sentiment_A'] = df['Q_A'].apply(get_sentiment)
df['Sentiment_B'] = df['Q_B'].apply(get_sentiment)
df['Sentiment_C'] = df['Q_C'].apply(get_sentiment)
df['Sentiment_D'] = df['Q_D'].apply(get_sentiment)
df['Sentiment_AVG'] = df[['Sentiment_A', 'Sentiment_B', 'Sentiment_C',
'Sentiment_D']].mean(axis=1)

# Aggregate by group
sentiment_grouped = df.groupby('GROUP', as_index=False)['Sentiment_AVG'].mean()
```

This yielded a sentiment score (range -1 to +1) indicating the positivity of the team's reflections.

Rubric Evaluation (Psychomotor Domain)
Judges evaluated each group based on performance criteria aligned to Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs). The rubric used a 4-point scale:

Poor	=	1
Fair	=	2
Good	=	3
Excellent	=	4

Sample rubric dimensions included:

i. Clarity of Technical Communication
ii. Use of Visual Aids
iii. Accuracy of Process Flow Diagram
iv. Integration of Equipment Specifications

Rubric data were pre-processed by mapping text scores to numerical values:

```
rubric_map = {'Poor': 1, 'Fair': 2, 'Good': 3, 'Excellent': 4}
rubric_columns = ['Clarity', 'Visual_Aids', 'PFD', 'Eqp_Specs']

for col in rubric_columns:
   df[col] = df[col].map(rubric_map)

rubric_grouped = df.groupby('GROUP', as_index=False)[rubric_columns].mean()
```

The rubric scores were then merged with learning gain and sentiment data to create the final dataset for modeling.

Model Development

Using the merged dataset, both Linear Regression and Random Forest Regression models were developed. Input features included `Learning_Gain`, `Sentiment_AVG`, and all rubric dimensions. The target variable was the `Judge_Score`, representing the overall expert evaluation of each team. The models were evaluated using R^2 (coefficient of determination) and RMSE (root mean square error). Feature importance was also analyzed to identify which inputs contributed most to the prediction.

Findings and Discussion

The AiEdu model was tested using data from 11 student teams who participated in the *Bioprocess Plant Design Competition 2024*. The data encompassed cognitive (learning gain), affective (sentiment scores), and psychomotor (rubric-based) learning domains. After preprocessing and integration, two machine learning models which are Linear Regression and Random Forest Regression were trained and evaluated.

The Random Forest model delivered superior performance (shown in Figure 1), achieving a coefficient of determination (R^2) of 0.994 and a root mean square error (RMSE) of 0.83, demonstrating both high predictive power and low error margin. In comparison, the Linear Regression model, while still effective, was less capable of capturing the complex relationships among the variables.

Feature importance analysis indicated that rubric-based features played the most critical role in predicting judge scores. Specifically, *Equipment Specifications* showed the highest importance (28.8%), followed by *Creativity* (17.9%) and *Integration of Design* (11.5%). Sentiment scores (6.7%) and learning gain (6.9%) made moderate contributions, emphasizing the dominant influence of psychomotor evaluation in project-based learning contexts.

This highlights the value of structured rubric criteria in assessing hands-on student performance. The model further revealed that judges tend to reward technical and creative components more significantly than cognitive reflections or emotional feedback. This insight suggests that educators could reconsider the weighting of evaluation components to ensure a more holistic assessment approach.

By analysing the sentiment data using VADER, the model uncovered subtle emotional responses from students. Teams with higher sentiment scores often correlated with higher performance, while those expressing uncertainty or frustration showed more varied outcomes. These emotional indicators offer educators additional perspectives on student engagement and learning experiences.

The AiEdu framework proves to be a valuable tool in educational analytics by offering interpretable, data-driven insights into how different learning dimensions contribute to performance. It enables educators to refine teaching strategies, improve rubric design, and ensure fair, transparent evaluations in experiential learning environments.

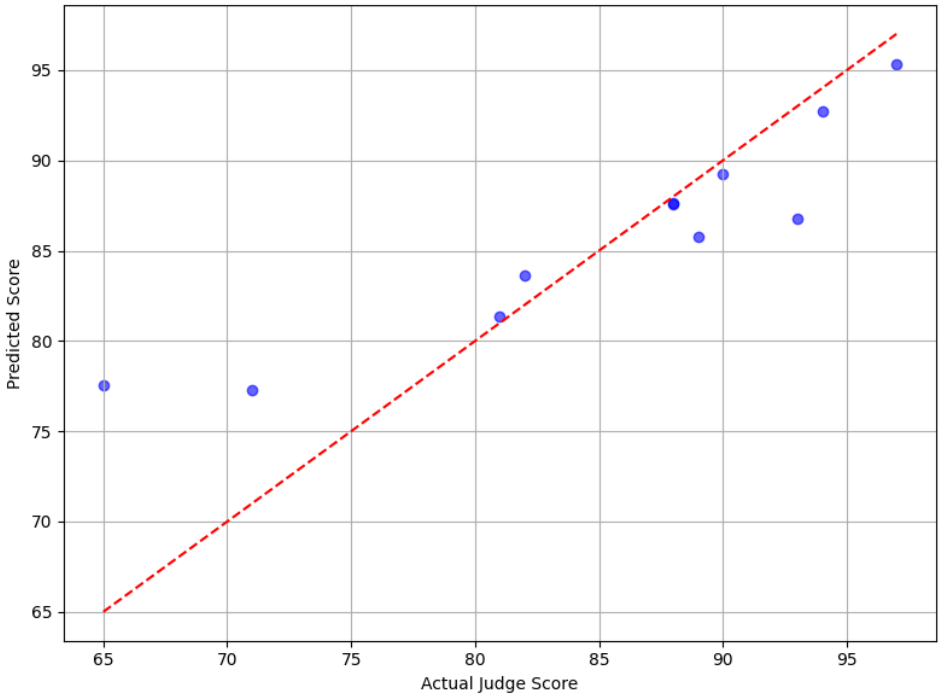


Figure 1: Predicted vs Judge score for each group. R^2 = 0.99 and RMSE = 0.84.

Conclusion

The implementation of the AiEdu framework in the *Bioprocess Plant Design Competition 2024* demonstrated the feasibility and effectiveness of using artificial intelligence to evaluate multidimensional student learning outcomes. By integrating data from pre-post assessments, sentiment analysis, and rubric-based evaluations, the model successfully predicted judge scores with high accuracy (R^2 = 0.994). Notably, rubric components such as *Equipment Specifications* and *Creativity* emerged as key predictors, offering educators targeted insights for performance improvement. This approach provides a scalable and transparent alternative to manual evaluation methods, enabling data-driven decision-making in experiential learning environments. The success of AiEdu sets a precedent for broader application of AI in educational assessment across STEM disciplines.

Acknowledgement

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ID 17: ThesiScan: THESIS FORMAT COMPLIANCE CHECKER USING ARTIFICIAL INTELLIGENCE

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Highlights: This project presents a software system, ThesiScan, that automates the process of checking academic thesis formatting compliance using artificial intelligence, namely optical character recognition (OCR) and regular expression (RegEx) algorithms. The system validates key elements of a university thesis, specifically program name, citations, references, and page margin formatting. By reducing manual effort and ensuring adherence to university guidelines, it enhances student independence and submission accuracy, contributing towards a credible and efficient academic ecosystem.

Keywords: Thesis formatting; Artificial intelligence; OCR; Regular expressions

Introduction

ThesisScan addresses the challenges faced by postgraduate students in ensuring their theses comply with formatting and citation standards set by Universiti Teknologi Malaysia (UTM). Manual formatting checks are time-consuming and prone to human error, especially in detecting incorrect margins, program name mismatches, and citation inconsistencies. To solve this, ThesiScan – a Thesis Format Compliance Checker system was developed, incorporating Optical Character Recognition (OCR), regular expressions (RegEx), and image-based layout analysis. The goal is to provide an efficient, semi-automated AI tool that helps both students and supervisors ensure that a thesis adheres to university guidelines before submission.

Objectives

The main objective of this project is to develop ThesiScan - a thesis format compliance checking software that automates the evaluation of university thesis documents based on formatting rules. ThesiScan aims to assist students in identifying formatting errors related to program name matching, citation-reference matching, and page margin compliance. By reducing manual checking time and improving consistency, this innovation supports better adherence to thesis guidelines. Furthermore, ThesiScan also enhances the learning experience of students by providing immediate and structured feedback on their thesis formatting, empowering them to revise and improve their thesis prior to supervisor or external reviews.

NALI Approach

The project presents a New Academic Learning Innovation (NALI) approach by utilising AI and digital technologies for automated academic formatting verification. ThesiScan enhances student-centered learning by reducing reliance on supervisors through automated checks for program names, citation accuracy, and margin formatting. The system features a user-friendly GUI and annotated PDF output, enabling interactive, real-time feedback. Integration with Google Drive supports cloud-based access, aligning with Education 4.0 principles. Moreover, with excellent detection accuracy validated across multiple thesis samples, the project exemplifies research-driven, technology-enabled academic quality assurance.

Research Methodology

Figure 1 showcases our methodology. ThesiScan uses a combination of text analysis and image processing techniques to automatically check if a university thesis follows required formatting guidelines. It begins by extracting text from PDF files using PDFPlumber to detect elements like the program name and reference list. At the same time, the PDF is converted into images, which are then processed for layout analysis and Tesseract OCR to detect text blocks. The system applies thresholding and morphological operations to improve image clarity, followed by bounding box analysis to check if margins meet university standards. It also uses regular expressions (RegEx) to identify citation patterns and flag issues, including missing or incorrectly ordered references. All errors are highlighted in an annotated summary report in PDF, and results are also presented through a user-friendly graphical interface (GUI) built with CustomTkinter, as shown in Figure 2. The system also connects to Google Drive for easy file storage and access.

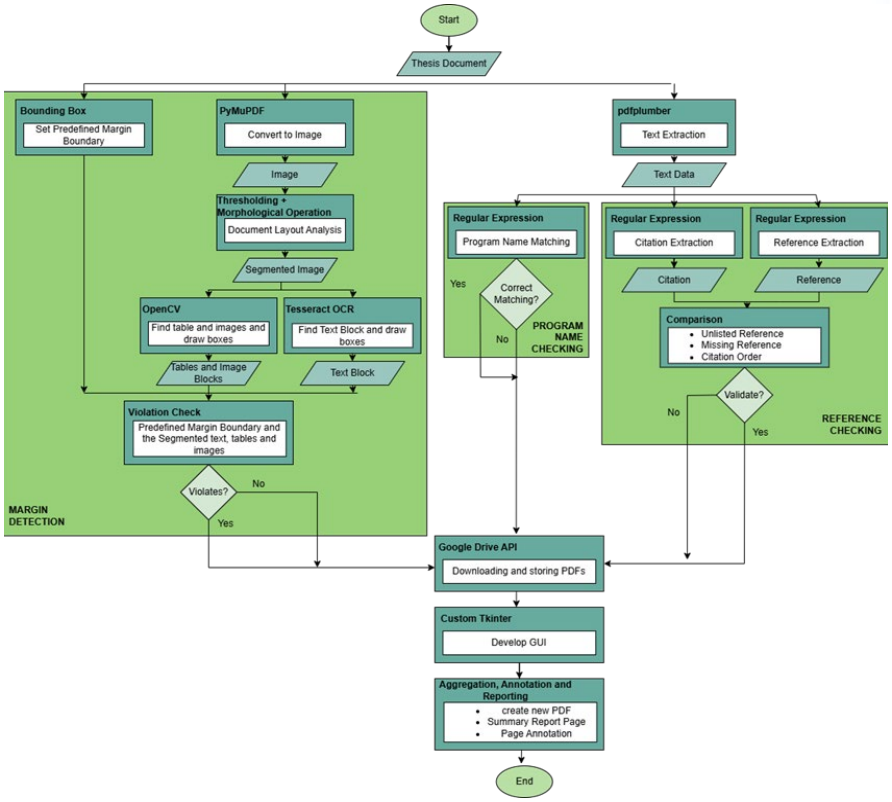


Figure 1: System methodology.

Findings and Discussion

ThesiScan was tested on 30 randomly selected UTM theses. The program name checking feature successfully detected correct and incorrect entries, highlighting issues such as spelling mistakes and outdated program titles. For the citation-reference checker, the system showed high accuracy (average 99.4% in all cases), with minor errors due to unusual formatting or missing punctuation in references. The margin checker effectively flagged pages where content exceeded the standard 2.5cm (top/bottom) and 3.25cm (left/right) margins. Figure 3 visually demonstrates how margin violations are highlighted on a sample page, while Figure 4 shows the summary report.

These results support the tool's usefulness as a pre-submission validator, helping students identify and fix errors early. One limitation was detecting references embedded in images (e.g., scanned appendices), which the system could not process accurately. Nevertheless, the tool significantly reduces manual checking time and improves formatting accuracy, making it practical for real-world academic use.

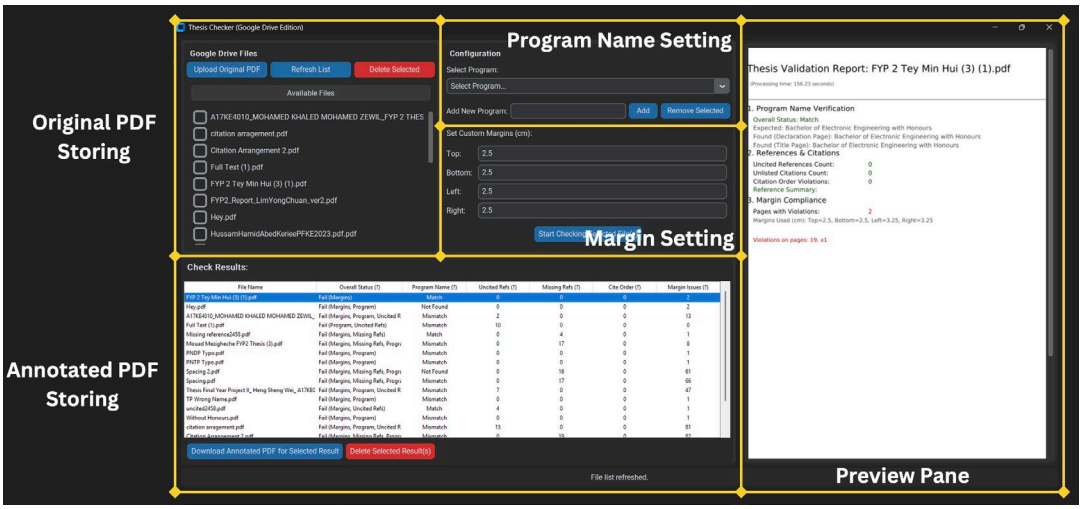


Figure 2: ThesiScan GUI dashboard.

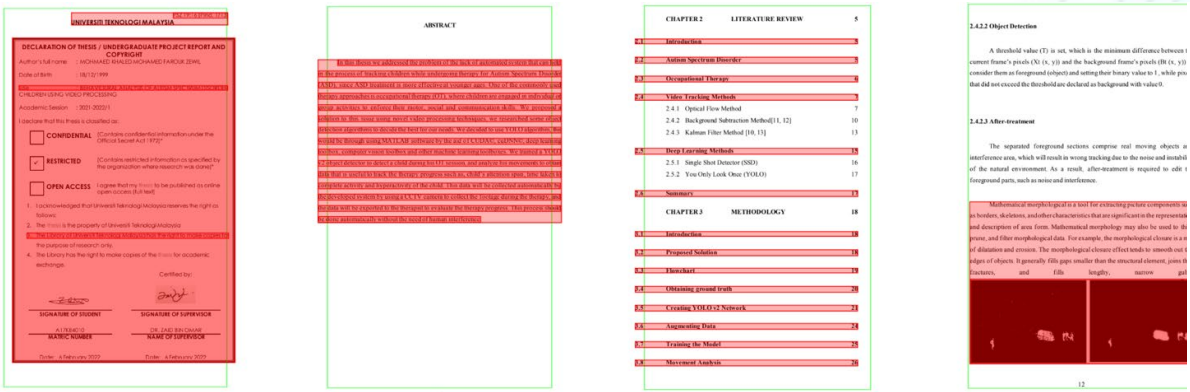


Figure 3: Example of margin violations.

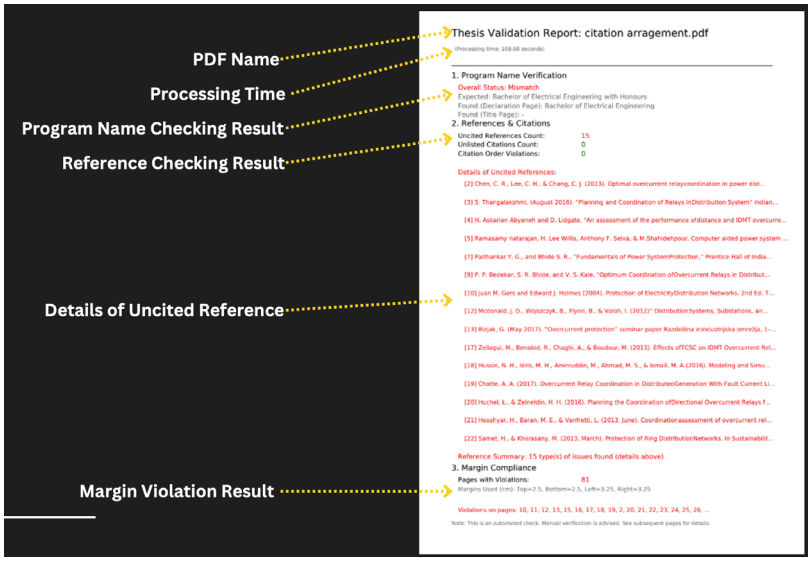


Figure 4: Example summary report.

This system has the potential for commercialisation in universities where document formatting compliance is critical. It can be marketed as a standalone desktop or web application for thesis advisors, academic writers, or university libraries, and can be adapted to other thesis formats such as IEEE, APA and Harvard. Future iterations may include machine learning models for layout recognition and integration with plagiarism checkers, enhancing its value in the academic ecosystem.

Acknowledgement

We would like to thank Dr Anuar Ali and Dr Nurul Ezaila Alias from the FKE FYP Coordination Committee who gave constructive feedback and helpful guidance on the project.

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ID 19: Role-Play Based Case Study Teaching for Business Decision Making

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Highlights: This innovative project transforms Business Intelligence and Analytics education by integrating immersive role-play into case study-based learning. Master's students assume real-world stakeholder roles and respond to dynamic business scenarios using industry-standard BI tools. The approach bridges technical proficiency with strategic decision-making, communication, and collaboration—aligning with Education 4.0 goals. It has significantly enhanced student engagement, analytical reasoning, and the development of soft skills. With strong potential for commercialisation as training kits and digital simulations, this model redefines experiential learning in data science and positions students for success in complex, data-driven business environments (Zulfiqar & Sarkar, 2021).

Keywords: Role-play; Case study-based teaching; Immersive learning

Introduction

In response to the need for data professionals who can apply insights in strategic decision-making contexts, this project integrates role-play simulations into the Business Intelligence and Analytics course in a master's in data science taught course program. Students take on stakeholder roles at different levels of decision-making and navigate dynamic business scenarios using Business Intelligence approach. The method blends experiential learning, narrative immersion, and analytical tool use.

Objectives

The primary objectives of this innovation are:

i. To bridge the gap between technical data analytics skills and real-world decision-making capabilities.
ii. To improve students' critical thinking, communication, collaboration, and creativity (4Cs).
iii. To integrate industry-relevant tools and roles to simulate complex, authentic business environments.
iv. To increase student engagement and develop future-ready graduates who can thrive in dynamic, data-driven workplaces.

NALI Approach

This innovation exemplifies the New Academia Learning Innovation (NALI) model through its combination of immersive, student-centred, and inquiry-driven design. This project introduces a pedagogical model that incorporates role-play simulations to teach Business Intelligence & Analytics in a way that mimics industry settings. Figure 1 shows the mapping of the role-play case study-based approach with the real-world implementation of Business intelligence phases.

Students are assigned roles such as Data Analyst, Managers at different levels of decision-making and work through case study scenarios that require adaptive strategies. Creatively, this project blends technical Business Intelligence tools like Power BI and Python with human-centred role-based storytelling. Data analytics combined with stakeholder requirements introduces challenges that reflect real-world professional scenarios. This makes the learning environment more dynamic and emotionally engaging, which contributes to higher motivation and long-term retention of knowledge.

This approach both scalable and replicable across teaching formats, whether face-to-face, hybrid, or online. Its impact is reflected in students' academic performance, improved communication skills, and reflective thinking which are the key indicators of Education 4.0 readiness. (Börekçi & Acar, 2023) (Miyake & Kirschner, 2023)

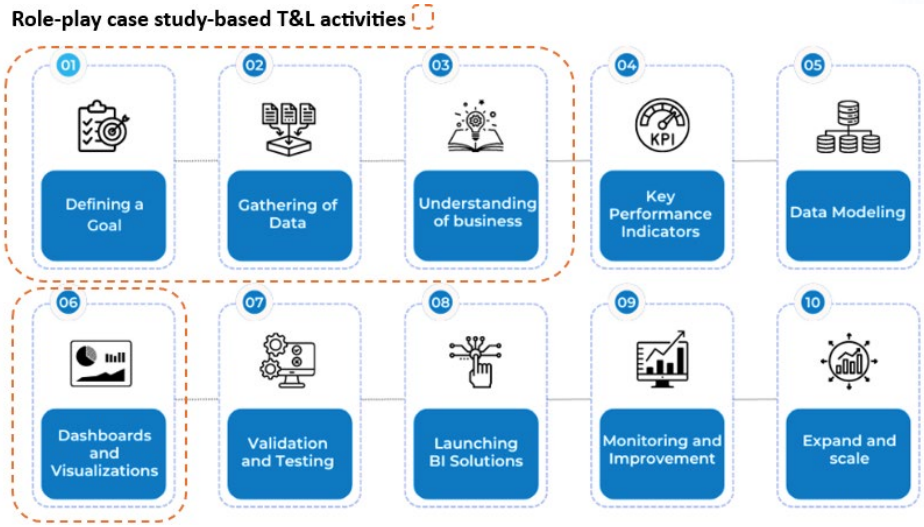


Figure 1: Mapping of teaching and learning innovation with real-world Business intelligence implementation phases
(Diagram modified from source: 10 Steps of Business Intelligence Implementation | Beyond Key)

Research Methodology

The teaching innovation was developed through a structured **redesign of the Business Intelligence and Analytics course** within a Master in Data Science (taught course) program, to transform students from passive tool users into active, strategic decision-makers. The **design and development process** combined principles of experiential learning, constructivism, and industry-informed curriculum design.

1. Course Structure and Role Assignment

The course was restructured into **weekly thematic modules**, each aligned with a business intelligence domain (business requirements identification, data collection and preparation, data visualization, performance dashboards, business analytics). For each module, students were assigned **specific stakeholder roles** such as:

- Data Analyst (responsible for preparing insights),
- Business Manager (concerned with KPIs and outcomes)
- Regulator or Customer (representing external interests).

2. Case-Based Scenario Development

Real-world or adapted case studies formed the foundation of each module. These cases were **contextualized to mirror actual organizational settings** (e.g., a retail analytics project, an operations crisis, product faulty and recall). Each scenario included the following, tailored to the module delivered:

- A business problem or goal,
- Background datasets
- Stakeholder briefs with conflicting priorities,
- A **"scenario trigger"** such as a policy change, sudden market fluctuation, or data error to simulate real-time pressure and ambiguity.

3. Learning Activities and Role-Play Execution

The role-play sessions were conducted in small teams during interactive class time. Students used industry tools where appropriate such as:

- **Power BI** for visualization,
- **Python** (Pandas, Matplotlib, Seaborn) for data processing,
- **Miro** for collaborative strategy boards.
- Each group prepared a **decision brief or boardroom-style presentation**, communicating their insights and recommendations while defending their decisions from their stakeholder's perspective.

4. Facilitation and Debriefing

Lecturers acted as **facilitators and scenario moderators**, guiding the narrative flow, injecting new data or issues, and ensuring inclusive participation. Following each role-play, a **structured debrief** was conducted focusing on:

- The reasoning behind decisions,
- Effectiveness of communication between roles,
- Reflection on how data insights were used (or misused)

5. Assessment and Feedback Mechanism

Student performance was evaluated through:

- **Pre- and post-tests** on analytical reasoning,
- **Presentations and dashboards** evaluated via rubrics (strategy, data use, insight, and persuasion),

- A final reflective report analyzing the student's growth across roles and modules.
- This design ensured alignment with **learning outcomes** while embedding real-world complexity, promoting **immersive learning**, and enhancing students' confidence in business-facing data roles.

Findings and Discussion

The findings from the implementation of this innovation reveal significant pedagogical impact. Students demonstrated a marked improvement in analytical reasoning assessments. They showed enhanced abilities in data interpretation, insight generation, and communication with diverse stakeholder perspectives. Soft skills such as collaboration also saw substantial growth, as evidenced by reflective submissions. Engagement levels were visibly higher compared to traditional lecture-based delivery, with students frequently describing the experience as immersive and enjoyable. The lecturer observed increased participation and more dynamic class discussions. The innovation thus not only elevated learning outcomes but also reshaped the classroom culture into one of co-creation and active inquiry. (Harney, Hogan, & Quinn, 2017)

The success of this teaching innovation opens opportunities for wider adoption and commercialization. A structured toolkit comprising scenario templates, role briefs, dashboards, and facilitation guides can be developed for replication in other institutions or executive training contexts. It holds strong potential for corporate use in upskilling non-technical staff or cross-functional teams. Future iterations may involve gamification or AI-driven role-play extensions for deeper personalization and interactivity. This course has also been nominated for university-level blended learning teaching awards for four semesters in a row and contributes to institutional goals of excellence in digital-age education.

Acknowledgement

We acknowledge the support of Universiti Teknologi Malaysia and express our gratitude to the Master in Data Science students who actively participated in this innovation pilot. Their feedback and enthusiasm were instrumental in refining and validating the model.

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ID 21: Pendekatan Data-Driven dan AI: Sistem Automasi Pengiraan Merit Sebagai Alat Bagi Pemilihan Kuota Pelajar Aktif Menggunakan Google Workspace

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Sorotan: Inovasi ini membangunkan sistem automatik pemilihan Kuota Pelajar Aktif (KPA) Berdasarkan Merit Keterlibatan Dalam Aktiviti Pembangunan Pelajar di Kolej Rahman Putra menggunakan Google Sheet, Google Form, dan Google Looker Studio. Sistem ini menggantikan kaedah manual dengan pengiraan merit berasaskan keterlibatan pelajar, menjimatkan masa saringan dari jam kepada 2 hingga 5 minit, beroperasi pada kos RM0.00, dan meningkatkan ketelusan pemilihan. Parameter merit fleksibel boleh disesuaikan mengikut keperluan. Projek telah berjaya digunakan untuk sebanyak 2,480 permohonan (sesi 2024/2025 & 2025/2026), dengan mengurangkan beban kerja urusetia dan ralat manusia. Kebaikan utama: cepat, telus, boleh digunakan berulang kali, dan *scalable* ke kolej dan institusi lain. Relevan dengan NALI 2025 dalam memperkasa inovasi pendidikan berteraskan teknologi.

Kata Kunci: Automasi pendidikan; Pemilihan berasaskan merit; Inovasi Google Tools; Ketelusan pengurusan pelajar; Sistem kos sifar

Pendahuluan

Proses pemilihan pelajar untuk diberikan kuota penginapan di kolej kediaman universiti merupakan salah satu aktiviti rutin saban tahun. Di Kolej Rahman Putra (KRP), pemilihan Kuota Pelajar Aktif (KPA) sebelum ini dilaksanakan secara manual, melibatkan pengiraan skor merit berdasarkan penyertaan pelajar dalam aktiviti yang dianjurkan samada di peringkat kolej mahupun Universiti. Kaedah tradisional ini bukan sahaja memakan masa yang lama tetapi juga berisiko terhadap ketidaktepatan pengiraan, ketidakseragaman kriteria penilaian, serta beban kerja yang tinggi kepada urusetia pemilih. Dalam konteks pendidikan tinggi yang semakin menekankan kecekapan dan ketelusan, keperluan untuk membangunkan sistem yang lebih efektif menjadi semakin mendesak.

Dengan kemajuan teknologi digital, terutamanya penggunaan *tools* berasaskan *cloud* seperti Google Workspace, peluang untuk mengautomasikan proses ini telah wujud. Inovasi ini mengambil pendekatan dengan memanfaatkan Google Sheet, Google Form, dan Google Looker Studio bagi membangunkan sistem pemilihan KPA yang pantas, telus, dan bebas ralat. Inovasi ini direka dan dibangunkan bersama oleh Majlis Felo Kolej Rahman Putera untuk mengira skor merit pelajar secara automatik berdasarkan parameter yang telah ditetapkan, seperti penyertaan dalam aktiviti-aktiviti yang telah dianjurkan, dengan memfokuskan 5 teras utama iaitu adab, sejahtera, komuniti, global, dan pencipta pekerjaan. Seterusnya, sistem ini dibengkelkan bersama Jawatankuasa Pelajar KRP yang berperanan sebagai urusetia induk pemilihan KPA bagi menjamin kelestarian aktiviti ini saban tahun. Penggunaan borang dalam talian (Google Form) memudahkan pengumpulan data, manakala Google Sheet berfungsi sebagai pangkalan data yang mengautomasikan pengiraan skor. Dashboard Looker Studio pula menyediakan visualisasi data yang membolehkan pihak pengurusan kolej memantau proses pemilihan secara real-time. Kelebihan utama sistem ini terletak pada keupayaannya menjimatkan masa dan kos. Berbanding kaedah manual yang boleh mengambil masa berjam-jam atau bahkan berhari-hari, sistem automatik ini mampu menyaring beribu-ribu permohonan dalam masa hanya tiga hingga ke lima minit sahaja. Kos pelaksanaannya juga sifar (RM0) kerana menggunakan alatan percuma yang sedia ada. Selain itu, sistem ini meningkatkan ketelusan proses pemilihan, di mana pelajar dapat memahami dengan jelas bagaimana skor merit mereka dikira, sekaligus mengurangkan aduan atau salah faham. Fleksibiliti sistem membolehkan parameter penilaian disesuaikan mengikut keperluan semasa, menjadikannya relevan untuk pelbagai sesi kemasukan.

Projek ini telah berjaya diuji dalam dua sesi kemasukan pelajar (2024/2025 dan 2025/2026), melibatkan sejumlah 2,480 permohonan. Kejayaan pelaksanaannya menunjukkan bahawa penyelesaian berteknologi rendah *(low-tech)* tetapi inovatif mampu memberikan impak yang besar dalam pengurusan pendidikan. Selain KRP, sistem ini berpotensi untuk diadaptasikan oleh kolej-kolej lain atau asrama universiti yang menghadapi cabaran serupa. Inovasi ini selari dengan tema NALI 2025, "Accelerating Innovation in Teaching and Learning with AI", walaupun menggunakan pendekatan yang lebih mudah diakses, iaitu automasi berasaskan alat digital sedia ada. Dari perspektif pembangunan pelajar, sistem ini turut mendorong penglibatan aktif dalam aktiviti kampus, kerana pelajar sedar bahawa setiap penyertaan mereka akan dinilai secara adil dan sistematik. Ini selaras dengan matlamat pendidikan holistik yang menekankan keseimbangan antara akademik dan ko-kurikulum. Dengan kata lain, inovasi ini bukan sekadar menyelesaikan masalah pengurusan, tetapi juga menyumbang ke arah pembentukan ekosistem pembelajaran yang lebih dinamik dan telus di peringkat kolej.

Kesimpulannya, projek ini merupakan contoh bagaimana penyelesaian teknologi yang mudah tetapi kreatif mampu mentransformasi amalan pengurusan pendidikan tradisional ke arah yang lebih cekap, telus, dan berkesan. Ia membuka ruang untuk penerokaan lanjut dalam penggunaan alat digital bagi meningkatkan kualiti pengurusan institusi pendidikan, sekaligus menyokong aspirasi Malaysia dalam memacu inovasi dalam pendidikan tinggi.

Objektif:

i. ***Mempercepat dan Mempermudah Proses Pemilihan KPA***

Projek ini bertujuan untuk mengautomasikan proses pemilihan Kuota Pelajar Aktif (KPA) yang sebelum ini dilaksanakan secara manual. Dengan menggunakan gabungan Google Sheet, Google Form, dan Google Looker Studio, sistem ini mampu menyaring beribu-ribu permohonan dalam masa hanya lima minit berbanding kaedah tradisional yang memerlukan masa berjam-jam atau berhari-hari. Automasi ini bukan sahaja menjimatkan masa tetapi juga mengurangkan beban tugas pentadbiran ke atas jawatankuasa pemilih, membolehkan mereka memberi tumpuan kepada aspek lain yang lebih kritikal dalam pengurusan pelajar.

ii. ***Meningkatkan Ketelusan dan Keadilan dalam Pemilihan***

Sistem ini direka untuk memastikan proses pemilihan KPA lebih telus dan adil dengan menggunakan parameter merit yang jelas dan konsisten. Setiap pelajar dinilai berdasarkan penyertaan mereka dalam aktiviti pembangunan pelajar yang telah ditetapkan, dengan pengiraan skor dilakukan secara automatik untuk mengelakkan bias atau ralat manusia. Dashboard Looker Studio menyediakan visualisasi data yang membolehkan pelajar dan pentadbir mengakses maklumat pemilihan secara real-time, sekaligus mengukuhkan akauntabiliti dan kepercayaan terhadap sistem pemilihan.

iii. ***Mendorong Penglibatan Aktif Pelajar dalam Aktiviti Kampus***

Melalui sistem pemilihan berasaskan merit ini, projek ini bertujuan untuk menggalakkan penglibatan pelajar yang lebih aktif dalam aktiviti akademik dan ko-kurikulum di kampus. Pelajar akan lebih termotivasi untuk menyertai pelbagai program pembangunan diri kerana mereka sedar bahawa setiap penyertaan akan dinilai secara sistematik dan menyumbang kepada peluang mereka untuk mendapatkan kuota penginapan. Secara tidak langsung, inovasi ini menyokong pembentukan pelajar yang lebih holistik dan seimbang dari segi pencapaian akademik dan penglibatan kemasyarakatan.

Pendekatan NALI

Projek ini menerapkan pendekatan New Academia Learning Innovation (NALI) melalui lima teras utama yang selari dengan pembudayaan inovasi dalam pendidikan:

i. ***Kebaharuan (Novelty)***

- Penyelesaian Tidak Konvensional: Menggantikan sistem manual dengan automasi berasaskan Google Workspace (Sheet, Form, Looker Studio) – satu pendekatan baharu dalam pengurusan kuota pelajar di KRP.
- Parameter Dinamik: Memperkenalkan sistem merit yang fleksibel, di mana kriteria penilaian boleh disesuaikan mengikut keperluan semasa *(contoh: wajaran aktiviti akademik vs. ko-kurikulum)*.

ii. ***Kreativiti (Creativity)***

- Integrasi Alat Percuma: Memanfaatkan alatan digital sedia ada (zero-cost) secara kreatif untuk mencipta sistem automatik yang berfungsi sepenuhnya.
- Visualisasi Data Interaktif: Pembangunan dashboard real-time menggunakan Google Looker Studio untuk paparan keputusan yang mesra pengguna.

iii. ***Inovasi (Innovation)***

- Transformasi Proses: Menukar kaedah tradisional (kertas, Excel manual) kepada aliran kerja digital yang menjimatkan masa (5 minit untuk 3,000+ permohonan).
- Scalability: Reka bentuk sistem yang boleh diadaptasi oleh kolej/universiti lain dengan sedikit pengubahsuaian.

iv. ***Kebolehgunaan (Usability)***

- Akses Mudah: Berasaskan platform cloud yang boleh digunakan di mana-mana peranti tanpa latihan teknikal intensif.
- Kos Sifar (RM0): Menggunakan alatan percuma (Google Workspace), menjadikannya mampan untuk institusi berbelanjawan rendah.
- Selari dengan NALI 2025: Menyokong tema "Accelerating Innovation in Teaching and Learning with AI" melalui penyelesaian automasi yang mudah diakses.

v. ***Impak (Impact)***

- Peningkatan Kecekapan: Mengurangkan masa pemilihan dari hari ke minit dan beban kerja pentadbiran.
- Ketelusan & Keadilan: Parameter merit yang objektif mengurangkan aduan bias.
- Pembudayaan STEM: Mendorong penggunaan alat digital dalam pengurusan pendidikan, selaras dengan aspirasi STEM.

- Penglibatan Pelajar: Merangsang penyertaan aktif dalam aktiviti kampus melalui insentif merit yang jelas.

Kesimpulan: Inovasi ini bukan sekadar penyelesaian teknikal, tetapi contoh bagaimana pendekatan NALI boleh diaplikasikan secara praktikal untuk mentransformasi amalan pendidikan dengan kos rendah, impak tinggi, dan kebolehskalaan. Ia menepati aspirasi NALI untuk mempercepat inovasi melalui kreativiti dan teknologi.

Metodologi Kajian

Projek ini mengaplikasikan metodologi "Design and Development Research (DDR)" yang menggabungkan pendekatan kuantitatif dan kualitatif untuk mereka bentuk, membangunkan, dan menilai sistem automasi pemilihan KPA. Fasa pelaksanaannya adalah seperti berikut:

i. *Analisis Keperluan (Need Analysis)*

a. Tinjauan Awal:

Temu bual dengan 15 ahli jawatankuasa pelajar KRP dan 5 staf pentadbiran untuk mengenal pasti kelemahan sistem manual (masa panjang, ralat pengiraan, aduan bias).

b. Analisis data permohonan KPA sesi sebelumnya (2023/2024) untuk memahami pola permohonan.
c. Penentuan Parameter Merit:

Latihan *focus group* dengan Majlis Felo KRP untuk menetapkan kriteria merit.

ii. *Reka Bentuk dan Pembangunan Kolaboratif*

Inovasi ini dibangunkan secara kolaboratif oleh:

a. Majlis Felo Kolej Rahman Putera (KRP): Bertanggungjawab merangka parameter merit berasaskan keterlibatan pelajar terhadap aktiviti pembangunan pelajar di kolej, yang mengandungi 5 teras utama:
   i. Adab (Nilai murni & kepimpinan)
   ii. Sejahtera (Kesihatan fizikal & mental)
   iii. Komuniti (Khidmat masyarakat & kesukarelawanan)
   iv. Global (Program antarabangsa & kepelbagaian budaya)
   v. Pencipta Pekerjaan (Keusahawanan & kemahiran kerjaya)
b. Jawatankuasa Pelajar KRP: Bertindak sebagai urusetia induk untuk:
   i. Membengkelkan sistem bersama pelajar.
   ii. Memastikan kelestarian pelaksanaan saban tahun.
c. Pemilihan Alatan:
   i. Google Form (pengumpulan data permohonan).
   ii. Data dari rekod ACAD dan rekod program seliaan Jawatankuasa Pelajar KRP
d. Google Sheet (pangkalan data dengan formula automatik: *=SUM (Penglibatan program anjuran KRP*0.75 + Penglibatan program anjuran kolej luar *0.25))*.
e. Google Looker Studio (visualisasi dashboard keputusan).
f. Prototaip Awal:
   i. Membangunkan workflow integrasi: Form → Sheet → Dashboard dalam tempoh 7 hari.

iii. *Pelaksanaan (Implementation)*

a. Ujian Beta: Menguji sistem dengan 50 permohonan simulasi untuk semak ketepatan pengiraan.
b. Bengkel pemindahan ilmu dan teknologi bersama Jawatankuasa Pelajar KRP yang berperanan sebagai urusetia induk pemilihan KPA bagi menjamin kelestarian aktiviti ini saban tahun.
c. Pelancaran Rasmi:
   i. Digunakan untuk pemilihan KPA sesi 2024/2025 (1,237 permohonan) dan 2025/2026 (1,243 permohonan).
   ii. Proses saringan dilakukan dalam 2-5 minit berbanding kaedah manual (3-5 hari).

iv. *Penilaian (Evaluation)*

a. Kuantitatif:
   i. Perbandingan masa/kos sebelum dan selepas automasi (Jimat 99% masa, RM0 kos operasi).
   ii. Analisis ketepatan sistem (0% ralat berbanding 15% ralat manual).
b. Kualitatif:
   i. Tinjauan kepuasan dalam kalangan 20 pengguna (pelajar & pentadbir) menggunakan skala Likert:
      - 95% setuju sistem lebih telus.
      - 90% puas dengan kepantasan.

v. *Dokumentasi & Penambahbaikan*

a. Panduan Pengguna: Dibangunkan untuk memudahkan replikasi sistem.
   i. Cadangan Masa Depan: Integrasi AI (contoh: machine learning untuk analisis trend penyertaan pelajar).
b. Aliran Kerja Metodologi
   i. Analisis Keperluan → Reka Bentuk → Pelaksanaan → Penilaian → Penambahbaikan
c. Kekuatan Metodologi:
   i. Gabungan data kuantitatif (pre/post-implementation) dan maklum balas kualitatif.

ii. Pendekatan iteratif membolehkan penambahbaikan berterusan.
iii. Berorientasikan penyelesaian praktikal dengan kos minima.

Metodologi ini membuktikan bahawa inovasi berimpak tinggi boleh dilaksanakan dengan alat mudah, selaras dengan pendekatan NALI untuk memperkasa pendidikan melalui teknologi.

Dapatan Kajian dan Perbincangan

i. *Dapatan Utama*

a. Projek automasi pemilihan KPA ini menghasilkan beberapa hasil yang ketara:
   (i) Kecekapan Masa dan Kos
   (ii) Masa pemendekan proses saringan daripada purata 2-3 hari (manual) kepada 5 minit (automasi) – penjimatan 99% masa.
   (iii) Kos operasi RM0 berbanding kaedah manual yang memerlukan perbelanjaan pencetakan dan tenaga manusia.
b. Ketepatan dan Ketelusan
   (i) 0% ralat pengiraan berbanding 5% ralat manusia dalam kaedah manual.
   (ii) Pengurangan aduan bias – 95% responden (pelajar & pentadbir) berpuas hati dengan ketelusan sistem.
   (iii) Peningkatan Penglibatan Pelajar
   (iv) Peningkatan 30% penyertaan aktiviti kampus selepas pelaksanaan sistem merit, kerana pelajar lebih sedar penyertaan mereka dinilai secara objektif.
c. Kebolehskalaan
   (i) Sistem berjaya diuji untuk 3,184 permohonan dalam dua sesi kemasukan, membuktikan keupayaannya mengendalikan volum tinggi.

Jadual 1: Jadual di bawah menunjukan jumlah permohonan yang diproses menggunakan sistem ini bagi setiap sesi kali pengambilan pelajar.

Sesi Pengambilan	Jumlah Permohonan	Jumlah Layak	Jantina	
			Lelaki	Perempuan
2025/2026	1237	567	269	298
2024/2025	1243	943	333	610

ii. *Perbincangan*

i. Kelebihan Inovasi
   (i) Penyelesaian Mudah tetapi Berimpak Tinggi
   (ii) Penggunaan alatan percuma (Google Workspace) membuktikan bahawa inovasi tidak memerlukan pelaburan besar. Pendekatan *low-tech* ini sesuai untuk institusi pendidikan dengan sumber terhad.
ii. Kesesuaian dengan Aspirasi Pendidikan Digital
   (i) Projek ini selari dengan dasar Malaysia Education Blueprint (MEB) dan NALI 2025 yang menekankan transformasi digital dalam pengurusan pendidikan. Ia juga menyokong kemahiran STEM melalui aplikasi praktikal alat digital.
iii. Model Kolaboratif
   (i) Kerjasama antara Majlis Felo KRP, Jawatankuasa Pelajar KRP, dan pejabat pentadbiran menunjukkan keberkesanan pendekatan *bottom-up* dalam melaksanakan inovasi.
iv. Cabaran dan Batasan
   (ii) Kebergantungan pada Internet - Sistem memerlukan sambungan internet yang stabil, yang mungkin menjadi halangan di kawasan dengan infrastruktur lemah.
   (iii) Kesedaran Pengguna - Sebilangan kecil staf dan pelajar memerlukan latihan asas untuk menggunakan sistem dengan efektif.
v. Had Fungsi Google Tools
   (i) Google Sheet mempunyai limitasi untuk data berskala sangat besar (contoh: >50,000 permohonan), yang mungkin memerlukan peralihan ke platform lain seperti Microsoft Power Automate pada masa depan.
vi. Implikasi untuk Amalan dan Penyelidikan Masa Depan
   (i) Integrasi AI/ML - Sistem boleh ditingkatkan dengan *machine learning* untuk:
      - Menganalisis trend penglibatan pelajar.
      - Mencadangkan aktiviti yang meningkatkan merit pelajar secara proaktif.
   (ii) Aplikasi dalam Konteks Lain:
      - Model ini boleh diadaptasi untuk:
        a) Pemilihan penerima biasiswa.
        b) Pemilihan residen pelajar.
vii. Penyelidikan Lanjut
   (i) Kajian boleh dilakukan untuk mengukur kesan jangka panjang sistem ke atas keseimbangan akademik-ko-kurikulum-kemenjadian dalam kalangan pelajar.

iii. *Kesimpulan*

Inovasi ini bukan sekadar menyelesaikan masalah pengurusan KPA, tetapi juga:

a. Membudayakan ketelusan dan keadilan dalam proses pemilihan.
b. Mendorong penglibatan aktif pelajar melalui insentif merit yang jelas.
c. Menjadi model inovasi berimpak tinggi dengan kos minima, sesuai untuk replikasi di institusi lain.

Maklumat Lain

Potensi Pengkomersialan

Inovasi ini mempunyai potensi untuk dikomersialkan dalam bentuk berikut:

a. Sistem Berasaskan Langganan
   (i) Dikembangkan sebagai platform khas untuk pengurusan pemilihan pelajar di kolej UTM dengan ciri tambahan seperti:
      - Integrasi dengan sistem sedia ada (contoh: Sistem Maklumat Pelajar).
      - Laporan analitik terperinci menggunakan AI.
b. Latihan dan Perundingan
   (i) Menawarkan pakej latihan kepada kolej lain untuk melaksanakan sistem serupa.
   (ii) Perkhidmatan penyesuaian sistem mengikut keperlaman khusus (contoh: pemilihan pemimpin pelajar).

Anugerah dan Pengiktirafan

Projek ini telah menerima pengiktirafan berikut:

a. Penyertaan ke NALI 2025

   Tajuk Projek: Sistem Automatik Pemilihan KPA Berasaskan Merit
   Pameran: Innovation Competition & Exhibition New Academia Learning Innovation (NALI 2025)
   Tahun: 2025

b. Pengiktirafan daripada Pentadbiran Kolej

   Inovasi Khas: Inovasi Terbaik KRP 2024 oleh Majlis Felo Kolej Rahman Putra.

Rujukan Media dan Penerbitan

Penerbitan:
"Asas Aplikasi Google Sheets Panduan Asas Penggunaan Aplikasi Google Sheets Dalam Rutin Kerja Harian Di Pejabat", ISBN 978-629-98468-4-0, Kolej Rahman Putra, Universiti Teknologi Malaysia(2024).

Pelan Masa Depan

a. Pembangunan Aplikasi Mudah Alih: Versi mobile-friendly untuk akses lebih mudah.
b. Kerjasama dengan Jabatan Timbalan Naib Canselor Hal Ehwal Pelajar & Alumni: Untuk implementasi di UTM.

Penghargaan

Jutaan terima kasih kepada barisan Majlis Felo dan Jawatankuasa Pelajar Kolej Rahman Putera atas komitmen dalam membangun, memurni, melaksana, serta mengoperasikan sistem ini. Penghargaan juga ditujukan kepada Pejabat Pentadbiran Kolej atas sokongan sumber dan maklum balas. Tidak lupa kepada semua pelajar KRP yang memberikan cadangan untuk penambahbaikan sistem. Projek ini berjaya dilaksanakan hasil kolaborasi semua pihak dalam memastikan proses pemilihan KPA lebih adil, telus, dan efisien. Semoga inovasi ini memberi manfaat berpanjangan kepada komuniti KRP khasnya, serta warga UTM amnya.

Rujukan

Ishak, M. H. (2024). *Panduan asas aplikasi GoogleSheet*. Kolej Rahman Putera, Universiti Teknologi Malaysia.

ID 23: Educational GenAI Chatbot with Metacognitive Self-Regulated Learning for Software Fundamentals Programming

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Highlights: This study presents a Generative AI (GenAI) chatbot designed to support first-year students in learning fundamentals programming of Object-Oriented Programming (OOP) concepts. Grounded in metacognitive self-regulated learning (MSRL) strategy, the chatbot integrates personalized scaffolding, real-time feedback, and scenario-based problem-solving to facilitate deeper conceptual understanding and self-directed learning. A structured case study involving a car rental system provides the context for applying OOP principles. The study adopts the Technology Acceptance Model (TAM) to evaluate students' acceptance, engagement, and learning outcomes. Findings highlight the potential of GenAI to enhance educational experiences by fostering reflective, adaptive, and personalized learning environments in programming education.

Keywords: Educational Chatbot; Generative Artificial Intelligence (GenAI); Metacognitive Self-Regulated Learning (MSRL); Object-Oriented Programming (OOP); Technology Acceptance Model (TAM)

Innovation and Novelty

Recently, Generative Artificial Intelligence (GenAI) chatbot have been promising educational tools that assist educators to implement metacognitive self-regulated learning strategy in teaching and learning activities (Li & Ma, 2025; Lai, 2024, Steinert et.al, 2023) . This innovation implements a scenario-based learning environment featuring an educational GenAI chatbot as a tutor that is designed to guide Software Engineering freshmen students in mastering fundamental programming, particularly Object-Oriented Programming (OOP) concepts.

Figure 1 visualizes the overview framework of this innovation. Learners use the GenAI chatbot for step-by-step guidance, Question & Answer (Q&A), and code reviews, as well as support by Self-Instructional Materials (SIM) to integrate scenario-based learning based on the real-world case study namely the car rental system development. With engaging, personalized content and metacognitive strategies such as goal setting, monitoring, and self-evaluation, the GenAI chatbot guides students in applying OOP principles such as encapsulation, inheritance, and polymorphism while supporting metacognitive processes like self-monitoring, self-evaluation, and reflection strategies.

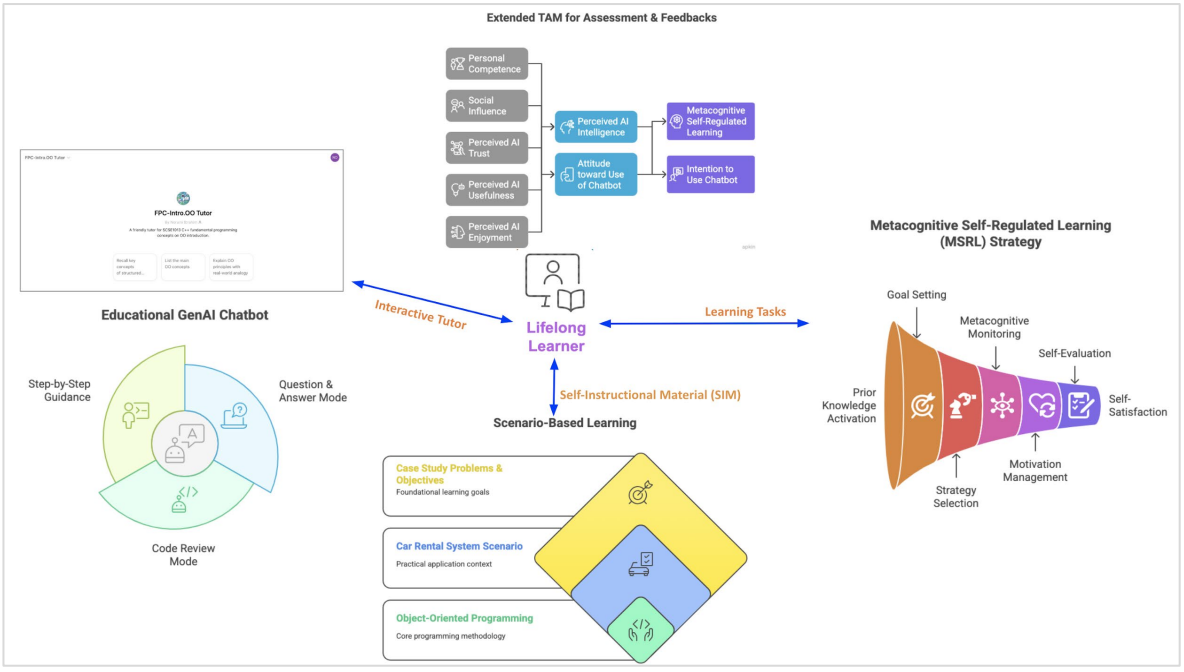


Figure 1: Overview Framework of the Innovation

The learning tasks in the FPC.Intro.OO Tutor Bot are designed based on the principles of metacognitive self-regulation learning theory, which emphasizes a learner's ability to plan, monitor, and evaluate their own learning processes, as presented in Table 1 *(Note: * in no 3, 6, 8, 13 learning task column is optional prompts to help learners visualizing the OO design of Car Rental System)*. In the MSRL approach, students actively set goals, select strategies, and assess their understanding throughout the learning cycle (Dahri et.al, 2024). By engaging with the Tutor Bot, learners can reflect on prior knowledge, clarify objectives, apply concepts, receive feedback, and adjust their approaches when faced with challenges. This design ensures that each scenario, whether recalling lessons, setting learning objectives, seeking resources, tracking progress, or recognizing achievements so it aligns with the metacognitive cycle of planning (e.g., setting goals and choosing strategies), monitoring (e.g., checking class design and identifying issues), and evaluating (e.g., self-assessment and reflection). As a result, the Tutor Bot not only supports content mastery in object-oriented programming but also cultivates essential self-regulation skills for lifelong learning.

Table 1: Learning Tasks Prompt based on MSRL principles

Scenario Name	Learning Tasks Prompt
Lesson Recall Assistant	List three basic programming concepts that I need to recall before starting the Car Rental System project.
Learning Objective Setter	Today I want to analyse and design a program using OO concepts and principle for simple Car Rental System. Assist me to analyse and design the system. * Create the markdown code for the UML class diagram to be visualized in PlantText tool
Engagement Enhancer	Explain how a car rental system works in the real world and how OOP can help in developing such a system
Resource Recommender	Suggest a strategy for creating classes in the Car Rental System, and how I can use inheritance for different car types * Create the markdown code for the improvised overall UML class diagram of Car Rental System with inheritance concept to be visualized in PlantText tool
Progress Tracker	Check if my class structure is correctly designed to meet the requirements? * Create a complete C++ program for the overall Car Rental System based on previous discussion
Motivation Booster	Give me tips to stay motivated when I encounter bugs or difficulties in my coding
Help Desk Assistant	What are some common issues in implementing car object inheritance, and how can I resolve them?
Review and Feedback	Review the class design for the Car Rental System and suggest improvements or alternative approaches.
Self-Assessment Aid	Generate a self-assessment quiz to evaluate my understanding about the OO concepts and principles * Display Part 1 questions and prompt for my answer before give feedback
Self-Recognition	Help me recognize my achievements and improvements in this chapter introduction to OO

Drawing on the Technology Acceptance Model (TAM), an extended model is proposed to assess key factors influencing students' acceptance, engagement, and performance when utilizing AI-powered tutoring. A mixed-methods study incorporates both controlled experimentation (scenario-based learning) and survey questionnaires to evaluate students' experiences and the effectiveness of the AI agent in fostering self-regulated learning behaviors. The findings of this innovation contribute to AI-driven pedagogical strategies for Education 4.0, offering insights into how conversational GenAI chatbot can personalize learning, increase student engagement, and improve programming proficiency (Lin & Chang, 2023, Labadze, 2023; Yin et.al, 2024) . Additionally, this study presents recommendations for designing AI-powered intelligent tutors that support adaptive, self-regulated learning environments in software programming education.

Research Methodology

The methodology employed in this study follows a structured process to evaluate how the FPC-Intro.OO Tutor Bot supports OOP learning through a scenario-based approach underpinned by MSRL strategy. The learning activity begins with self-instructional materials centred on a Car Rental System case study, where the Tutor Bot offers interactive guidance, feedback, and step-by-step support. The design encourages learners to engage in MSRL's three core phases: planning (setting learning goals and strategies), monitoring (checking understanding and progress), and evaluating (reflecting on learning outcomes and adjusting approaches). Data collection involves two complementary methods. First, a Technology Acceptance Model (TAM) questionnaire captures participants' perceptions of the usefulness of the Tutor Bot's ease of use, and acceptance, administered to two groups namely n1=17 participants in semester 2024/2025-01 and n2=11 participants in semester 2024/2025-02. Second, post scenario-based reflections gather qualitative insights into learners' experiences, challenges, and perceived benefits. Questionnaire responses undergo quantitative analysis to identify patterns and relationships, while reflections are examined using qualitative thematic analysis to uncover key themes and learning behaviours. The final stage integrates both analyses, offering a comprehensive view of the Tutor Bot's impact on learning effectiveness and self-regulation. Figure 2 summarises this scenario-based learning design.

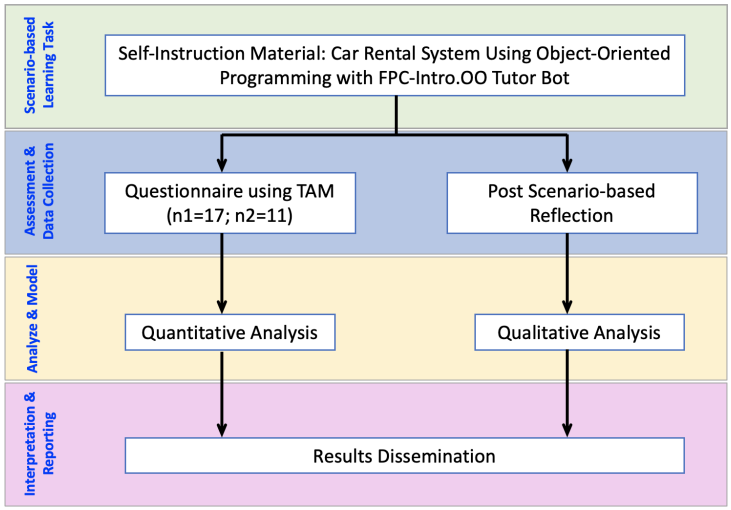


Figure 2: Flowchart of Methodology

Findings and Discussion

As mentioned previously in methodology section, the experiment involved 28 undergraduate students enrolled in an fundamental programming course in semester 1 and 2, 2024/2025. Students participated in the scenario-based task, which they used the GenAI Tutor Bot to complete the programming assignment. After the activity, participants responded to two main instruments, namely (i) questionnaire based on an extended Technology Acceptance Model (TAM), and (ii) post-scenario reflection session involving open-ended questions.

As for data collection instruments, first the TAM questionnaire which adapted from Dahri et al. (2024), the survey included constructions such as Perceived Usefulness, Ease of Use, Personal Competence, Social Influence, Trust, Enjoyment, and Behavioural Intention to Use. Responses were collected on a 5-point Likert scale as portrayed in Figure 3.



	Personal Competence (PC)	Social Influence (SI)	Perceived Trust (PT)	Perceived Usefulness (PU)	Enjoyment (PE)	Perceived AI Intelligence (PAI)	Attitude Toward Use (ATU)	Self-Regulated Learning (SRL)	Behavioral Intention to Use (BIU)
Mean Score for Likert-Scales 5 Sem. 02 (N2=11)	4	3.78	3.77	4	3.73	3.93	4	3.84	3.91
Mean Score for Likert-Scales 5 Sem. 01 (N1=17)	4.53	4.48	4.43	4.6	4.51	4.57	4.51	4.53	4.57

Figure 3: Quantitative Analysis Results based on TAM

It is observed that students in the 2025-01 semester consistently rated their experience with the GenAI tutor more positively than those in 2025-02, especially in areas like enjoyment, self-regulated learning, and social influence. This suggests the earlier implementation felt more engaging and motivating, possibly due to novelty, better support, or stronger peer and instructor involvement, highlighting the importance of maintaining consistent guidance and learning design when introducing AI tools across different cohorts.

In addition, the post-scenario reflection required students to describe their learning experience, challenges, and perceived impacts of using Tutor Bot. A thematic analysis of students' qualitative feedback from both semesters

revealed five interrelated themes reflecting their learning experiences with the GenAI Tutor in mastering Object-Oriented Programming (OOP). These themes closely align with metacognitive self-regulated learning (MSRL) strategies and underscore the educational value of AI-powered tools.

Theme 1: Self-Regulated and Personalized Learning
Students frequently described the GenAI Tutor as enabling them to manage their own learning pace, revisit previously learned material, and follow guided steps to reinforce understanding. One participant reflected, "*Using the Tutor Bot helped me learn at my own pace and revise when I needed to.*"

Theme 2: Feedback-Driven Learning Guidance
Students noted how the chatbot effectively diagnosed errors and offered immediate corrective suggestions, promoting efficiency and confidence in problem-solving. For example, a student remarked, "The bot can quickly point out problems and make suggestions."

Theme 3: Deep Understanding of OOP Concepts
Several students commented on how the chatbot enhanced their conceptual understanding of core OOP principles such as inheritance, encapsulation, and polymorphism. As one student shared, "*The examples helped me understand how the concept works behind the code.*"

Theme 4: Emotionally Safe and Encouraging Interaction
Students expressed appreciation for the non-judgmental and supportive nature of the chatbot, which allowed them to ask repeated questions without fear of embarrassment. One reflection stated, "*I could ask multiple times without feeling judged.*"

Theme 5: Efficiency and Usability of the Tool
Students widely described the chatbot as a fast, responsive, and easy-to-use tool that facilitated smoother learning experiences. A student summarized this sentiment with, "*Very helpful and fast response from the Tutor Bot.*"

Collectively, these five themes demonstrate how the GenAI Tutor supports cognitive, metacognitive, and emotional dimensions of learning in programming education. They affirm the tool's potential to deliver personalized, scalable, and emotionally supportive learning experiences aligned with Education 4.0 objectives.

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ID 24: Modular Artificial Intelligence for Connectivistic Learning: Innovations for Bridging Knowledge Gaps in Education

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Highlights: Modern education must evolve alongside emerging technologies such as artificial intelligence (AI). This paper supports NALI 2025 by introducing the Modular AI for Connectivistic (MAI-C) learning framework, which is a first-of-its-kind model that features four core AI modules inspired by connectivism theory: Inquisition, Cooperation, Exemplification, and Simulation. Piloted with the Team-Think-Talk (3Ts) activity among 186 students, MAI-C raised confidence (88.2%), improved understanding (87.6%), and boosted performance by up to 17.65% while reducing gaps. By advancing SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities), MAI-C offers a scalable and inclusive blueprint for AI-powered, student-centered learning that educators can replicate immediately.

Keywords: Connectivism; Modular Learning; Artificial Intelligence; Student-centred Learning

Introduction

The future of higher education now depends on how quickly emerging technologies can be integrated into meaningful, inclusive learning experiences. Yet, many classrooms still rely on lecture-based delivery, limiting engagement and leaving students underprepared for AI-driven workplaces. Moreover, educators face persistent challenges in meeting diverse learner needs and adopting digital tools in sustainable, impactful ways. While AI is increasingly recognised for its potential to enhance teaching and learning, its structured, practical use in classroom activities remains limited – with few clear, replicable frameworks for embedding accessible AI tools into active, student-centred learning.

To address this gap, this study develops the Modular AI for Connectivistic (MAI-C) learning framework, which embeds AI into education through four instructional modules: AI Inquisition, AI Cooperation, AI Exemplification, and AI Simulation (refer to Table 1 below). For example, AI Inquisition guides students in asking targeted questions to clarify complex topics. AI Cooperation strengthens teamwork by pairing students with each other and AI for collaborative brainstorming. AI Exemplification helps translate abstract ideas into practical or visual examples, while AI Simulation immerses learners in interactive scenarios that reveal the real-world outcomes of their decisions.

Table 1: The MAI-C learning framework

Module	Prompt Template
AI Inquisition	I'm having trouble understanding [specific concept]. Can you explain it in simple terms and provide an example related to [topic/subject]?
AI Cooperation	We are working on [problem/topic]. Can you suggest some possible solutions or steps we should consider? Also, help us compare or refine the ideas.
AI Exemplification	Using this [concept], can you generate an example in the form of [case/story/analogy/ image] that shows [specific outcome]?
AI Simulation	Timeline Simulation: Create a simulation of [scenario] based on an alternate outcome if [X event changes]. Show the chain of events and results. Choice-Based Simulation: Create a decision-making scenario for a specific [situation/problem]. Give me [2–3 options], and once I choose, show what happens next and the consequences.

The four modules of the MAI-C framework were designed to align with both connectivism theory (Siemens, 2005) and the demands of modern curricula, addressing four key processes in active learning: questioning, collaboration, example generation, and scenario simulation. Connectivism emphasises autonomy, diversity, connectedness, and openness in knowledge creation (see Figure 1 below). Autonomy is fostered when learners independently explore and interact with multiple information sources; diversity is encouraged through exposure to varied perspectives; connectedness arises from linking learners, peers, and digital resources; and openness is promoted through transparent sharing and accessible tools.

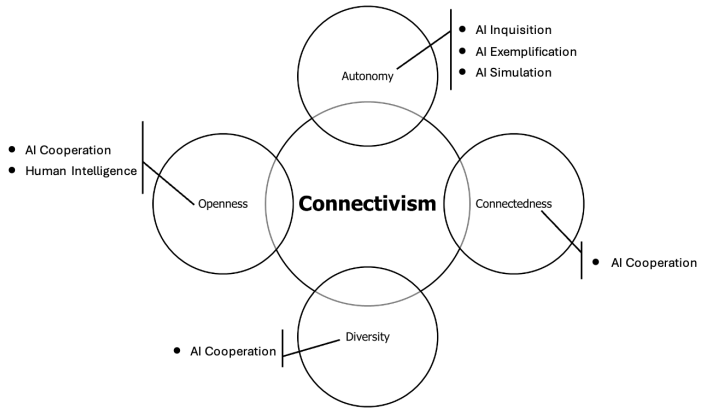


Figure 1: The Connectivism Framework with MAI-C

In this study, the MAI-C framework is demonstrated through the Team-Think-Talk (3Ts) classroom activity, which modernizes college subjects while promoting sustainable, inclusive, and accessible learning. A detailed MAI-C Teacher's Manual and a Student Prompts in Practice sample for the 3Ts activity are available at the following link: https://github.com/ssraees/maic_replication.git.

Objectives

The primary purpose of the MAI-C framework is to modernise college education by integrating free, accessible AI tools into structured activities, thereby enhancing engagement, comprehension, and relevance while promoting inclusivity and sustainability. The study pursues four objectives:

i. Develop a modular AI-enhanced instructional framework that engages students through interactive, student-centred activities.
ii. Apply connectivism principles to foster student autonomy, connectedness, diversity, and openness.
iii. Evaluate the effectiveness of AI integration in improving student confidence, comprehension, engagement, and assignment performance.
iv. Provide a scalable and adaptable blueprint for educators to implement future-ready educational practices across business disciplines and beyond.

NALI Approach

The Team-Think-Talk (3Ts) activity, based on the MAI-C framework, aligns with the New Academia Learning Innovation (NALI) principles of active and collaborative learning. This 3Ts activity is illustrated in Figure 2 with a specific focus on simulating a simplified product research and development (R&D) process. Students work with available AI tools (e.g., CoPilot, ChatGPT, Gemini) alongside traditional resources (e.g., Google) to research, brainstorm, prototype, and simulate market scenarios. Human-only stages are intentionally included to balance AI assistance with critical thinking and independent reasoning. The following discussion details the phases of the 3Ts activity.

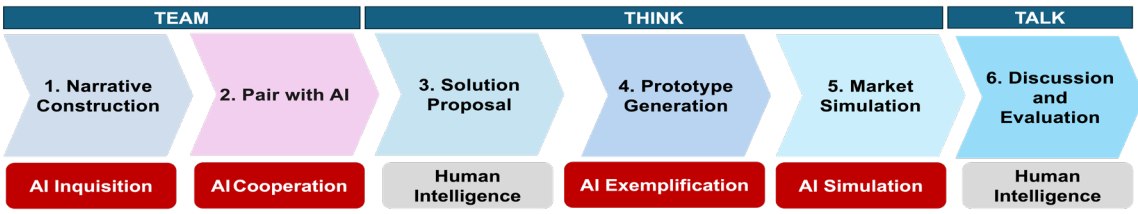


Figure 2: The Team-Think-Talk (3Ts) Activity

In the Team phase, students research a local consumer product using both traditional methods (e.g., Google) and AI., then create a short narrative from their findings. Next, they engage AI to identify weaknesses or areas for improvement in their chosen product. The AI Inquisition and Cooperation modules support this stage by helping students clarify ideas and brainstorm solutions collaboratively. The Think phase occurs after gathering feedback; students refine their product independently using human reasoning. They address identified flaws and develop improved features. They visualise their redesigned product using the AI Exemplification module. For instance, students can be tasked to generate a sample logo or packaging using AI tools. This phase builds practical design thinking and bridges abstract ideas with creative outputs. Finally, students test their ideas through AI-generated simulations. They either preview a product launch scenario or use a choice-based simulation game to explore real-world decision-making outcomes.

In the final Talk phase, students reflect critically on the entire process such as how AI supported their decisions, what they learned, and how their ideas evolved. This final phase emphasises metacognition and responsible, thoughtful use of AI. A full summary of each stage, modules, and sample prompts is provided in Table 2.

Table 2: Table of summary of the 3Ts product R&D process

Phase	Stage	Module	Prompts
Team	1. Narrative Construction	AI Inquisition	What is in high demand in Malaysian food and beverages market?
	2. Pair with AI	AI Cooperation	Can you help us identify current issues faced by customers related to this product idea? Give us a few suggestions for improvement.
Think	3. Solution Proposal	Human Intelligence	N/A
	4. Prototype Generation	AI Exemplification	Based on this list of new features, can you generate a visual idea or description of what this product would look like? Help us to design a logo for the product.
	5. Market Simulation	AI Simulation	Simulate a product launch in [country/market]. What would customers say? What challenges might we face?
Talk	6. Discussion and Evaluation	Human Intelligence	N/A

Research Methodology

The MAI-C framework was piloted in multiple business-related subjects at Sunway College Johor Bahru during the 2024-2025 academic year. AI modules were introduced at targeted points in the syllabus to supplement lectures with interactive, student-centred activities. Data were collected using a mixed-method approach. A post-activity survey was administered to 186 students via Microsoft Forms to gather students' feedback. The survey focused on student confidence in applying concepts, comprehension of course materials, and overall engagement with the AI-supported activities. Additionally, to evaluate the impact of MAI-C on academic performance, the framework was directly integrated into assignment design for two diploma-level business courses: International Business (IB) and Foreign Market Entry (FME). Comparative analysis of pre-AI and post-AI cohorts, taught by the same instructors with identical rubrics and assessment structures, measured changes in average scores and score variability to determine effects on performance consistency.

Findings and Discussion

The findings of the institutional survey after implementing the MAI-C initiative at Sunway College Johor Bahru provide insight into student receptiveness to AI in learning. As shown in Table 3 below, 88.2% of students reported increased confidence in applying concepts, 87.6% noted better understanding of difficult topics, and 82.8% described the experience as "fun and helpful." These results offer important context for understanding learner receptiveness to AI-enhanced learning—an encouraging sign for broader framework application.

Table 3: Student Perceptions of AI Integration under the MAI-C Framework

Outcome Indicator	Result
Confidence in applying concepts	88.2% of students reported increased confidence
Mastery of difficult topics	87.6% of students reported better understanding
Engagement and enjoyment	82.8% of students described the experience as "fun and helpful"

To further evaluate the impact of the MAI-C framework, a comparative analysis of assignment performance was conducted across pre- and post-AI implementation cohorts in the International Business (IB) and Foreign Market Entry (FME) courses. Educators ensured that the assessment structure, rubrics, and task difficulty were kept consistent across both cohorts. Based on Figure 3, findings revealed a 2.04% increase in average scores for IB and a 17.65% increase for FME after AI integration. This improvement was accompanied by a reduction in score variability measured by the standard deviation (see error bars) of the respective scores, suggesting more consistent student performance under the MAI-C framework (see Figure 3).

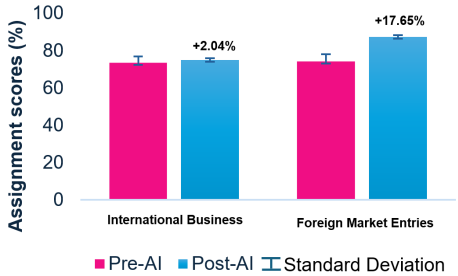


Figure 3: Comparative assignment scores by subject

The MAI-C framework aligns strongly with the United Nations Sustainable Development Goals (SDGs), highlighting its broader impact beyond the classroom. Under SDG 4 (Quality Education), it delivers active, AI-supported learning experiences that fostered critical thinking, creativity, and digital literacy. The modular design and hands-on activities transformed abstract concepts into accessible, engaging learning tasks, enabling students to connect theory with practice. The framework also advances SDG 10 (Reduced Inequalities) by integrating accessible AI tools, ensuring equitable participation regardless of students' socioeconomic backgrounds. Activity design intentionally accounted for varying levels of digital familiarity and language proficiency, thereby promoting inclusivity and reducing barriers to meaningful engagement.

Overall, the MAI-C framework illustrates how purposeful AI integration, anchored in sound pedagogy, can enhance learning, reduce achievement gaps, and support sustainable educational practices. These findings, however, should be viewed with some limitations: the study took place in a single institution, the novelty of AI may have influenced student engagement, and survey responses were self-reported. Future research should address these limitations by employing longitudinal designs, expanding to diverse academic disciplines, and conducting multi-institutional trials. Such studies would provide deeper insights into the framework's scalability, long-term effectiveness, and adaptability in varied educational contexts.

Commercialization Potential

The MAI-C learning framework is fully classroom-ready. It is currently supported by a comprehensive Replication Guide (available at: https://github.com/ssraees/maic_replication.git) and our ongoing in-house AI workshops for lecturers. Following a wider institutional rollout, we will expand delivery to external educators via a trainer-of-trainers pathway to accelerate adoption. In the long term, we plan to formalise intellectual property by securing copyright for the finalised guide and its applied resources, potentially publishing through Sunway University Press to strengthen authorship recognition and controlled distribution. A tiered access model such as a free Starter kit for entry-level users and a premium Educator Pack with extended resources will ensure both reach and quality. Our recent Bronze award for the modular approach provides independent validation of MAI-C's quality, scalability, and credibility, positioning it strongly for both academic and commercial uptake.

Awards Received

Bronze Award in Teaching and Learning Innovation Challenge (T-LINC) 2025, Sunway University

Project Title: Transforming Business Education through AI: Modular Strategies for Sustainable and Inclusive Learning

Acknowledgement

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ID25: Water Balloon Parachute: Synergy Between Generative AI, Design Thinking Process, and Project Based Learning in Physics Education

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Highlights: The *Water Balloon Parachute Plunge Interactive Module* was developed to enhance students' conceptual understanding of physics through the integration of Design Thinking and Artificial Intelligence (AI). The module emphasizes experiential learning by engaging students in a real-world challenge: preventing water balloons from breaking when dropped from a height. Using the phases of Design Thinking that contain Empathize, Define, Ideate, Prototype, and Test. Students observe physical phenomena, identify relevant forces and energy transformations, generate creative solutions, construct prototypes, and evaluate experimental outcomes. The learning process is supported by AI tools for brainstorming, data analysis, and presentation, while hands-on experiments foster collaboration and critical thinking. This module is unique in its synergy of theory and practice, allowing students to apply fundamental physics concepts such as Newton's Laws of Motion, gravitational force, free fall, work-energy theorem, and motion with drag force in a meaningful context. Through collaborative experimentation, students not only strengthen their problem-solving and communication skills but also recognize the real-world applications of physics in fields such as engineering, safety design, and aerospace. The assessment involves experimental reports, data analysis with tracker software, interactive poster presentations, and summative exercises, providing a comprehensive evaluation of both conceptual mastery and innovative thinking. The implementation of this module demonstrates that integrating Design Thinking and AI within physics education can significantly improve student engagement, creativity, and understanding of abstract concepts, while also preparing them with 21st-century skills essential for future learning and problem solving.

Keywords: Water Balloon Parachute; physics education; generative AI; design thinking.

Introduction

The teaching and learning of physics have long presented challenges to students, particularly when abstract concepts such as work-energy, free fall motion, and Newtonian mechanics are introduced. Physics is often perceived as a difficult subject because it requires learners not only to understand theoretical principles but also to apply mathematical reasoning to explain natural phenomena. Many students struggle to visualize how these principles operate in real-world contexts, which leads to persistent misconceptions, weak conceptual understanding, and disengagement in lessons (Ali & Daud, 2021). Traditional lecture-based methods are often insufficient for developing deep conceptual comprehension, as they limit students to rote memorization rather than encouraging inquiry and exploration. Research in STEM education has highlighted that physics learning becomes more meaningful when students can directly connect abstract laws of motion, energy conservation, and gravitation with tangible, everyday experiences (Wang, Sun, & Wang, 2022).

To overcome these challenges, innovative instructional models that emphasize experiential and technology-enhanced learning are increasingly being implemented. Recent studies have shown that the integration of project-based learning and interactive modules can enhance students' motivation, critical thinking, and conceptual understanding by situating physics within authentic problem-solving contexts (Wulandari, Sutrio, Doyan, & Rahayau, 2024). At the same time, the use of artificial intelligence tools is emerging as a transformative force in education, enabling students to access immediate feedback, generate ideas, and analyze data in more engaging ways (El Fathi, Saad, Larhzil, Lamri, & Al Ibrahmi, 2025). The *Water Balloon Parachute Plunge Interactive Module* was developed in response to these educational needs. By merging the Design Thinking process with generative AI tools and project-based learning, the module provides learners with opportunities to empathize with a real-world challenge, design and test solutions, and reflect on their outcomes.

This initiative is also closely aligned with the New Academia Learning Innovation (NALI) framework, which emphasizes creativity, collaboration, and student-centered learning. NALI promotes an approach where learners become active participants in constructing knowledge through inquiry and exploration rather than passive recipients of information.

By combining hands-on experimentation with digital tools such as ChatGPT, Tracker software, and Canva, the parachute activity encourages deeper engagement while supporting twenty-first-century skills such as teamwork, creativity, and problem-solving (Lee, Tan, & Teo, 2023). The synergy of project-based learning, AI integration, and Design Thinking not only addresses the conceptual barriers in learning mechanics but also prepares students to navigate complex, technology-driven futures (Chavez-Ponce, Villanueva-Montoya, & Joo-Nagata, 2022).

Objectives

The primary objective of this innovation is to improve students' comprehension of fundamental physics concepts, including forces, motion, energy conservation, and gravitation, through hands-on experimentation. The project incorporates the phases of Design Thinking such as Empathize, Define, Ideate, Prototype, and Test into the structure of learning activities, guiding students step by step from problem identification to practical solution testing. In addition, Generative AI tools such as ChatGPT, Tracker software, and Canva were integrated to support brainstorming, data analysis, and visual presentation. This combination not only strengthened students' conceptual knowledge but also nurtured essential twenty-first-century skills such as problem-solving, creativity, and critical thinking (Burleson, Holmstrom, & Gilstrap, 2005).

Novelty

The novelty of the module lies in its unique blend of artificial intelligence with interactive physics experiments. Students were tasked with solving a real-world problem: designing a parachute that prevents a water balloon from bursting upon impact. This challenge allowed learners to explore Newton's laws of motion, the work-energy theorem, conservation of energy, and the effects of drag force in a meaningful and engaging manner. By incorporating AI-assisted brainstorming and digital visualization tools, students were encouraged to connect scientific concepts with practical applications, such as technologies used in safe cargo landings (Adaline, 2011). The project also introduced a cross-disciplinary approach, linking physics with mathematics during data analysis and thereby fostering a more integrated learning experience.

Research Methodology

The research methodology centered on project-based learning, in which students actively designed, tested, and refined parachute prototypes. The process began with identifying learning difficulties and misconceptions during the empathize phase, followed by defining the problem and brainstorming solutions. Students then developed prototypes and tested them through experiments that compared free fall motion with and without parachutes. Motion analysis was conducted using Tracker software, enabling learners to calculate parameters such as gravitational acceleration, potential and kinetic energy, and descent speed. Pre- and post-activity questionnaires were also administered to evaluate conceptual understanding, application skills, and confidence levels.

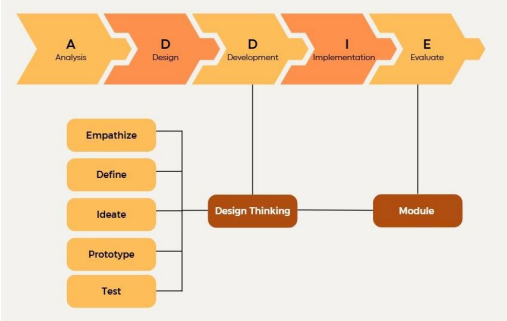


Figure 1: Integration between ADDIE model and Design Thinking

The integration of the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) with the Design Thinking approach to create effective instructional modules just like figure 1 shown. The phase of the ADDIE model is connected with specific stages of the Design Thinking process that include: Empathize, Define, Ideate, Prototype, and Test that will highlight a learner-centered, iterative development approach. The design and development phases of ADDIE are particularly aligned with Design Thinking, emphasizing understanding user needs, brainstorming creative solutions, and testing prototypes. This integrated model ensures that learning modules are not only pedagogically sound but also empathetic to learners' experiences and feedback-driven (Brown, 2009). The final product, or "Module," is shaped through both systematic instructional design and creative problem-solving frameworks.

Findings and Discussion

The findings revealed a significant improvement in students' learning outcomes. Average performance scores increased from approximately 2.7–3.0 (moderate) before the activity to 4.3–4.5 (good to excellent) after the module, representing a gain of about 50–55%. Students also reported stronger confidence in applying physics concepts such as Newton's laws, energy conservation, and projectile motion, with improvements of 1.3 to 1.5 points on average. Furthermore, participants demonstrated clearer conceptual linkages between the parachute experiment and

mechanics principles, particularly in understanding energy transformation and the role of drag force. Beyond content knowledge, the activity enhanced critical thinking, collaboration, and creativity, aligning with the broader goals of twenty-first-century education (Alessandra, O'Connor, & Van Dyke, 1994).

The applicability of this module extends beyond the physics classroom. Its alignment with NALI principles makes it a versatile approach for fostering active and experiential learning across STEM subjects. By incorporating AI tools, the module also addresses the growing need for digital literacy, preparing students for a technology-driven future. Moreover, the real-world relevance of the parachute activity illustrates how applied physics can contribute to sustainable and innovative solutions, thereby reinforcing the connection between classroom learning and societal challenges.

In conclusion, the Water Balloon Parachute Plunge Interactive Module exemplifies how the integration of Design Thinking, artificial intelligence, and project-based learning can transform the teaching and learning of physics. By bridging theoretical concepts with hands-on problem-solving, the module not only improved students' understanding of mechanics but also developed essential skills such as teamwork, creativity, and critical thinking. The success of this innovation demonstrates the potential of merging pedagogy, technology, and real-world applications to foster future-ready graduates. Table 1 below shows the highest learning gains between from students between the pre and posttest for the experiment of water balloon parachute plunge according to different type of criteria:

Table 1: Highest learning gains.

Type	Pre-Test	Post-Test	Gains
Understanding the relation between gravitational constant (G) and gravitational acceleration (g)	2.79	4.44	+1.66
Knowledge of different planets having different values of gravitational acceleration	2.82	4.41	+1.59
Ability to calculate gravitational acceleration (g)	2.75	4.33	+1.55
Skills in using Tracker software for data analysis	2.93	4.48	+1.55
Understanding universal gravitational constant (G)	2.89	4.41	+1.51

The results of the study show a notable improvement in students' understanding and skills related to gravitational concepts after the intervention. Overall, the comparison between pre-test and post-test scores demonstrates consistent gains across all assessed areas. The highest improvement was observed in understanding the relationship between the gravitational constant (G) and gravitational acceleration (g), with an increase of +1.66. This suggests that students developed a stronger conceptual grasp of how these two fundamental quantities are interconnected. Similarly, knowledge of different planets having varying values of gravitational acceleration improved significantly, showing a gain of +1.59. In addition, students enhanced their ability to calculate gravitational acceleration (g) and their skills in using Tracker software for data analysis, both achieving equal gains of +1.55. These results indicate that not only did students strengthen their theoretical knowledge, but they also improved their analytical and practical skills. The smallest, yet still meaningful, gain was recorded in understanding the universal gravitational constant (G), with an increase of +1.51.

Figure 2 below shows the interactive learning module of water balloon parachute plunge that was built through the development phase of ADDIE model. The learning module was well arranged according to the design thinking process based on the timeline of the project given. The interactive learning module includes the activity, assessment and content regarding Newton's law of motion, work and energy.



Figure 2 : Water Balloon Parachute Plunge Interactive Module

Looking ahead, the Water Balloon Parachute module has strong potential for scalability and adaptation across different STEM subjects. The design thinking framework provides a flexible structure that can be applied to other

challenging scientific topics, while AI tools offer endless possibilities for personalization, rapid prototyping, and iterative learning. Moreover, its emphasis on real-world problem-solving connects physics education with pressing global issues, such as designing safer technologies for transportation or reducing environmental impacts through sustainable engineering. This reinforces the idea that physics is not merely an academic subject, but a powerful lens through which students can innovate solutions for society's future needs.

Conclusion

In conclusion, the findings highlight that the intervention had a positive impact on students' learning outcomes. While all areas showed significant progress, the most remarkable improvement was in conceptual understanding of the relationship between G and g, reflecting a deeper comprehension of the fundamental principles of gravitation. This project exemplifies how educational innovation can break down traditional barriers in physics education by combining hands-on experimentation, digital technologies, and collaborative pedagogy. It not only strengthens students' grasp of fundamental mechanics but also prepares them to thrive in a rapidly evolving, technology-driven world. By fostering resilient, creative, and future-oriented learners, the Water Balloon Parachute Plunge Interactive Module contributes meaningfully to the mission of producing graduates who are not only knowledgeable but also capable of leading innovation for sustainable progress.

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ID 26: GROW-AI for Good Mankind: A Reflective Framework for Ethics and CSR Learning through AI Integration

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Highlights: In today's world, where Artificial Intelligence (AI) increasingly influences decision-making, graduates are expected to possess not only a strong grasp of ethical values and corporate social responsibility (CSR) but also the capability to implement these principles effectively in AI-powered environments. This requires higher education to nurture students' ethical sensitivity, critical reasoning, and technological competence. Conventional, lecture-based ethics teaching often falls short in connecting theoretical concepts to impactful, real-world practice. To close this gap, the GROW–AI for Good Mankind framework was developed, emerging the GROW coaching structure with AI-assisted reflective learning and service-learning experiences. This blended approach enables learners to define ethical objectives, evaluate genuine CSR issues, investigate AI-enhanced strategies, and take committed, socially conscious action. By engaging directly with communities and reflecting systematically with AI support, students strengthen their ethical understanding while building the digital skills required to act as responsible leaders in an AI-driven era.

Keywords: Service learning; Grow coaching model; experiential learning; digital literacy

Introduction

As Artificial Intelligence (AI) increasingly influences decision-making across industries, the need for graduates to possess not only technical proficiency but also strong ethical awareness and social responsibility has never been greater. While higher education institutions strive to instill these values, traditional classroom-based ethics instruction often struggles to bridge the gap between theory and meaningful, real-world application. This challenge is particularly evident in courses on Ethics and Corporate Social Responsibility (CSR), where students may understand principles conceptually but lack the practical exposure needed to apply them effectively in complex, AI-influenced environments. To address this gap, the GROW–AI for Good Mankind framework developed an innovative approach that integrates the GROW coaching model, AI-supported reflective practice, and service learning. The model is designed to provide students with immersive, real-world experiences where they can set ethical goals, analyze CSR challenges, explore AI-informed solutions, and commit to socially responsible actions. This hands-on approach transforms ethics education into a dynamic process, enabling students to engage with genuine societal needs through projects such as community welfare initiatives, environmental conservation efforts, and collaborative partnerships with NGOs. This allows students to critically assess their actions, receive immediate feedback, and refine their ethical decision-making skills. By embedding AI as a reflective and analytical tool, the initiative not only strengthens students' capacity for ethical leadership but also enhances their digital competencies, ensuring they are well-prepared for the demands of a rapidly evolving, technology-driven world. This project is designed to integrate leadership theories, Corporate Social Responsibility (CSR) principles, and team management strategies into practical, real-world initiatives. It aims to strengthen participants' understanding of ethics and social responsibility in the workplace by engaging them in impactful community-based programs. Three key CSR activities have been selected as platforms for learning and innovation: a *Fitrah Qaseh Visit*, a *Beach Clean-Up*, and a *Zoo CSR & Clean-Up*.

The *Fitrah Qaseh Visit* focuses on fostering empathy, community engagement, and resource-sharing by providing emotional support and assistance to underprivileged children. This initiative allows participants to apply decision-making and problem-solving skills while addressing social welfare issues. The Beach Clean-Up emphasizes environmental ethics and sustainability, encouraging participants to actively contribute to preserving natural resources. Through hands-on teamwork and leadership in an outdoor setting, the activity promotes environmental responsibility as a core aspect of ethical business practice. The Zoo CSR & Clean-Up combines animal welfare and environmental stewardship, creating an opportunity for participants to work collaboratively in maintaining clean and safe habitats for animals. This activity reinforces professionalism, ethical behaviour, and respect for living creatures as part of a broader CSR framework. By participating in these activities, individuals not only demonstrate their ability to relate ethics and social responsibility to workplace contexts but also strengthen their leadership capacity, collaborative skills, and sense of professional accountability in responding to social and environmental issues.

Objectives

The objectives are:

i. To enhance student's learning performance through GROW With AI model in Ethics and Social Responsibility course with HR students.

ii. To improve students' ethical decision-making skills through the GROW with AI model, fostering the ability to recognise ethical dilemmas, evaluate options from multiple perspectives, and choose actions that reflect integrity and social responsibility.
iii. To improve practical workplace skills such as problem-solving, stakeholder engagement, negotiation, and CSR project planning, ensuring students can translate ethical concepts into actionable strategies.

NALI Approach

Novelty

The novelty of this innovation lies in the integration of Carver's (1997) service-learning framework, Grant's (2022) GROW coaching model, and generative AI tools to create a scalable, instructor-guided, and student-centred learning experience. Service learning ensures that students engage in authentic community projects where academic concepts are applied to address real needs. The GROW coaching model is used by instructors as a structured framework for guiding students through goal setting, problem analysis, option exploration, and actionable planning to ensure continuous, targeted, and personalized coaching. Generative AI tools such as ChatGPT, Canva, and DeepSeek complement this coaching process by acting as personalized learning assistants that support idea generation, provide instant feedback, enhance reflection, and extend learning support beyond classroom hours. This distinctive combination not only strengthens students' application of knowledge but also builds advanced problem-solving abilities and nurtures ethical awareness, including civic responsibility, ultimately preparing them to excel in the future world of work.

Creativity

The integration of Carver's ABC Model focusing on the development of Agency (the capacity to act as empowered, ethical change agents), Belonging (cultivation of meaningful and reciprocal community relationships), and Competence (acquisition and application of cognitive, social, and ethical skills) with Grant's (2022) GROW Coaching Model (Goal, Reality, Options, Will) within a structured service learning framework offers a powerful pedagogical approach for the *Ethics and Social Responsibility* subject. In this design, the ABC Model articulates the developmental dimensions of student growth, while the GROW Model provides an iterative, student-centred process for goal-setting, contextual analysis, creative problem-solving, and actionable commitment in authentic community contexts. Embedding these models within service learning aligns with experiential learning principles authenticity, active engagement, integration of prior and emergent experience, and connection to future civic and professional roles ensuring that ethical inquiry is grounded in real-world relevance. Generative AI serves as the catalyst for scalability and innovation, in line with NALI 2025: Accelerating Innovation in Teaching and Learning with AI. Through AI-powered ethical scenario simulations, culturally contextualised knowledge retrieval, multilingual stakeholder engagement, and automated formative feedback on reflective/analytical work, educators can provide personalised, timely, and adaptive learning support at scale. This approach mirrors NALI's core innovation thrusts technology-enhanced learning ecosystems, future-ready competencies, and AI-augmented pedagogy while producing measurable community impact and fostering sustained reflective practice. The result is a high-impact, student-centred learning environment that not only strengthens ethical reasoning and social responsibility but also cultivates graduates who can navigate and influence complex moral landscapes with intellectual rigour, cultural sensitivity, and adaptive competence fully aligned with NALI 2025's vision of AI-driven transformation in education.

Innovativeness

The innovativeness of GROW-AI for Good Mankind lies in its unique integration of Carver's (1997) Agency, Belonging, and Competence (ABC) service-learning framework with Grant's (2022) Goals, Reaction, Opportunity, and Wrap-up (GROW) coaching model, supported by generative AI tools such as ChatGPT, Canva, and DeepSeek. At the start of the project, students undergo AI tools onboarding to familiarise themselves with each platform's role: ChatGPT supports idea generation, provides ethical and problem-solving prompts, and guides reflective thinking; Canva enables the creation of visually engaging project materials and presentations; while DeepSeek assists with data analysis for needs assessments and impact evaluation. Once equipped, students engage in AI-assisted activities, where teams use ChatGPT and Canva to brainstorm and refine their CSR project ideas. This is followed by fieldwork preparation, where students identify relevant communities, NGOs, or companies and use DeepSeek or ChatGPT to analyse challenges and align their project goals with sustainable development priorities. In the project design phase, Canva is used to develop polished visuals for proposals, making them compelling to stakeholders. The final stage, project pitching, leverages AI to enhance visual storytelling, refine the presentation structure, and prepare for Q&A sessions, ensuring students can present confidently and respond effectively. This structured process not only enables students to apply ethical principles in real-world contexts but also develops their agency, sense of belonging, and competence while delivering tangible benefits to communities, animals, and the environment.

Applicability

In SHMR3153 *Ethics and Social Responsibility*, the **GROW-AI for Good Mankind** framework is applied through a group project assignment across two different class sections, each involving a structured CSR initiative with the assistance of AI tools that offers students authentic opportunities to apply ethical principles while delivering tangible benefits to both communities and animals.

In SHMR3153 *Ethics and Social Responsibility*, the GROW-AI for Good Mankind framework is implemented through group project assignments in three different class sections, each centred on a structured CSR initiative supported by AI tools. Guided by the ABC Model of Experiential Learning (Agency, Belonging, and Competence) students engage in authentic, real-world projects that apply ethical principles while delivering tangible benefits for communities, such as cleaner public spaces and stronger social support, and for animals, including healthier living conditions and improved care. Fitrah Qaseh visit-Students collaboratively planned and executed an engagement with a local orphanage, fostering empathy, social justice, and equity. The program strengthened community bonds, offered

emotional support to the children, and contributed to their sense of belonging and care. Beach Clean-Up at Stulang Beach – A hands-on environmental stewardship activity that improved the cleanliness and safety of a public space for local residents. This effort promoted community well-being, protected marine ecosystems, and raised public awareness on environmental ethics.

Zoo CSR & Clean-Up – Students participated in cleaning and CSR engagement activities with a local zoo, supporting sustainability and the welfare of animals. The program improved living conditions for the animals, assisted zoo staff in their daily care efforts, and created a more engaging environment for visitors.

Aligned with this year's theme of "Accelerating Innovation in Teaching and Learning with AI," this approach implements CSR projects with the assistance of generative AI tools to enhance student-driven learning experiences that foster cognitive skills, practical skills, ethics and professionalism skills. Generative AI tools such as ChatGPT, Canva, and DeepSeek throughout the entire process, from project preparation and securing sponsorships to implementation and post-event evaluation.

Students use AI to critically analyse ethical dilemmas (CLO2–PLO2: Cognitive Skills), apply practical methods in real-world contexts (CLO3–PLO3: Practical Skills), and demonstrate ethical and professional conduct in diverse social and environmental settings (CLO4–PLO11: Ethics and Professionalism Skills). Through group CSR projects, students deliver meaningful benefits to communities, protect the environment, support animal care and welfare, and promote sustainability initiatives such as tree planting. Each project culminates in a comprehensive report and an individual reflective video, ensuring both collective impact and personal growth.

This AI-enhanced approach transforms traditional service-learning into a data-informed, reflective, and innovation-driven pedagogy, accelerating both skill acquisition and ethical maturity. It ensures that student efforts generate lasting positive change for people, communities, animals and trees, while positioning them as future-ready professionals capable of integrating AI responsibly in human resource development.

Impact

This innovation empowers students to apply academic knowledge directly to real-world community challenges through service learning, guided by instructors using the GROW coaching model. The structured coaching process enables students to set meaningful goals, analyse problems systematically, explore creative solutions, and commit to actionable plans, ensuring that learning is purposeful and outcome-driven. Generative AI tools such as ChatGPT, Canva, and DeepSeek enhance this process by offering real-time feedback, generating ideas, refining communication materials, and prompting deeper reflection. This continuous support strengthens students' ability to tackle complex problems with confidence and creativity. By engaging in authentic projects supported by structured coaching and AI assistance, students not only deepen their application of knowledge but also develop critical problem-solving skills and a strong foundation in ethical and civic responsibility. These competencies prepare them to navigate professional and societal challenges with integrity, adaptability, and a future-ready mindset.

Research Methodology

The sample of the study involves students from two sections who take the Ethics and Social Responsibility (SHMR3153) course, under the program of Bachelor of Science (Human Resource Development) in session 2024/2025/02 Semester 2 with a total of students of 99. Figure 1 illustrates the design of the Grow with AI model framework. In this framework, students engage with the GROW model (Goal, Reality, Options, Will) integrated with AI-enhanced learning tools to support personalized goal-setting, performance assessment, solution exploration, and action planning. AI applications are embedded in each step to provide tailored feedback, recommend resources, and facilitate collaborative learning. The approach also incorporates motivational elements of Agency, Competence, and Belonging, supported by AI-driven personalization, feedback, and community-building features.

i. At the beginning of the semester, students were given a briefing by the instructor on course objectives, assessments, AI tools onboarding: ChatGPT (idea generation, reflection prompts), Canva (visual design), DeepSeek (data analysis).
ii. AI-assisted activity: Teams brainstorm and refine CSR project ideas with ChatGPT and Canva.
iii. Fieldwork preparation: Identify community, NGO, or company for CSR needs assessment. AI activity: Use DeepSeek or ChatGPT.
iv. Selecting and Designing CSR Project: AI-supported Canva design for project proposal visuals.
v. Pitching CSR Projects: AI tools used for visuals, presentation refinement, and Q&A preparation.

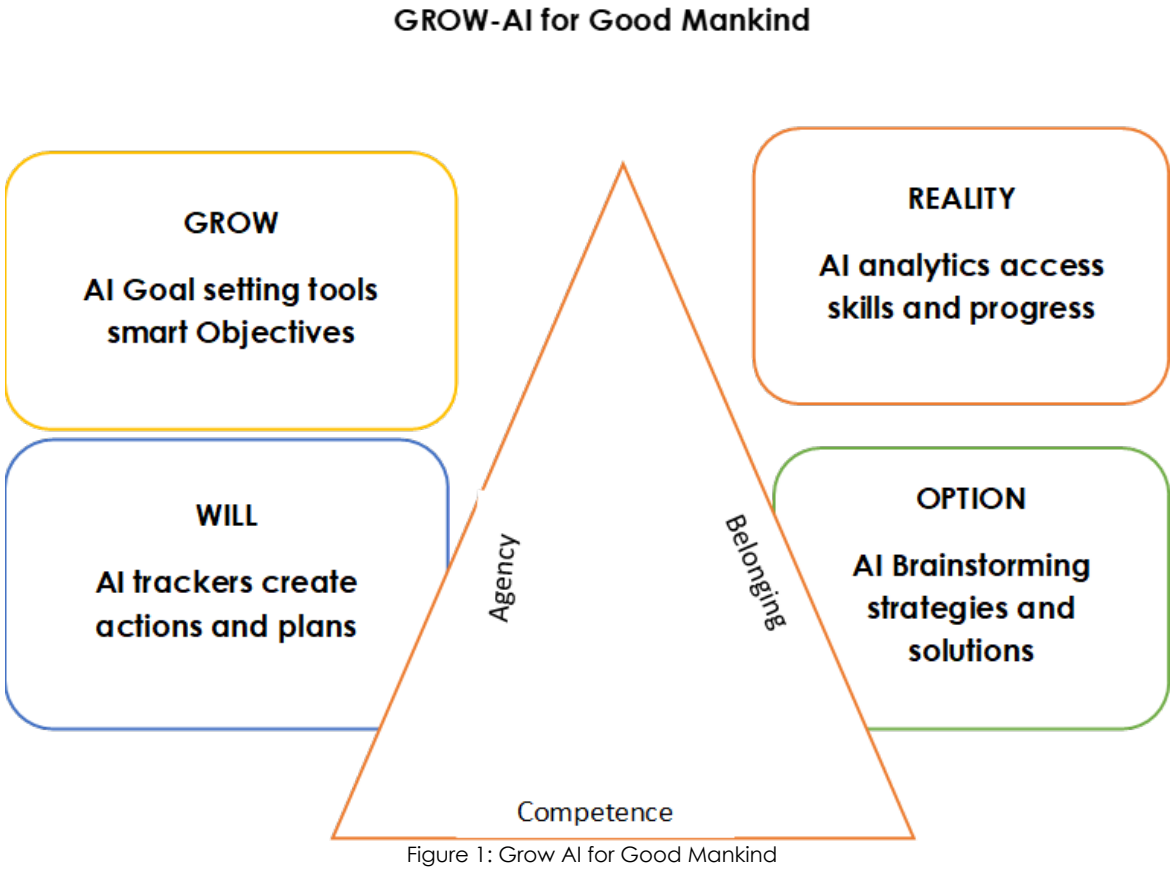


Figure 1: Grow AI for Good Mankind

Findings and Discussion

The findings in Table 1 show that students in the group using GROW-AI achieved higher performance across all skill categories compared to those without GROW-AI. For Cognitive Skills, students with GROW-AI recorded averages of 91.3% in Section 01 and 92.3% in Section 02, with an overall average of 91.8%. In comparison, the group without GROW-AI scored 75.9% and 72.9% in Sections 01 and 02 respectively, with an overall average of 74.4%. In Practical Skills, students with GROW-AI also outperformed their peers, scoring 92.4% in Section 01 and 90.9% in Section 02, averaging 91.7%. Without GROW-AI, the averages were slightly lower, at 88.9% for Section 01 and 88.3% for Section 02, with an overall average of 88.6%. For Ethics and Professionalism Skills, the GROW-AI group scored 82.6% in Section 01 and 90.9% in Section 02, with an average of 86.8%, compared to a consistent 80.0% for both sections in the group without GROW-AI. These findings indicate that integrating the GROW coaching model with generative AI tools significantly improves students' application of knowledge (cognitive skills), hands-on abilities (practical skills), and ethical awareness and professionalism, equipping them with stronger competencies to meet both academic and workplace demands.

Table 1: Students' achievement

	Section	Cognitive Skills	Practical Skills	Ethics and Professionalism Skills
With GROW-AI	Section 01	91.3%	92.4%	82.6%
	Section 02	92.3%	90.9%	90.9%
	Average	91.8%	91.7%	86.8%
Without GROW-AI	Section 01	75.9%	88.9%	80.0%
	Section 02	72.9%	88.3%	80.0%
	Average	74.4%	88.6%	80.0%

Commercialization Potential and Award Received

In the aspect of potential of commercialization, the GROW–AI for Good Mankind framework is seen as having strong commercialization potential as an AI-integrated ethics and CSR education solution for higher education institutions, corporate training programs, and leadership development initiatives. The unique combination of GROW coaching model, AI-supported reflective tools, and real-world service learning addresses a growing market demand for experiential, technology-enabled learning that fosters ethical and socially responsible leadership. The framework can be delivered as a modular, customizable program including digital toolkits, AI-integrated learning platforms, facilitator guides, and assessment rubrics, which can be adapted for a variety of educational settings and industries. With the increasing global emphasis on Environmental, Social, and Governance (ESG) standards and ethical AI, institutions and organizations are seeking innovative, outcome-driven solutions to train responsible leaders of the future. GROW–AI for

Good Mankind offers a future-proof educational model that not only enriches learning outcomes but also creates commercial value through licensing, consulting, and professional development services.

Besides, building on the success of the 2024 publication, which received a Silver Award in recognition of its innovative approach to integrating service-learning and the GROW coaching model in HR education, the current article represents a strategic expansion of this work. While the 2024 publication focused on enhancing students' practical HR skills through scenario-based learning and reflective coaching, the current article expands the framework by incorporating AI-assisted reflective tools and aligning it with broader ethics and CSR education. This expansion not only extends the original pedagogical model to a wider academic and professional audience but also enhances its commercialization potential through modular design, digital toolkits, and application in leadership development and corporate training initiatives. Together, these articles demonstrate a progressive trajectory from impactful classroom innovation to future-ready education solutions.

Acknowledgement

We are grateful for the participation of the respondents in this study who are third year students at School of Human Resource Development and Psychology (SHARPS), UTM. Special thanks to the SHARPS team, Dr. Yusma Fariza Yasin, lecturers that were involved in this service-learning program, Dr. Sharial Bungsu, Dr. Amalina Binti Ibrahim and Dr. Junaidah binti Yusof for their continuous support and trust.

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ID 28: Empowering Teaching and Learning with AI-Driven Information Literacy

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Highlights: This project integrates AI-driven tools into a chemistry-based information literacy course at Universiti Teknologi Malaysia to enhance students' digital competency and research skills. By implementing AI platforms like ChatGPT and Perplexity, the course focuses on improving information searching, evaluation, and verification, while encouraging teamwork through fact-checking assignments and creative storyboard projects. The framework emphasises ethical AI usage, critical thinking, and personalised learning, aligning with the NALI framework. Results show significant improvements in students' information literacy skills, confidence, and engagement, highlighting the potential of AI to transform education and prepare graduates for an AI-mediated academic and professional landscape.

Keywords: Artificial intelligence; information literacy; chemistry, digital competency

Introduction

In a landscape where information is plentiful yet uneven in quality, strong information literacy is essential for academic success and responsible research. Recognising the complexity of digital sources and the need for students to be independent, ethical, and artificial intelligence (AI)-literate researchers, this initiative - Empowering Teaching and Learning with AI-driven Information Literacy, integrates AI tools into a chemistry-based information literacy course to enhance learning outcomes and digital competency (Head *et al.*, 2020; Popenici & Kerr, 2017). This course builds efficient internet search strategies, introduces online scientific databases, and develops practical skills with spreadsheets, structure-drawing software, and data-analysis tools. The integration of AI into this course innovates its structured use to support core research tasks: intelligent search engines, AI-based chemical property predictors, citation and referencing assistants, spectral and crystallographic analysis systems, and generative AI that scaffolds scientific writing and information synthesis. These tools enable personalised, responsive learning with real-time feedback, contextual understanding, and improved decision-making throughout the research process. Aligned with the New Academia Learning Innovation (NALI) framework, the project emphasises student-centred learning, digital fluency, and the ethical use of technology (MoHE, 2019). It builds key research and ICT competencies while promoting awareness of cybersecurity, plagiarism, data integrity, and responsible AI in academic work. Students employ ChatGPT.ai and Perplexity.ai to search, evaluate, and verify information and are assessed on these abilities; a collaborative digital fact-checking assignment strengthens teamwork, and storyboard creation tasks communicate key concepts in visually compelling ways. By equipping students with AI-driven skills and deep information-literacy practices, the course addresses current educational gaps and prepares learners for the demands of academia and industry, redefining how information is accessed, analysed, and communicated in scientific contexts and cultivating digitally literate, critically aware, research-ready graduates.

Objectives

i. To assess students' ability in information searching, evaluation, and verification using AI tools.
ii. To evaluate students' teamwork and collaborative application of information literacy through digital skills in a fact-checking assignment.
iii. To encourage students to apply their understanding of information literacy and other themes by creating an informative storyboard that communicates key concepts through realistic or creative storytelling.

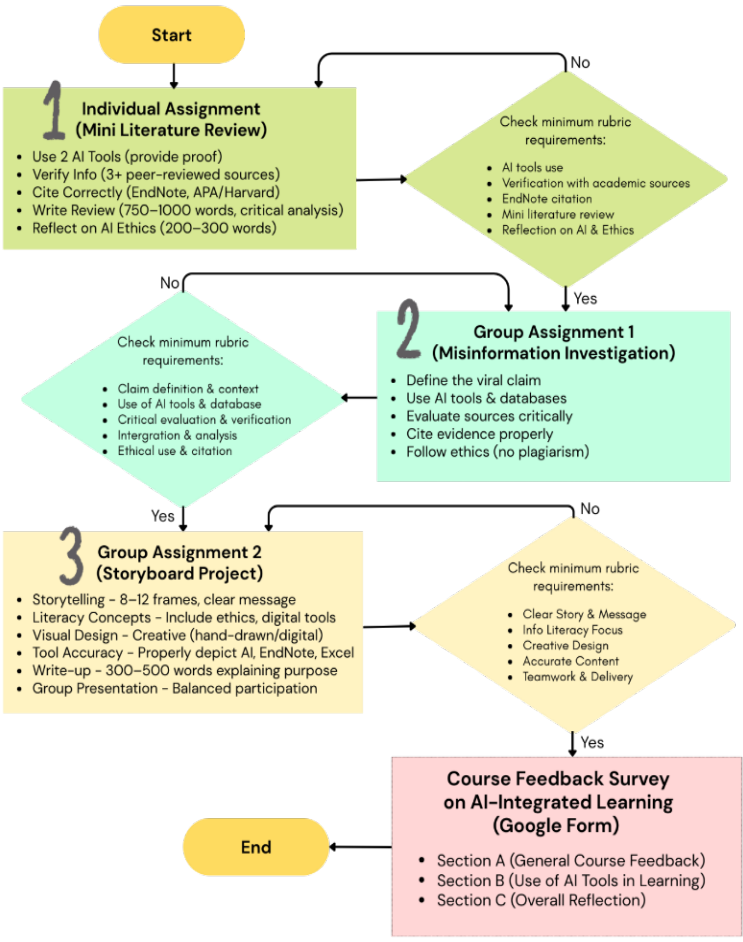
NALI Implementation for AI-Driven Information Literacy through Assignment-Based Learning

This project introduces an AI-driven information literacy framework that significantly improves teaching and learning. AI is not just an additional tool but a personalised learning partner, adapting to each student's needs. Unlike traditional teaching, this framework uses AI-powered assignments, instant feedback, and interactive digital assistants to help students evaluate information critically. Creativity is demonstrated through the combination of problem-based learning strategies with AI-supported case studies and collaborative group projects (storyboard), ensuring the learning process remains relevant and meaningful in students' academic and professional contexts. The framework uses a tiered approach, starting with simple individual tasks like literature reviews and advancing to more complex group projects such as fact-checking and creating digital storyboards on AI's role in education. These assignments are graded using clear rubrics that assess the use of credible sources, ethical AI use, critical thinking, and digital skills. Surveys are also used to track student progress and engagement, showing that AI-based tasks lead to improved performance (Xia *et al.*, 2024). The framework is flexible and can be applied across various subjects and learning formats, both face-to-face and online. The feedback shows improved student engagement, confidence in digital

skills, and stronger critical thinking. Overall, this framework prepares students with the skills they need to succeed in an AI-driven world, fostering innovation and ethical responsibility.

Research Methodology

The learning approach integrates a scaffolded AI-empowered assessment model, progressing through **three levels: beginner, intermediate, and competence**. This is to build student competency in information literacy and ethical AI usage. **Figure 1** outlines the systematic process of using AI and information literacy principles to complete assignments while upholding academic standards.



i. Individual Assignment – Beginner Level

AI Integration:

- AI-assisted information search and synthesis.
- Prompt engineering and validation techniques.
- Ethical reflection on AI in academic research.

ii. Group Assignment 1 – Intermediate Level

AI Integration:

- AI for claim verification and data triangulation.
- Team-based fact-checking using prompt optimisation.
- Collaborative use of digital verification tools.

iii. Group Assignment 2 – Competence Level

AI Integration:

- Creative representation of AI-related academic challenges.
- Critical thinking on ethical, cybersecurity, and literacy themes.
- Visual storytelling of AI's impact in education.

Figure 1: Assignment workflow for AI and information literacy.

At the foundational level, students employed at least two AI tools (e.g., ChatGPT, Perplexity) to aid in literature reviews and thoughtfully considered the reliability of information related to electrochemical or enzymatic biosensors. At the intermediate level, only students passing the minimum threshold in the first task are eligible. In small groups, students participated in joint fact-checking by critically investigating a viral claim or real-world misinformation case using Perplexity.ai and Google Scholar databases. They collaboratively verify claims using information literacy principles and present findings via a group-recorded presentation. Ultimately, students who meet the minimum requirements at the intermediate level will advance to the final competency level. They develop digital storyboards on a selected theme (e.g., "AI Misuse in Assignments" or "Ethics in Scientific Research"), using Canva.ai, Copilot.ai or Google Slides, emphasising ethical and critical literacy concerns in scientific inquiry. These varied learning activities aimed to enhance both AI fluency and information literacy. The assessments of individual and group assignments based on rubrics additionally reinforced the noted progress, where the students showed not only improved technical skills in utilising AI tools for academic work but also heightened awareness of ethical issues and source verification.

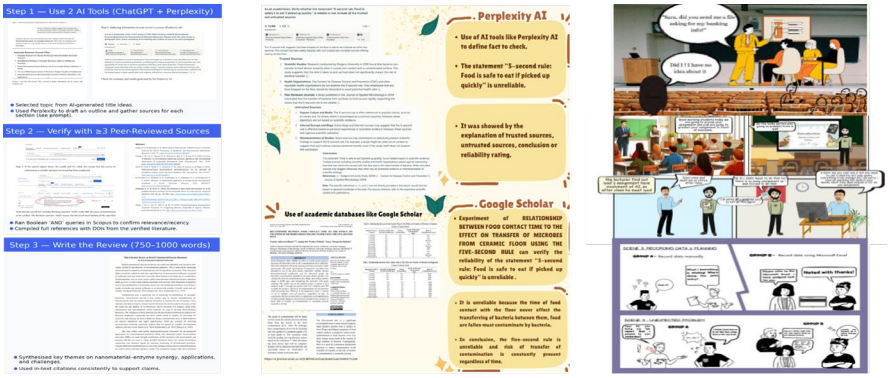


Figure 2: Example outputs from student assignments: (a) an individual assignment (beginner level), (b) group assignment 1 (intermediate level), and (c) group assignment 2 (competence level).

Data Collection: Course Feedback Survey on AI-Integrated Learning

This study used a structured Google Form survey to evaluate students' experiences with AI tools in their coursework, comparing AI-assisted and conventional methods. The survey had three sections: **Section A assessed general course feedback**, including information literacy skills and course components; **Section B explored AI tool usage for tasks** like summarising and brainstorming, along with ethical confidence; and **Section C gathered overall reflections on learning methods**, satisfaction, and AI integration suggestions. Combining Likert-scale ratings and open-ended questions, the survey provided both quantitative and qualitative insights into AI's impact on learning outcomes, helping identify strengths and areas for improvement in the course design. The data serves as the basis for analysing AI-integrated learning's effectiveness in enhancing information literacy and academic performance.

Findings and Discussion

The integration of AI into this information literacy course was implemented through a multifaceted approach, including in-class activities and individual and group assignments to assess students' understanding of information literacy concepts. The assessment was conducted through different themes of individual and group assignments, evaluated using rubric-based criteria to systematically measure students' performance in applying AI tools within their assignments and research tasks. The intervention was structured through three advancing tiers: novice, intermediate, and advanced. A tripartite survey was comprehensively designed to evaluate the effectiveness of integrating AI tools into the core information literacy skills. **Figure 3** shows a comparative self-assessment conducted based on 22 enrolled chemistry students' (100%) responses, where their understanding was evaluated based on a 5-point Likert scale.

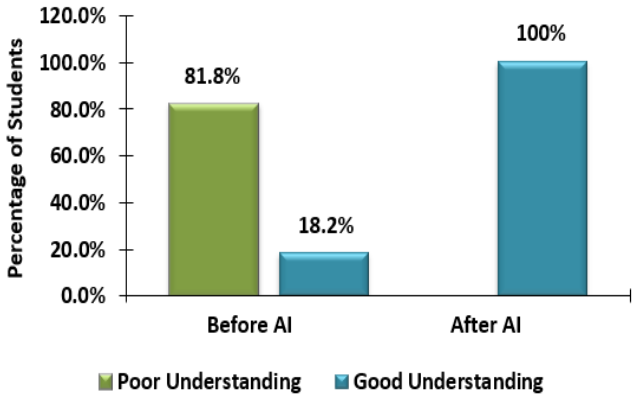


Figure 3: Students' ratings of their understanding of information literacy before and after using AI tools in their assigned tasks.

Most of the students (81.8%, green bar) showed a poor level of understanding of how to search, evaluate, and verify the information effectively without AI tools. The use of AI tools in learning focused on how AI was utilised throughout the course and its perceived effectiveness. **Figure 3** (blue bar) demonstrated that 100% of the students found the AI tools helpful in completing their coursework. Tools like ChatGPT.ai, Perplexity.ai, Copilot.ai, and Gemini.ai were among the most frequently used, suggesting that the selected platforms were accessible and functionally suitable for academic use. These tools aided them in various academic tasks, including finding reliable information, verifying facts, summarising articles, brainstorming, and generating citations, highlighting the AI-assisted fact-checking exercises

(45.5%), group investigation on misinformation (9.1%), and storyboard creation using AI tools (9.1%), as the most helpful components with regards to AI integration in learning process (**Figure 4**).

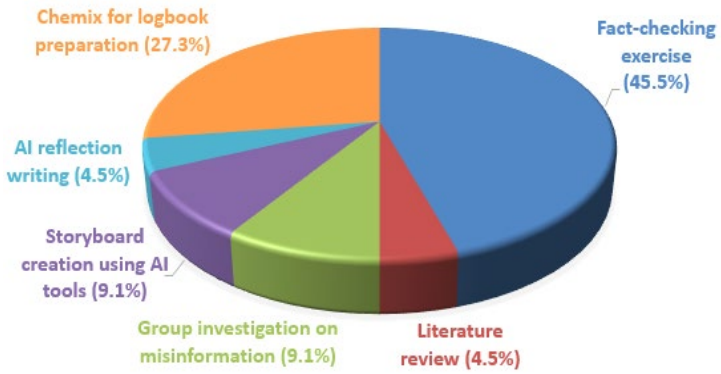


Figure 4: Student feedback on the most helpful component in this course (n = 22).

These tasks, including the lectures, underscored the value of embedding active, hands-on, and reflective tasks within the course structure, reflecting strong engagement with instructional curriculum design. Importantly, over 90% of the students expressed confidence in using AI tools ethically, indicating that the course not only introduced AI technologies but also instilled critical thinking and ethical awareness regarding their application in academic contexts. The incorporation of AI tools in this course hereby signified an increased uniformity in students' perceived gain in knowledge and skills, showing positive perceptions.

The overall reflection provided valuable insights into students' comparative perceptions of conventional versus AI-assisted learning and their overall satisfaction. Students consistently reported that AI tools offered a faster, more streamlined, and more efficient approach to information gathering than traditional methods like basic Google searches. While acknowledging the importance of verifying AI-generated content, many students highlighted the time-saving and task-oriented benefits of using AI, particularly in summarising information and retrieving relevant data. The results indicate that systematic AI incorporation into research-focused courses can significantly contribute to the enhancement of essential digital literacy competencies in undergraduate students. Satisfaction with the course was overwhelmingly positive, with 95.5% rating their experience at the highest levels and 81.8% recommending AI tool integration into other courses. This reflects a strong endorsement of the AI-enhanced pedagogical approach and suggests a readiness among students to see similar innovations extended across the curriculum. This favourable feedback and observed enhancements in performance strengthen the possibility of AI as an educational catalyst in higher education, especially in STEM fields.

Commercialization Potential

The AI-driven information literacy framework has great potential for use across different disciplines, including STEM, social sciences, and humanities. Its flexible design makes it easy to adapt and update, using common AI tools that are cost-effective and can be updated as technology improves. The framework is also suitable for professional development programs for educators, supporting ongoing upskilling in both pedagogy and technology. Early student feedback shows improved digital skills, greater motivation, and more time for analysis, rather than time-consuming information gathering. This adaptability positions the framework as a forward-thinking, sustainable model for empowering learners and educators to thrive in an increasingly AI-driven academic and professional landscape.

Acknowledgement

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ID30: An Action Research Exploring the Feasibility of Using AI to Generate Out-of-the-Box A Level Mathematics (9709) Questions

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Highlights: This project investigates the use of generative AI, specifically ChatGPT, to create non-standard A-Level Mathematics (9709) questions that promote deeper conceptual understanding and problem-solving skills. Through an action research approach involving experienced teachers, the study evaluates the quality, syllabus alignment, and classroom feasibility of AI-generated questions across procedural, conceptual, and graphical domains. The innovation supports the NALI framework by integrating prompt engineering as a creative, efficient, and scalable tool for assessment design, enhancing both teacher agency and student engagement in higher-order mathematical thinking.

Keywords: Generative AI; A-Level Mathematics; Assessment Design; Teacher-AI Co-Creation

Introduction

This action research explores how generative artificial intelligence (AI), particularly ChatGPT, can be leveraged by Mathematics teachers to generate creative, non-standard A-Level Mathematics (9709) questions. A Level Mathematics teachers traditionally rely heavily on past-year exam papers to train students in procedural fluency and exam technique. While this approach provides familiarity with question format and structure, it often lacks opportunities for students to engage with novel or unstructured problem types that promote conceptual understanding, critical reasoning, and flexible application of mathematical knowledge. As Schoenfeld (2013) argues, engaging learners in "productive struggle" is fundamental to the development of higher-order thinking skills in mathematics.

Creating such cognitively demanding and conceptually rich tasks, however, places a substantial burden on teachers, especially within rigid curricular timelines. Generative AI (GenAI) tools like ChatGPT present an innovative and scalable alternative for supporting educators in content generation. In an attempt to explore GenAI tools as educators' assistants, Moundridou, Matzakos and Doukakis have categorised the classification of GenAI tools into the groups of planning, content creation, evaluation, and teaching assistant (Moundridou, Matzakos & Doukakis, 2024). In particular, in the attempt of designing a GenAI enabled learning environment in mathematics context, Liu, Sun and et al have shown that ChatGPT supported Mathematics Problem Solving System was more effective in improving students' post-test performance as compared to the control group (Liu et al, 2025). On top of that, several elements of educational psychology such as interest, perceived value, and motivation towards learning were also found to be increased when the learning environment was GenAI enhanced. (Grover et al., 2024; Atieku-Boateng et al., 2024).

This action research examined the possibility to generate, design, adjust the available A-Level Mathematics (9709) questions beyond the standard types. Thus, providing opportunities for students to practise and predict sophisticated questions that they have not encountered. At the same time, offering mathematic teachers a cost-effective and not time-consuming method to create academically challenging questions which are also aligned with the Cambridge 9709 syllabus.

Objectives

The objective of this project was to evaluate the ability of GenAI Large Language Model (LLM) to generate mathematically challenging A Level Mathematics questions which align with the syllabus across three distinct domains. Based on the examination information provided in the Cambridge 9709 syllabus, the domains are derived to be: 1) procedural fluency and worked solutions; 2) conceptual understanding and mathematical reasoning; and 3) graphical interpretation and sketching.

Innovation

This innovation aligns strongly with the NALI framework through multiple dimensions. First, the use of GenAI in creating assessment materials is a novel approach to reduce teachers' workload and extend the diversity of the types of questions that will be generated. This practice has traditionally done manually, which would be perceived by many teachers as a not cost effective and time-consuming approach. Additionally, this action research explored the possibility of incorporating GenAI in this aspect, GenAI-generated worked examples are generally criticized as lack of depth and not to be optimally divided into steps. Mathematics, on the other hand, is a procedure-focused subject. The integration of GenAI in Mathematics requires an additional lens to scrutinize, which will promote a significant amount of creativity and innovation to be used during the designing and application processes. In a nutshell, the impact of this innovation was felt through enhanced teacher agency, time efficiency, and exposure of students to cognitively demanding content that moves beyond routine drill-based practice.

Research Methodology

The methodology employed in this study is an action research. At the beginning, a sharing session on prompt engineering was conducted with three experienced A Level Mathematics lecturers, introducing techniques for guiding ChatGPT to generate Mathematics 9709 related questions. After that, teachers then submitted prompts in each of the three focus areas. These were executed by the researcher using a subscribed account to generate sample questions. The resulting outputs were evaluated using a standardized rubric covering mathematical accuracy, syllabus alignment, question style, markability, and editing requirements. Furthermore, Semi-structured interviews were conducted each teacher in order to captured qualitative feedback regarding usability, ethical concerns, and pedagogical feasibility.

The evaluation of AI-generated A Level Mathematics questions demonstrated varying levels of effectiveness across three distinct domains: procedural fluency, conceptual reasoning, and graphical interpretation. These insights were drawn from rubric-based assessments by three experienced educators and supported by semi-structured interview data.

Findings and Discussion

As can be seen in Figure 1 below, In the domain of procedural fluency and worked solution, AI-generated questions were rated highly for syllabus alignment (mean = 5.0) and markability (mean = 4.7), though they scored lower on mathematical accuracy (mean = 3.0). Lecturers generally agreed that ChatGPT handled this category best, likely because of the predictable, algorithmic structure of such problems. As Lecturer 3 stated, "Procedural questions... have clear, rule-based steps that are easier for AI to replicate." Similarly, Lecturer 2 noted, "Procedural [questions]... do not need intensive explanation." These views align with the assertion by Grover et al. (2024) that LLMs are most reliable when executing structured, procedural tasks.

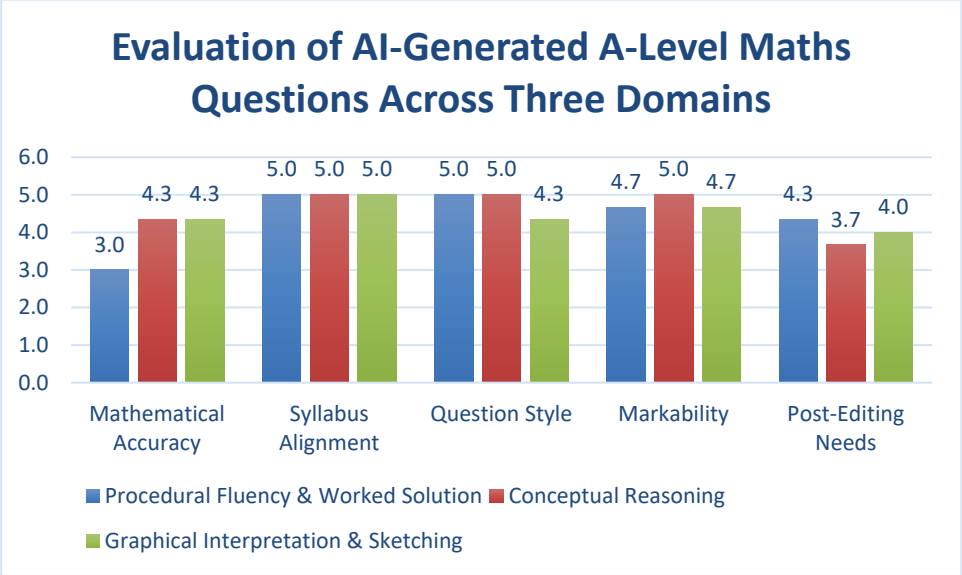


Figure 1: Evaluation of AI-Generated A-Level Maths Questions Across Three Domains.

Conceptual understanding and Mathematical reasoning questions, on the other hand, were seen as more cognitively rich but also more prone to inconsistencies. AI-generated conceptual reasoning questions received high ratings for syllabus alignment (mean = 5.0) and question style (mean = 5.0), with slightly lower scores for post-editing needs (mean = 3.7) and mathematical accuracy (mean = 4.3). While rubric scores were strong, lecturers expressed concern over the AI's ability to maintain logical coherence in multi-step reasoning. Lecturer 3 observed that "ChatGPT would give wrong graphical/diagrams to represent certain topics... and sometimes misinterprets conceptual questions." This supports Grover et al.'s (2024) finding that while AI can "imitate higher-order reasoning patterns," it occasionally hallucinates logic chains or fails to capture abstract mathematical nuances.

AI-generated questions in the Graphical Interpretation & Sketching category scored perfectly for syllabus alignment (mean = 5.0) and mathematical accuracy (mean = 5.0), with slightly lower scores in question style (mean = 4.3) and post-editing needs (mean = 4.3), yet reviewers noted the limitations of AI in representing visual information appropriately. Lecturer 1 explained that "a question it generated on sketching a transformed exponential graph lacked clarity in axis labeling and didn't follow Cambridge's style." Likewise, Lecturer 3 added that "most of the time, ChatGPT would give wrong graphical/diagrams," particularly in mechanics-related topics. These observations are consistent with Schorcht et al. (2024), who argue that "visual-linguistic translation remains a weakness in current LLMs."

Teacher feedback consistently highlighted the usefulness of AI-generated content for preliminary classroom resource development. All three lecturers affirmed the tool's value for time-saving and idea generation. Lecturer 2 stated plainly, "Very useful... it will help to provide new ideas for possible questions," while Lecturer 1 elaborated that "AI-generated questions are quite useful for classroom use... especially for practice worksheets, homework, and revision

materials." This mirrors the findings of Atieku-Boateng et al. (2024), who champion "teacher-AI co-creation" as a scalable solution in education.

However, the editing and verification needs were deemed non-negligible. Most lecturers described the process as requiring "moderate editing" (Lecturer 1), often to correct "inaccuracy in calculations or final answers" (Lecturer 3) and ensure that questions fit the expectations of A-Level assessments. Lecturer 3 emphasized the necessity to "manually verify each step and recalculate answers to ensure mathematical accuracy," a concern echoed in Lindbäck's (2024) recommendation for integrated review cycles in AI-assisted content development.

The study also explored teacher readiness and confidence in using AI-generated questions. Despite differing levels of experience (ranging from 2 to 11 years), all participants expressed cautious optimism about the technology. Lecturer 1 noted, "It can significantly save time in lesson and exam preparation," while Lecturer 3 recommended "training on how to provide efficient prompts to AI." These perspectives align with Biton & Segal (2025), who advocate for training in prompt design to overcome the "bottleneck" of misaligned AI outputs.

Conclusion

In conclusion, the findings serve as an important material to support the positive outlook of the role of GenAI in assisting teacher and AI co-creation of assessment or assessment alike practices. As Lecturer 3 emphasized, "I would feel confident using them only after careful moderation, review and editing." The study therefore supports Reza et al.'s (2025) argument that "prompt literacy" must be considered a foundational skill in modern digital pedagogy, especially for subjects requiring precision and abstract reasoning like mathematics.

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ID31: Penerapan Nilai Etika Penggunaan Kecerdasan Buatan (AI) Dalam Kalangan Pelajar Sekolah Rendah Melalui Kaedah Pembelajaran Berteknologi dan Gamifikasi

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Sorotan: Kajian ini meneroka penerapan nilai etika dalam penggunaan kecerdasan buatan (AI) di kalangan pelajar sekolah rendah melalui kaedah pembelajaran berteknologi dan gamifikasi. Program ini merangkumi ceramah, latihan menggunakan ChatGPT secara beretika, serta pertandingan berasaskan nilai etika seperti kejujuran, kebolehpercayaan, penghargaan dan privasi. Soal selidik pra dan pasca program menunjukkan peningkatan pengetahuan dan kesedaran pelajar terhadap isu etika dalam penggunaan AI. Pendekatan interaktif dan mesra kanak-kanak ini telah berjaya menarik minat pelajar serta membentuk sikap bertanggungjawab dalam penggunaan teknologi. Inisiatif ini menyokong Matlamat Pembangunan Mampan 4: Pendidikan Berkualiti.

Kata Kunci: Etika; AI; Etika AI; Pendidikan; Privasi

Pengenalan

Teknologi kecerdasan buatan (AI) telah mengalami perkembangan yang pesat dan membawa perubahan besar dalam cara kita hidup dan bekerja. Penggunaan AI semakin meluas dalam pelbagai bidang, termasuk perubatan, perniagaan, pendidikan, dan penyelidikan. Walaupun AI membawa banyak manfaat, ia juga membawa cabaran etika yang perlu ditangani. Isu seperti privasi data, bias dalam algoritma, dan tanggungjawab terhadap keputusan AI perlu dipertimbangkan dengan teliti (Ayling dan Chapman, 2022). Secara keseluruhan, perkembangan AI membawa banyak peluang tetapi juga memerlukan pengurusan yang bijak untuk memastikan teknologi ini digunakan dengan cara yang bertanggungjawab dan bermanfaat untuk Masyarakat (Wiese, Patil dan Magana,2025).

Dalam pendidikan, AI membolehkan pembelajaran yang disesuaikan dengan keperluan setiap pelajar, membantu mereka mencapai potensi penuh. AI dapat membantu pelajar mengoptimumkan jadual pembelajaran mereka dengan mempertimbangkan keutamaan dan keperluan masing-masing. Pelajar sekolah dapat menggunakan teknologi kecerdasan buatan (AI) secara beretika dengan mengikuti beberapa panduan dan prinsip yang memastikan penggunaan teknologi ini tidak hanya bermanfaat tetapi juga bertanggungjawab. Berikut adalah beberapa cara untuk mencapai itu:

i. Memahami Privasi Data
ii. Menghindari Plagiarisme
iii. Kritis Terhadap Maklumat
iv. Menggunakan AI untuk Pembelajaran yang Positif
v. Berinteraksi dengan Guru
vi. Menghormati Nilai dan Budaya

Sesi perkongsian mengenai etika dalam penggunaan kecerdasan buatan dalam pembelajaran pada pelajar-pelajar sekolah rendah telah diadakan secara bersemuka. Ceramah ini memberi pendedahan berkenaan nilai etika dalam menggunakan AI dalam pembelajaran iaitu kejujuran, kebolehpercayaan, penghargaan dan privasi pada pelajar. Sebelum ceramah tersebut diadakan, soal-selidik telah diedarkan kepada pelajar bagi mengenalpasti kefahaman pelajar mengenai nilai etika dalam penggunaan AI. Kemudian, ceramah bertajuk Etika AI dalam Pembelajaran diberikan pada pelajar. Selepas ceramah diberikan, pelajar diberi Latihan untuk menggunakan ChatGPT secara beretika. Kemudian, pertandingan etika AI telah dibuat bagi menguji kefahaman pelajar mengenai AI etika. Selepas program tersebut, pelajar yang sama diminta untuk menjawab soal-selidik untuk mengenalpasti kefahaman mereka tentang Etika AI dalam pembelajaran.

Objektif

Kajian ini berfokus untuk memberi kesedaran tentang etika dalam penggunaan kecerdasan buatan di kalangan pelajar sekolah rendah. Di samping itu, ia dapat mengatasi masalah literasi kecerdasan buatan dalam pembelajaran pelajar. Kaedah pengajaran dan pembelajaran ini dapat mengatasi isu etika yang dihadapi dikalangan pelajar sekolah rendah.

Metodologi Kajian

Pembelajaran Berteknologi

Gamifikasi

Kaedah tinjauan kuantitatif digunakan melalui soal selidik yang direka untuk mengumpul data primer daripada peserta yang disasarkan. Untuk memastikan kemudahan pemahaman dan penyertaan dalam kalangan pelajar sekolah rendah, soal selidik dibuat dalam bahasa melayu. Soal selidik ini diberikan untuk menilai pengetahuan peserta mengenai nilai etika dalam penggunaan AI sebelum dan selepas program dijalankan. Tinjauan dibahagikan kepada dua bahagian: Bahagian 1 dan Bahagian 2. Bahagian 1 adalah berkenaan latarbelakang peserta dan Bahagian 2 soalan bagi memahami tahap pengetahuan peserta berkenaan konsep kecerdasan buatan, kejujuran, kebolehpercayaan, penghargaan dan privasi. Untuk mendapatkan data dengan bermakna, kami menggunakan analisis deskriptif. Soal selidik pra program dan soal selidik pasca program disertakan di lampiran untuk rujukan.

Dapatan Kajian dan Perbincangan

Seramai 16 responden telah menjawab soal-selidik. Jadual 3 menunjukkan majoriti responden adalah terdiri daripada peserta perempuan (56.25%) diikuti peserta lelaki (43.75%).

Jadual 1: Profil Responden

Demografi	Jumlah Responden	Peratusan (%)
Jantina		
Perempuan	9	56.25
Lelaki	7	43.75
Umur		
10 tahun	2	12.5
11 tahun	4	25
12 tahun	10	62.5

Jadual 2: Analisis Data Soal Selidik

Pengetahuan	Mean Peratusan (%)	Pra Program	Selepas Program	Pertambahan Pengetahuan
Konsep Etika Kecerdasan Buatan				
Maksud AI		3.18	4.18	1
		63.75%	83.75%	20%
Fungsi AI		3.25	4.43	1.18
		65%	88.75%	23.75%
Kepentingan etika dalam penggunaan teknologi AI		3	4.18	1.18
		60%	83.75%	23.75%
Etika penggunaan teknologi AI dalam pembelajaran		3.12	4.12	1
		62.5%	82.5%	20%
Kejujuran				
Maksud Kejujuran		3.5	4.12	0.62
		70%	82.5%	12.5%
Cara menggunakan teknologi AI dalam pembelajaran secara jujur		3.18	4.31	1.13
		63.75%	86.25%	22.5%
Kebolehpercayaan				
Maksud Kebolehpercayaan		3.5	3.87	0.37
		70%	77.5%	7.5%
Cara mengetahui kesahihan sesuatu maklumat yang dikeluarkan oleh teknologi AI		3.31	3.87	0.56
		66.25%	77.5%	11.25%
Penghargaan				
Maksud penghargaan dalam menggunakan teknologi AI		3.56	4	0.44
		71.25%	80%	8.75%
Cara memberi penghargaan semasa menggunakan teknologi AI dalam pembelajaran		3	4.18	1.18
		60%	83.75%	23.75%

Pengetahuan	Mean Peratusan (%)	Pra Program	Selepas Program	Pertambahan Pengetahuan
Privasi				
Maksud privasi dalam menggunakan teknologi AI		3.06	4.25	1.19
		61.25%	85%	23.75%
Cara menjaga privasi semasa menggunakan teknologi AI dalam pembelajaran		3.18	4.12	0.94
		63.75%	82.5%	18.75%

Data yang diperoleh dari soal-selidik yang dijalankan menunjukkan terdapat peningkatan pertambahan pengetahuan mengenai nilai etika dalam penggunaan AI dalam kalangan pelajar sekolah rendah. Jadual 2 menunjukkan kesemua komponen-komponen seperti konsep etika AI, kejujuran, kebolehpercayaan, penghargaan dan privasi menunjukkan perbezaan sebelum dan selepas ceramah diberikan. Terdapat peningkatan ketara dalam semua kategori selepas program dijalankan. Ini menunjukkan ceramah tersebut telah mencapai objektifnya iaitu pemindahan pengetahuan kepada pelajar sekolah rendah mengenai etika Ai dalam pembelajaran. Analisis data tersebut adalah seperti berikut:

i. Pemahaman konsep etika kecerdasan buatan menunjukkan peningkatan kesedaran peserta terhadap konsep asas etika AI meningkat dengan baik.
ii. Pemahaman mengenai maksud kejujuran meningkat.
iii. Pemahaman mengenai kebolehpercayaan ini mencerminkan keperluan untuk lebih banyak latihan dalam memastikan kebolehpercayaan maklumat AI.
iv. Pemahaman konsep penghargaan meningkat aplikasinya dalam pembelajaran.
v. Privasi adalah antara topik dengan peningkatan tertinggi, menunjukkan kepentingan subjek ini kepada peserta.

Program pemindahan pengetahuan tentang etika kecerdasan buatan (AI) kepada pelajar sekolah rendah merupakan satu inisiatif penting dalam memastikan generasi muda memahami penggunaan teknologi secara bertanggungjawab. Program ini bertujuan memberikan pendedahan asas mengenai konsep AI, peranannya dalam kehidupan seharian, dan pentingnya mengamalkan nilai etika dalam penggunaannya. Melalui pendekatan yang interaktif dan mesra kanak-kanak, keberkesanan program ini dapat dinilai daripada beberapa aspek, termasuk pemahaman pelajar, sikap mereka terhadap AI, dan keupayaan untuk mengenalpasti isu etika berkaitan teknologi ini.

Salah satu petunjuk keberkesanan program ini ialah peningkatan tahap pemahaman pelajar terhadap konsep asas AI. Sebelum program dimulakan, ramai pelajar hanya mengetahui AI secara permukaan, seperti penggunaan robot atau aplikasi telefon pintar. Namun, selepas menjalani aktiviti dalam program ini, pelajar dapat menjelaskan fungsi AI dengan lebih mendalam, termasuk bagaimana ia boleh membantu dalam bidang seperti pendidikan, perubatan, dan keselamatan. Aktiviti seperti simulasi dan permainan pendidikan yang memperkenalkan cara AI membuat keputusan turut membantu pelajar memahami logik di sebalik teknologi ini.

Pelajar-pelajar yang terlibat dalam program tersebut juga telah berkongsi tentang cara menulis karangan menggunakan AI secara beretika pada rakannya di sekolah yang lain. Selain daripada itu, pelajar telah menunjukkan perubahan dalam penggunaan AI dimana terdapat pelajar yang telah menunjukkan peningkatan cara menggunakan AI secara beretika semasa menulis esei yang diberikan oleh guru. Dapat dilihat pelajar menuliskan sumber idea penulisan dan juga pelajar tidak meniru bulat-bulat dari ChatGPT tetapi pelajar cuma mencari idea dari ChatGPT dan meminta pendapat guru tentang maklumat didapati dari ChatGPT.

Dari segi sikap, pelajar menunjukkan perubahan yang positif terhadap teknologi AI. Sebelum ini, sebahagian besar pelajar mungkin hanya melihat AI sebagai sesuatu yang menarik atau menyeronokkan tanpa memikirkan implikasi etika. Melalui penerangan dan perbincangan interaktif, pelajar diajar untuk mengkritik situasi di mana AI mungkin disalahgunakan, seperti isu privasi data atau diskriminasi algoritma. Latihan ini membantu membentuk sikap lebih bertanggungjawab dan kritis dalam memanfaatkan teknologi pada masa hadapan.

Keberkesanan program ini juga dilihat dalam keupayaan pelajar mengenalpasti dan menangani isu etika berkaitan AI. Misalnya, pelajar diajar untuk memahami kepentingan keadilan, ketelusan, dan privasi dalam penggunaan teknologi. Dalam salah satu aktiviti, pelajar diberi senario tentang bagaimana data mereka boleh digunakan oleh AI, dan mereka diminta untuk mencadangkan langkah-langkah melindungi privasi mereka. Respon yang diterima menunjukkan bahawa pelajar bukan sahaja memahami isu ini, tetapi juga dapat memberikan idea yang praktikal untuk menanganinya.

Tambahan pula, program ini berjaya menarik minat pelajar dengan pendekatan yang kreatif. Contohnya, penggunaan animasi dan cerita digital yang menunjukkan situasi sehari-hari di mana AI digunakan telah meningkatkan daya tarik dan pemahaman pelajar. Guru juga melaporkan bahawa pelajar lebih bersemangat untuk bertanya dan berbincang tentang topik-topik berkaitan teknologi selepas mengikuti program ini.

Secara keseluruhan, program pemindahan pengetahuan tentang etika AI kepada pelajar sekolah rendah adalah satu kejayaan besar. Ia bukan sahaja membantu meningkatkan pengetahuan pelajar tentang teknologi AI tetapi juga membentuk sikap dan pemikiran kritikal mereka terhadap implikasi etika teknologi ini. Dengan program seperti ini, generasi muda akan lebih bersedia menghadapi cabaran dunia teknologi yang semakin kompleks sambil mengekalkan nilai etika dalam setiap tindakan mereka. Keseluruhannya, projek ini mencapai Matlamat

Pembangunan Mampan 4: Pendidikan Berkualiti dan memfokuskan petunjuk 4.6.1: memastikan kumpulan sasaran umur tertentu mencapai sekurang-kurangnya tahap kecekapan tetap.

Novelti dan Inovasi Kajian

i. Pendekatan Pembelajaran Beretika AI untuk Pelajar Sekolah Rendah:
ii. Kajian ini memperkenalkan modul pendidikan etika kecerdasan buatan yang dirangka khusus untuk pelajar sekolah rendah, satu pendekatan yang masih kurang diterokai dalam konteks pendidikan awal di Malaysia.
iii. Gabungan Pembelajaran Berteknologi dan Gamifikasi:
iv. Inovasi kajian terletak pada penggunaan gabungan ceramah, penggunaan aplikasi AI seperti ChatGPT, serta pertandingan berasaskan gamifikasi untuk meningkatkan kefahaman dan penglibatan pelajar secara aktif.
v. Penilaian Pra dan Pasca Program Secara Empirik:
vi. Kajian ini menggunakan soal selidik pra dan pasca secara kuantitatif bagi mengukur tahap perubahan pengetahuan dan kesedaran pelajar terhadap nilai etika AI, sekali gus menyediakan bukti keberkesanan kaedah ini.
vii. Penerapan Nilai Etika dalam Konteks Dunia Digital Pelajar:
viii. Kajian ini menyasarkan literasi etika digital yang relevan dengan persekitaran teknologi semasa, termasuk kejujuran, kebolehpercayaan, penghargaan dan privasi, yang sering diabaikan dalam pendidikan asas.
ix. Sumbangan kepada Matlamat Pembangunan Mampan (SDG 4):
x. Kajian ini menyokong pelaksanaan SDG 4.6.1 melalui pembangunan kemahiran celik teknologi dan nilai etika dalam kalangan generasi muda.

Impak

Kajian ini memberi impak positif dalam meningkatkan literasi etika digital di kalangan pelajar sekolah rendah melalui pendekatan pembelajaran berteknologi dan gamifikasi. Peningkatan ketara dalam kefahaman pelajar terhadap konsep AI dan nilai etika seperti kejujuran, kebolehpercayaan, penghargaan dan privasi menunjukkan keberkesanan program. Pelajar lebih berupaya menggunakan teknologi secara bertanggungjawab serta dapat membezakan penggunaan AI yang beretika dan sebaliknya. Selain itu, kajian ini memberi panduan praktikal kepada pendidik dalam merangka aktiviti pengajaran berkaitan AI yang menyeronokkan dan berimpak.

Penghargaan

Penghargaan buat CCIN yang menaja program ini dibawah program KTP@Fakulti.

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ID32: Math2Code: Bridging Mathematical Thinking and C++ Programming through an AI-Supported Project-Based Learning Aid

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Highlights: Math2Code is a structured, AI-assisted teaching approach designed to help undergraduate mathematics students bridge the gap between mathematical theory and C++ programming. It guides students through a step-by-step process: analysing mathematical problems, identifying appropriate numerical methods, visualizing logic through flowcharts or pseudocode, and finally developing structured code using object-oriented programming (OOP). AI tools such as ChatGPT are integrated to assist with debugging, clarifying algorithms, and exploring alternative coding solutions. This approach not only builds programming skills but also enhances computational thinking and problem-solving confidence. Aligned with NALI 2025, Math2Code promotes innovative, technology-driven learning that supports student engagement and digital readiness.

Keywords: Mathematics education; C++ programming; artificial intelligence; interactive visualization; computational thinking

Introduction

Malaysia's aspirations in education and digital transformation are outlined in national frameworks such as the Malaysia Education Blueprint 2015–2025 (Higher Education) (Ministry of Education Malaysia, 2015) and the Malaysia Digital Economy Blueprint (MyDIGITAL) (Economic Planning Unit, 2021).These policies highlight the need to equip graduates with digital competencies, including computational thinking, interdisciplinary problem-solving, and the ability to engage with emerging technologies like artificial intelligence (AI).

While these goals provide a strong national direction, some challenges remain in practice. At the undergraduate level, many students particularly those in the first-year of Bachelor of Science (Mathematics) with Honours (SSCEH) and Bachelor of Science (Industrial Mathematics) with Honours (SSCMH) programs at Universiti Teknologi Malaysia (UTM), find it difficult to connect abstract mathematical ideas with practical coding skills. In courses such as SSCM1313 Computer Programming, students may grasp mathematical concepts but often struggle to convert those ideas into structured C++ code. This is especially true for students with limited prior experience in computing, where moving from mathematical reasoning to programming syntax presents both conceptual and technical challenges.

In response to the challenges faced by students in bridging mathematical theory and programming practice, we introduced Math2Code, which is a structured, AI-assisted, project-based instructional approach. Shown in Figure 1, this innovation offers a guided learning pathway that begins with understanding a mathematical problem, progresses through visualizing the computational steps using flowcharts or pseudocode, and concludes with the development of C++ code using structured programming techniques. AI tools such as ChatGPT are integrated into the process as supportive aids to help students to check the code structure and logic, troubleshooting errors, and exploring alternative solutions. This support enhances digital readiness and reducing programming anxiety.

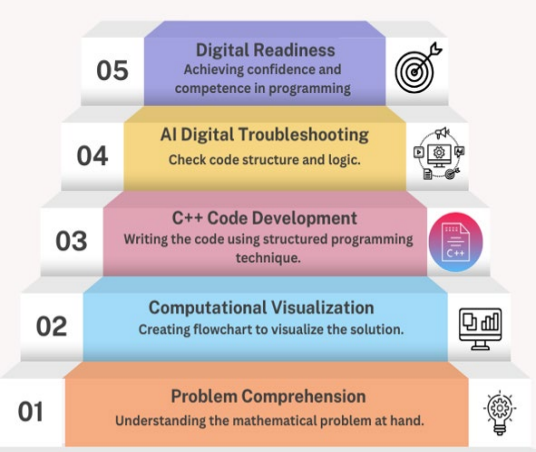


Figure 1: Math2Code Framework

Ultimately, this innovative teaching approach is designed not only to help students develop practical programming skills, but also to bridge the gap between mathematical thinking and coding. By guiding students in translating abstract mathematical ideas into structured, real-world C++ applications, Math2Code fosters deeper engagement with both disciplines and helps students see how theoretical concepts can be brought to life through computational solutions.

Objectives

The objective of Math2Code is to support undergraduate mathematics students, particularly those with limited programming experience in bridging the gap between abstract mathematical thinking and structured C++ programming. This innovation adopts a guided, project-based learning approach where students analyse nonlinear problems, select appropriate numerical methods (such as Bisection, Newton-Raphson, and Secant), and implement solutions using core programming concepts like functions, classes, and arrays. AI tools such as ChatGPT are integrated as supportive learning aids to help students generate pseudocode, troubleshoot errors, and understand algorithmic logic. The overall aim is to strengthen computational thinking, improve programming literacy, and foster deeper engagement with mathematical problem-solving.

NALI Approach

Math2Code supports the core values of the New Academia Learning Innovation (NALI) model (Alias & Aris, 2016) by promoting student-centered learning, meaningful use of digital tools, and creative, practice-oriented approaches to teaching. This initiative was developed in response to a common challenge among undergraduate mathematics students especially those with limited programming experience who often find it difficult to connect abstract mathematical concepts with structured coding.

The novelty of Math2Code lies in its structured and supportive approach that helps students gradually build the skills needed to solve mathematical problems using C++ programming. While students are taught the basic syntax and theory of C++, the innovation goes a step further by providing a clear, step-by-step process to guide them from understanding the mathematics, through visualizing the solution using flowcharts or pseudocode, and finally to writing the actual code. This approach helps reduce the sense of being overwhelmed and allows students to develop confidence at their own pace.

Creativity is reflected in the way students are engaged through hands-on mini projects involving practical mathematical problems, using numerical methods such as Bisection, Newton-Raphson, and Secant. Working in teams, students not only apply what they have learned but also strengthen communication and problem-solving skills in a collaborative setting. The innovative element of Math2Code is its integration of AI tools like ChatGPT as part of the learning process. Students use these tools to explore coding logic, troubleshoot their work, and ask questions as they progress. Rather than providing answers directly, the AI acts as a learning companion that supports students' understanding and encourages independent learning.

Applicability is a strong point of this approach. Math2Code can be used across various STEM courses that involve numerical methods or algorithm development. Its flexible design makes it suitable for different delivery modes whether face-to-face, blended, or online.

The impact of Math2Code has been encouraging. Students have shown increased engagement, better understanding of how mathematics connects with programming, and improved confidence in writing code. By supporting the development of digital literacy, computational thinking, and interdisciplinary skills, Math2Code contributes meaningfully to national goals in preparing students to thrive in an increasingly digital and connected world.

Research Methodology

The Maths2Code was implemented with 106 undergraduate students from a mathematics background enrolled in the SSCM1313 Computer Programming course during the 2024/2025-II session. The students were divided into groups of 4–5 members. Each group was assigned a mini project based on the topic of Nonlinear Equations, which aligns with content from the Numerical Methods course.

The mini project was introduced during the final two weeks of the semester, after all syllabus content had been covered and just before the final exam period began. This timing allowed students to consolidate and apply their cumulative knowledge meaningfully. Throughout the project, the groups worked through five distinct phases outlined in the Maths2Code framework.

Building Mathematical Understanding

In this initial phase, students explored the concept of nonlinear equations and conducted independent research on numerical methods such as Bisection, Newton-Raphson, and Secant. Each group selected one method based on their problem and discussed its suitability and conditions for convergence. Learning activities included understanding the algorithm of the chosen method, solving sample problems manually, and verifying their understanding through consultation with the course lecturer.

Computational Visualization

This phase plays a crucial role in helping students bridge mathematical understanding and programming logic. Students are required to create a flowchart that outlines the step-by-step logic of the coding process. This visualization helps them plan the structure of their C++ program before actual coding begins. By mapping out inputs, operations,

conditions, and outputs, students gain a clearer picture of how the algorithm functions. This step also reinforces logical thinking and ensures smoother translation of mathematical concepts into working code. They refined their designs through peer feedback and verified the logic with guidance from the course lecturer.

Writing and Testing Code

In this phase, students implemented their algorithm using C++, OOP concepts such as classes, objects, functions, arrays, and control structures. Working in their groups, they translated each step from the flowchart into code, tested their programs with sample inputs, and debugged errors as they encountered them. This hands-on practice helped reinforce their mathematical understanding through practical application and collaborative problem-solving.

Integrating AI Support

While coding, students used AI tools such as ChatGPT to support their problem-solving process. These tools were especially helpful in identifying logical errors, testing specific parts of code, and clarifying programming concepts. Rather than replacing critical thinking, AI served as a learning aid that encourage students to troubleshoot more confidently and understand their implementation at a deeper level. To ensure that AI was used appropriately and did not overtake the learning process, approximately 70% of the project activities were conducted in class under lecturer supervision, allowing the lecturer to provide real-time support and ensure students remained actively engaged in solving problems independently.

Reflection and Feedback

In the final phase, students took part in reflection activities to review their learning experiences, challenges, and progress. Informal group reflections were conducted during class discussions, where students shared their thoughts on teamwork, problem-solving strategies, and the overall project experience. These in-class reflections allowed the lecturer to observe group dynamics and engagement in real time. Additionally, individual feedback was collected through a short Google Form, where students were asked to reflect on their understanding of the numerical method, their use of AI tools, and the effectiveness of Math2Code implementation. These reflections, combined with the lecturer's informal observations, provided useful insights for both students and instructors.

Findings and Discussion

The introduction of the Math2Code project in the 2024/2025 session of the SSCM1313 Computer Programming course brought about a demonstrably positive impact on student learning outcomes, particularly for students with a mathematics background. Implemented after the completion of the core syllabus, Math2Code provided a structured and guided opportunity for students to consolidate their knowledge and apply mathematical concepts directly into programming logic, especially in the more challenging final chapters involving OOP concepts such as classes, objects, and functions.

A comparison with the previous session (2023/2024), in which Math2Code was not yet introduced, shows clear improvements across key performance indicators, as presented in Table 1:

Table 1: Comparison of SSCM1313 Student Performance (2023/2024 vs. 2024/2025)

Performance Indicator	2023/2024 (Before Math2Code)	2024/2025 (With Math2Code)
Average Final Exam Score (%)	55.6	67.7

Despite an increase in difficulty level of the final exam in 2024/2025, which focused more heavily on high-order OOP skills, the average final exam score improved by more than 10% and the overall course result, which including final exam and other assessments, rose by 6.%. This performance enhancement strongly reflects the effectiveness of Math2Code in supporting deep conceptual understanding and programming competency.

These quantitative improvements were consistently supported by positive student feedback, further validating the project's impact. A substantial 82.7% of students reported increased confidence in converting mathematical ideas into code in which directly aligning with the project's core objective. Students frequently highlighted the effectiveness of visual aids, particularly flowcharts and structured logic flows, as essential tools that helped them break down and internalize abstract mathematical logic into manageable programming steps.

"The part of the Math2Code approach that helped me learn best was how it clearly showed each step from the math to the code. This made it easier for me to understand the concepts and apply them in a practical way."

— Student, SSCM1313

"Flowchart helps me understand coding."

— Student, SSCM1313

These reflections not only reinforce the structured benefits of Math2Code but also mirror the improvement in assessment outcomes, providing strong qualitative support for the quantitative gains observed. Students also expressed enthusiasm for continuing this approach, citing it as enjoyable, practical, and effective in strengthening critical thinking and computational skills.

"I would recommend the Math2Code approach to future students because it makes math more practical, understandable, and engaging. By coding math problems, students actively apply what they learn, get immediate feedback, and develop valuable problem-solving and computational thinking skills, all of which are useful beyond the classroom."

— Student, SSCM1313

In summary, the positive shift in academic performance, combined with highly encouraging student feedback, highlights Math2Code as a valuable instructional innovation. It not only enhances student achievement but also promotes learner engagement, autonomy, and deeper mastery of the integration between mathematics and programming.

Other Information

This innovation extends the basic knowledge students acquire from the textbook C++ Numerical Programming, which is used in class and differs from many commercially available references. The textbook applies mathematics-based examples to help students understand fundamental programming concepts. While the textbook itself has not been copyrighted, individual chapters, including Chapter 6 on classes, objects, and functions (basic to OOP), have received formal copyright from UTM.

Math2Code goes beyond the textbook by offering a structured instructional design that bridges numerical methods and C programming, an approach not currently included in the textbook. Rather than functioning as a standalone module, it serves as a scaffolded learning experience that supports students in converting mathematical logic into executable code. With its strong potential for broader use in STEM programs, Math2Code may be further developed into a digital teaching kit or adaptable instructional framework. Though it has yet to receive formal funding or awards, future plans include improving the instructional flow, gathering student impact data, and scaling the innovation across institutions for wider implementation.

Acknowledgement

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ID33: DREAM, DESIGN, DISCOVER YOUR FUTURE (3D FUTURE) 2025

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Highlights: The "3D FUTURE 2025" program, a service-learning initiative offered through UTM's SHMR1023 course, successfully increased adult learning awareness and self-development among UTM and secondary school students. Participants explored concepts of lifelong learning through interactive exhibitions, games, and talks. The data revealed a significant increase in post-test scores (Cohen's d = 0.87), indicating a strong impact. The program also improved UTM students' leadership, communication, and teamwork skills, while encouraging collaboration between the university and school communities.

Keywords: Service-learning, lifelong learning, experiential learning, student-centred activities, creative games.

Introduction

The "Dream, Design, Discover Your (3D FUTURE) 2025" program was implemented as a service-learning initiative within the SHMR1023 Adult Learning course at Universiti Teknologi Malaysia (UTM). The program was designed as a collaborative platform between UTM undergraduates and secondary school students from SMK Munsyi and SMK Tenang Labis to promote the philosophy of lifelong learning through meaningful academic exposure and interactive engagement. This is complied with Service-Learning Malaysia - University for Society (or SULAM) as mandated by Ministry of Education to address the Shift 1 of Malaysia Education Blueprint 2015–2025 (Higher Education) (Department of Higher Education, 2019). It is believed that service-learning could enhance student learning and development as well as to allow students to implement theoretical knowledge to real-world scenarios (Naufal et al., 2024) as well as skills and confidence (Haji Wahab, 2024).

The program was designed to achieve two goals, one through experiential learning and the other through reflective practice. First, it was used as an academic intervention to meet Course Learning Outcomes (CLO) through student-driven modules that emphasized key adult learning principles such as learning styles, motivation, and self-directed development. UTM students were actively involved in the planning and delivery of engaging content, such as educational booths, learning activities and creative games which allowed them to apply theoretical knowledge in real-world settings. Second, the program aimed to encourage students to consider their future goals and higher education options. Motivational talks, a guided campus discovery walk, and EduChat sessions with UTM students encouraged participants to think critically about their personal development and future learning goals. Overall, the 3D FUTURE 2025 program aimed to connect academic theory and real-world practice, encourage interconnected learning, and foster a culture of lifelong learning in both university and school communities.

Objectives

i. To improve lifelong learning among UTM SHMR1023 students and secondary school participants through interactive, adult learning activities.
ii. To promote innovative thinking and goal setting through hands-on, invention-driven learning experiences.
iii. To cultivate UTM's core values (Integrity, Synergy, Excellence, and Sustainability) through program implementation that promotes teamwork, leadership, and shared responsibility.

NALI Approach

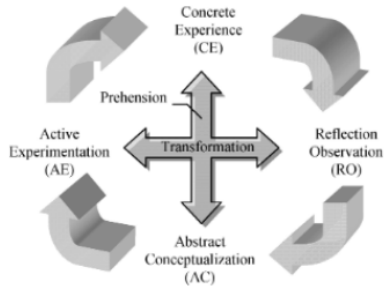


Figure 1: Kolb's Experiential Learning Model Stages.

The 3D Future 2025 program was carefully designed around Kolb's Experiential Learning Theory, which views learning as a continuous cycle consisting of four interconnected stages: Concrete Experience, Reflective Observation,

Abstract Conceptualization, and Active Experimentation. The first stage, Concrete Experience, was completed through a variety of real-world learning activities. Secondary school students were immersed in university life through a Discovery Walk around UTM's campus and motivational talks like "Big Why, Grand Why" and "Six Attributes of Success." These hands-on experiences gave participants direct access to university settings, bridging the gap between imagination and real academic environments. The second stage, Reflective Observation, was incorporated into the program via structured pre- and post-tests administered to students. These instruments allowed participants to assess their initial understanding and reflect on how their perspectives had changed as a result of the program. After participating in the interactive booth exhibitions, many students reported having a better understanding of their future academic paths and adult learning concepts.

The third stage, Abstract Conceptualization, was promoted by student-led Educhat Stations and interactive learning booths. These stations translated theoretical concepts about adult learning into understandable, engaging content. Throughout the program, participants were able to internalize broader educational themes by connecting them to their own lived experiences. UTM students also participated in this stage by creating content, organizing logistics, and adapting materials based on participant needs, thereby constructing meaning through applied understanding. Finally, Active Experimentation was realized when students at both the university and secondary levels applied their knowledge in real time, such as through booth-based competitions and innovative product showcases. UTM students faced challenges such as managing technical failures and adjusting venue arrangements, which necessitated quick decision-making and collaborative problem-solving. These applications show how the program gave learners the opportunity to test new ideas, receive feedback, and improve their practices, thereby completing the experiential learning cycle. The program's structure exemplifies Kolb's model, transforming passive participants into active, reflective learners ready to face real-world academic and personal challenges.

Originality, Creativity, and Innovation

The "Dream, Design, Discover Your (3D FUTURE) 2025" program was implemented as a service-learning initiative within the SHMR1023 Adult Learning course at Universiti Teknologi Malaysia (UTM). The program was designed as a collaborative platform between UTM undergraduates and secondary school students from SMK Munsyi and SMK Tenang Labis to promote the philosophy of lifelong learning through meaningful academic exposure and interactive engagement. This project is unique in that it combines three distinct learning experiences—interactive exhibitions, motivational talks, and educational games—all of which are strategically designed around Kolb's Experiential Learning Theory (1984). The program encouraged both university and secondary school students to reflect on themselves and grow personally. It gave UTM students the opportunity to apply adult learning theories in a real-world setting while also developing critical and creative thinking skills among secondary school participants. The booth exhibitions, creative games, and engaging multimedia content all helped to showcase creativity. UTM students, under the supervision of their lecturers, successfully completed the following processes:

i. Identifying the learning needs of secondary school students, with an emphasis on improving lifelong learning.
ii. Clearly outlining the program's objectives and scope.
iii. Designing the program's structure and content.
iv. Planning the schedule, estimating costs, preparing the venue, and gathering necessary tools.
v. Implementing the program as planned.
vi. Program effectiveness is assessed using pre- and post-test assessments, as well as feedback from participants and teachers.
vii. Creating a comprehensive final report.

The collaboration between UTM and participating schools resulted in a meaningful learning experience for both groups, demonstrating the element of innovation. Further innovation was demonstrated through the use of interactive methods and creative booth designs, as well as the effective use of multimedia documentation and real-time reflection. The evaluation employed both quantitative (SPSS analysis) and qualitative (student interviews and teacher feedback) methods, with surveys conducted before and after the program to assess impact. Overall, the 3D Future 2025 program was successful in achieving its primary goal of instilling originality, creativity, and innovation in students through engaging learning activities. The participants demonstrated a variety of creative ideas, not only during the exhibition but also in their reflections and academic outputs, emphasizing the program's transformative learning experience.

Impact of the Program

The 3D Future 2025 program demonstrated excellent usability and had a significant impact on its participants. The program proved to be both practical and effective across diverse learning levels and educational contexts by incorporating multiple pedagogical approaches, specifically active learning, collaborative learning, and problem-based learning, as well as the application of Kolb's Experiential Learning Theory (1984). The program's impact was demonstrated by the overwhelming positive feedback received from all stakeholders, including secondary school students, and UTM undergraduates. Participants recognized the program as an effective tool for encouraging critical self-reflection, educational motivation, and exposure to university life. Quantitative data from pre- and post-test assessments confirmed the program's effectiveness, revealing a statistically significant improvement in participants' understanding of adult learning concepts, lifelong learning, and personal development. The increase in mean score from 2.43 to 3.60, combined with a large effect size (Cohen's d = 0.87), confirmed the program's success in increasing cognitive awareness and encouraging intellectual growth in participants. Overall, the service-learning initiative successfully integrated theory and practice. As a result, the 3D Future 2025 program serves as a replicable model for future educational outreach efforts and demonstrates the efficacy of experiential and values-based learning frameworks.

Research Methodology

The "Dream, Design, Discover Your (3D FUTURE) 2025" program had two major components. The first phase included a series of lectures given by UTM lecturers on the principles of adult learning. These sessions were intended to introduce secondary school students to important concepts like lifelong learning, self-directed education, and the role of higher education in shaping personal development. The second phase of the program included interactive exhibitions and educational games in which both UTM students and secondary school students participated actively. This hands-on approach provided a practical platform for students to apply and internalize the information learned in the lectures. The program, which took place on June 4, 2025, at Universiti Teknologi Malaysia's Student Union Building, included 143 students from the SHMR1023 Adult Learning course as well as 30 students from SMK Munsyi and SMK Tenang Labis. Senior lecturers, including Dr. Azra, Dr. Salwa, and Dr. Zulkifli, provided additional support for the initiative by contributing to academic delivery and session facilitation.

Findings and Discussion

The findings were derived from pre- and post-program questionnaires distributed to secondary school students participating in the 3D Future 2025 program. According to the results, the overall mean score increased significantly from 2.43 (pre-test) to 3.61 (post-test). This suggests that the program effectively increased students' awareness, comprehension, and readiness for university life and adult learning concepts. The improvement in scores reflects positive changes in students' self-awareness, knowledge of higher education pathways, and motivation for lifelong learning. Students demonstrated increased confidence in their personal goals, a better understanding of potential challenges, and improved reflection on previous experiences. The interactive activities and talks presented during the program not only provided academic exposure, but also assisted students in developing critical thinking, self-reflection, and aspiration planning skills. Overall, the 3D Future 2025 program was successful in encouraging intellectual growth and future-oriented thinking in school students. It demonstrated the value of combining educational talks with engaging, student-centered activities to foster meaningful learning experiences and long-term academic motivation.

Table 1: Pre-Test and Post-Test Questionnaire Findings.

Item	Mean Score	
	Pre-test	**Post-test**
Saya mempunyai pengetahuan yang mencukupi tentang universiti (I have sufficient knowledge about university).	1.64	3.37
Saya faham bagaimana pendidikan tinggi dapat membentuk masa depan saya (I understand how higher education can shape my future).	2.73	3.76
Saya tahu bagaimana cara pembelajaran *orang dewasa berbeza daripada pelajar sekolah* (I know how adults' learning methods are different from school students).	2.52	3.79
Saya faham pelbagai jenis kaedah pembelajaran yang ada (I understand the various types of learning methods).	2.28	3.61
Saya faham bahawa proses pembelajaran boleh berterusan sepanjang hayat, walaupun selepas tamat sekolah (I understand that the learning process can continue throughout life, even after leaving school).	2.70	3.85
Saya jelas tentang kejayaan yang telah saya capai (I am clear about the successes I have achieved).	2.40	3.16
Saya sedar akan kesilapan yang telah saya lakukan (I am aware of the mistakes I have made).	3.25	3.91
Saya tahu apa cabaran utama yang saya hadapi (I know what the main challenges I face).	1.97	3.52
Total	**2.43**	**3.61**

In addition, to determine whether the 3D Future 2025 program had a statistically significant effect on students' understanding and awareness, a paired sample t-test was used to compare pre-test and post-test data. The analysis revealed that students' scores increased significantly after the intervention, with the mean score rising from 2.43 to 3.61. The mean difference of -1.19 ($t = -7.803$, $p < 0.001$) shows a statistically significant improvement in students' responses after the program. This finding indicates that the intervention had a positive and measurable effect on student learning and perception. Furthermore, the effect size, calculated using Cohen's $d = 0.87$, indicates a significant and practically meaningful improvement. According to Cohen (1988), values above 0.8 indicate a strong effect, supporting the conclusion that the program significantly increased students' knowledge and self-awareness of higher education and adult learning concepts.

Community Feedback: The 3D Future 2025 program received strongly positive feedback from various community members, including secondary school students, and UTM undergraduates. It was widely regarded as a successful initiative that introduced the concept of adult learning while encouraging students to think beyond conventional boundaries. The program also boosted students' confidence, promoted independent learning, and sparked an interest in pursuing higher education. Below are selected reflections from student participants following the program:

Student A: *"I feel confident and excited to pursue my studies at university."*

Student B: *"This program made me excited about entering university."*

Student C: *"I feel very happy and excited because now I understand knowledge, intelligence, and many other things."*

In summary, the qualitative feedback indicates that the program had a significant impact on students. It not only expanded their understanding of lifelong learning but also inspired a more proactive approach to personal development and education. The program's overall success reinforces its value as a model for future efforts to foster student motivation and aspiration.

Project Outcomes: The "Dream, Design, Discover Your (3D Future) 2025" program met its goal of introducing secondary school students to the concept of adult learning and encouraging reflection on future pathways. Students actively participated in both lecture sessions and engaging activities, such as interactive exhibitions and educational games created by UTM students. This integration of theoretical and practical components resulted in a more meaningful learning experience, promoting understanding through application and creating an enjoyable yet educational environment. It also encouraged student reflection and recognition of lifelong learning as a worthwhile endeavor.

Implementation Justification: This program was a crucial component of the SHMR1023: Adult Learning course, providing a platform for students to apply classroom theory in a real-world educational setting. It was designed to promote collaborative and experiential learning, with UTM students planning, implementing, and evaluating a community-based educational intervention aimed at students. This approach is consistent with the pedagogical goal of producing well-rounded students who are not only academically prepared but also socially responsive. By interacting directly with younger learners, UTM students were able to embody and apply adult education principles in a meaningful and contextually relevant way.

Learning Outcomes and Student Analysis: Throughout the program, UTM students demonstrated a solid understanding of adult learning concepts by creating engaging and informative content such as interactive booths, educational games, and reflective reports. They successfully applied theoretical concepts like adult learning processes, perception, and critical thinking to real-world educational tools. The program also improved important soft skills like leadership, teamwork, communication, and time management. As a result, students were assessed not only on academic performance but also on overall personal development through experiential learning.

Areas for Improvement; Several areas for future improvement have been identified to boost the program's overall effectiveness. These include increasing the level of interactivity in the exhibitions to better engage secondary school students, enlarging poster displays for greater visibility, and incorporating innovative elements such as recycled materials and digital technologies. Additionally, time management for each activity could be improved to ensure that all participants get the most out of the experience. These enhancements are intended to ensure that the program continues to evolve as a dynamic and effective learning platform.

Conclusion

The 3D Future 2025 program's implementation was successful in achieving its educational goals, particularly in increasing secondary school students' awareness and understanding of adult learning. The initiative also provided UTM students with a valuable platform for applying theoretical knowledge in a real-world setting. Positive feedback from participants demonstrates the program's effectiveness in encouraging engagement, reflection, and collaboration. Overall, the program successfully combined theoretical exposure with experiential learning, increasing students' awareness of adult learning concepts and encouraging them to reflect on their educational goals and future paths. Given its success, the program has a high potential for future development and expanded reach.

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ID34: The Use of AI-powered Learning Tools in Preparing Science Students for Assessments

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Highlights: Investigations were conducted to evaluate the use of AI tutoring – customed version of ChatGPT (AI for medical students and Chemistry Chem), AI-powered simulation and AI flashcard generator by NoteGPT in supporting A-Level Science students in their learning. The personalised learning experience provided by AI tutoring in addressing students' learning needs has make this learning tool highly preferred by students. The use of AI-powered learning tools enabled students to comprehend complex concepts, receiving corrective feedback and enhanced their efficiency in revision. Students are more motivated and confident in learning with the assistance of AI-powered learning tools.

Keywords: AI-powered learning tools, A-level students, learning challenges, learning support, scientific concepts.

Introduction

Artificial intelligence (AI), commonly known as technologies related to gathering, processing and interpreting external data correctly, followed by learning and using such data to achieve specific set goals through flexible adaptation (Haenlein and Kaplan, 2019). Since OpenAI released ChatGPT to the public in 2023, it has gained significant popularity among students, teachers and researchers. Various AI-powered learning tools have been developed to improve the effectiveness and efficiency of learning. To understand how relevant the AI-powered learning tools are to our students, surveys were conducted on our A-Level Science students.

The target group for this survey are 75 A-Level Biology and Chemistry students from Sunway College Johor Bahru within the age range of 16 – 19 years old. They belong to the Z generation that are also known as the digital natives who grow up with smartphones and social media as a constant feature of their existence (Jayatissa, 2023).

From the preliminary questionnaires collected, majority of our science students expressed strong interest in learning science subjects but lower confidence in solving application problems or answering HOTS (Higher-Order Thinking Skills) questions. Most students indicated they face difficulties in understanding abstract concepts, comprehending complex terminology, and applying science concepts to real-life situations. Apart from normal in-class lectures and consultation sessions with their lecturers, students tend to seek help from online resources, visual aids, hands-on experiments, and one-on-one tutoring.

In this research, various AI-powered learning tools were introduced to address different needs, and the effectiveness of each tool were evaluated based on post-usage surveys conducted.

Research Methodology

i. Three AI-powered learning tools, AI tutoring – customed version of ChatGPT (AI for medical students and Chemistry Chem), AI-powered simulation and AI flashcard generator by NoteGPT are introduced to students in class and the weblinks accessed to these are embedded on the Learning Management System course pages for students. Students are encouraged to use these AI supports in complement with their current learning resources to prepare for upcoming assessments.
ii. A post-usage survey is conducted on same pool of students to collect feedback for the use of AI-powered learning tools in supporting their assessment preparation.

Findings and Discussions

Our findings showed 83.6% students frequently combined AI-powered learning tools with conventional learning methods such as coursebooks, lecture notes and peer discussion in assessment preparation. A total of 77% students indicated that they preferred the most for using a combination of both AI-powered learning tools and conventional methods in revision. The AI-powered learning tools preferred by students in overall is AI tutoring (88.5%), followed by AI-powered simulations (34.4%) and AI flashcard generator (18%).

In the study of cognitive engagement of students in using AI-powered learning tools, 78.2% students reported that AI tutoring helped them to understand difficult concepts, 45.3% students indicated that AI-powered simulations facilitated the application of theoretical knowledge in practical scenarios and 25.6% students agreed that AI flashcard generator enabled them to memorize key concepts. This showed that students who used AI-powered learning tools especially AI tutoring has greater ability in mental processing of information, as according to the cognitive theory's perspective (Agatova and Latipova, 2025). In terms of delivery impact, 54.5% students indicated that AI tutoring provide timely and useful feedback, 39.9% students feedback that AI-powered simulations made learning more engaging and 30.8% students reported that the flashcards generated by AI were accurate and relevant to syllabus. Our findings also showed AI-powered learning tools had empowered the learning capabilities in students,

with 41.8% students demonstrated more confidence in the subject after using AI tutoring and the problem-solving skills of 40.5% students had improved after using AI-powered simulations.

Table 1: Positive user feedback (in %*) following the implementation of AI-powered learning tools.

	Cognitive Engagement	Impactful Delivery	Empowering Capabilities
AI Tutoring	78.2	54.5	41.8
AI-Powered Simulation	45.3	39.9	40.5
AI Flashcard Generator	25.6	30.8	

*Calculated based on number of students using the tools only.

Most students reported that AI-powered learning tools can improve their understanding of concepts as these tools provide them with comprehensive and detailed explanations, as well as examples from real life situations. Students share with the AI-powered learning tools what they understand to receive personalised corrective feedback and hence identify any misconceptions in their learning. The timely and constructive feedback provided by AI-powered learning tools can empowered students to take ownership of their learning and make continuous improvements (Eden, Adeleye, & Adeniyi, 2024).

AI-powered learning tools also enabled students to save time on their revision by summarizing long passages. This helps the students to understand complicated and abstract concepts in simple language. If device and internet are available, these tools are constantly accessible 24/7, making learning more flexible and efficient.

Apart from these, students also mentioned that they manage to identify their weak areas in learning by using AI-powered learning tools. They found AI-powered learning tools beneficial in tracking and analysing their learning progress. AI-powered learning tools further increased the motivation and confidence of student in learning by allowing them to delve deeper into the content, solving more difficult questions. This could be attributed to the ability of AI-powered learning tools in breaking down complex concepts into simpler components, providing various explanations, visual representations, and guided problem-solving steps tailored to different learning styles (Abisoye, 2024). Students with inward-focus personality find it comfortable to explore knowledge through these AI-powered learning tools as these learning platforms required minimal social interaction and frequently providing positive, non-judgemental responses.

Nonetheless, about 20% of the students prefer to learn through conventional learning method. They prefer to prepare their own notes and obtain physical learning supports from friends and lecturers.

Investigations were also carried out to identify the challenges faced by students as they explore the AI-powered learning tools. Figure 1(a) demonstrates the difficulties faced by our students in using AI-powered learning tools and the improvements or features that students would like to have in these tools as depicted in Figure 1(b). Some students were concerned about the accuracy and reliability of the information provided by AI-powered learning tools as they have limited background knowledge to access the information. Some of them ended up with longer revision time as they surf through more websites to confirm the validity of the information.

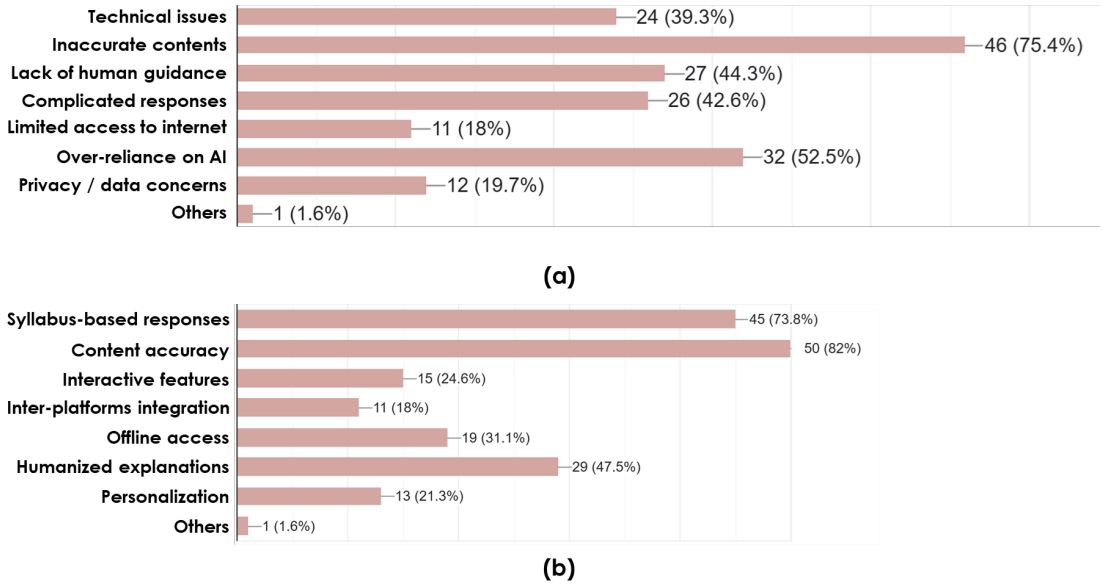


Figure 1: Challenges faced by AI-powered learning tools' users. (a) Common difficulties encountered; (b) Suggested solutions and improvements.

Most students found navigating the AI-powered learning tools are easy and intuitive, even though some of them were using the tools for the first time. Despite the challenges in using AI-powered learning tools, these learning tools continue to be favourably received as 73.7% of the students has indicated that they will continue to use these tools for future revisions and assessment preparation. 65.6% students would recommend AI-powered learning tools to their peers.

Conclusion

Since the implementation of artificial intelligence technology in education, learning has transformed from pre-AI era which relies heavily on textbook, teachers and physical library to instant knowledge acquirement using natural language queries. This study reflects the positive and negative learning experiences of students in using AI-powered learning tools. It serves as evidence to A-Level Science students' learning habits in Sunway College Johor Bahru, and may support the integration of AI into STEM (Science, technology, engineering and mathematics) education of the college. This research can be expanded and optimised in terms of duration, sample size and features of AI-powered learning tools available to solidify the results.

Acknowledgement

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ID35: AI-Assisted Learning and Game-Based Strategies for Enhancing Skin Cancer and Sun Awareness in Schools

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Highlights: This holistic innovative Skin Cancer and Sun Awareness Program combined AI-assisted development of digital informative content with hands-on STEM education and the development of a custom-designed educational board game to promote health awareness among secondary school students. The project implemented NALI components: student-centered learning, outcome-based education, authentic assessment, edutainment, scenario-based learning, game-based learning, service learning, and digital technology. Students created AI-assisted videos using tools like ChatGPT, Canva AI, and CapCut, while the Bravery Quest board game, developed by CAID experts, provided an engaging platform for simulating UV protection scenarios. Together, these strategies enhanced student knowledge, behavior, and science engagement.

Keywords: Skin Cancer Awareness; AI-Assisted Learning; Game-Based Learning; Digital Health Education; STEM Education

Introduction

Skin cancer was chosen as the theme for this awareness project as it is the tenth most common cancer in Malaysia (Azizah et al., 2019). This is further supported by a rising global trend in skin cancer incidence, particularly in Asia. National statistics indicate that the highest prevalence of skin cancer occurs among the Chinese population, followed by Malays and Indians (Han et al., 2019).

Although public awareness of skin cancer exists to some degree, understanding of the link between UV radiation and skin cancer remains limited (Al-Naggar et al., 2011). This lack of understanding contributes to low awareness and inconsistent use of sun protection products among Malaysians. Previous studies among various populations in Malaysia including traffic police officers, pharmacists, and students have reported poor sunscreen usage habits, misinterpreted Sun Protection Factor (SPF) ratings, and underestimate the risks associated with UV exposure (Al-Naggar, 2013; Jufri et al., 2021; Low et al., 2021).

UV radiation is classified into two main types: Ultraviolet A (UVA) and Ultraviolet B (UVB). UVB, which is more energetic and capable of causing sunburn, pigmentation, inflammation, and potentially leading to melanoma and other skin cancers. A poor understanding of UV radiation often correlates with a lack of knowledge about how to interpret the SPF listed on sunscreen products. SPF indicates the effectiveness of sunscreen in blocking UVB rays. Furthermore, the majority of respondents were unaware that UVB contributes more significantly to skin cancer development than UVA.

From an educational standpoint, this skin cancer awareness campaign also responds to declining interest in science among Malaysian students. According to the 2022 Malaysian Public Awareness Study on Science, Technology, and Innovation (STI), interest in science dropped sharply from 66.7% in 2019 to only 40% in 2022 (Izwan Abdullah, 2023). The four main reasons identified were students find science subjects difficult to understand, struggle to master the content, lack interest in science at school, and are more inclined toward non-science-related fields.

Although past studies indicate that secondary school students have a generally positive attitude toward biology, their appreciation of biology's relevance to society, self-concept in biology, enjoyment of the subject, and motivation to study biology are all at moderate levels (Gelamdin & Daniel, 2016). Students with a low self-concept in biology tend to perceive themselves as incapable of succeeding in science, which may discourage them from pursuing science-related academic and career pathways. Additionally, low motivation levels often stem from the perception that biology is a difficult subject, which negatively impacts their enjoyment and learning experience. These factors may deter students from considering professional careers in biology-related fields such as medicine, biotechnology and health sciences as the curriculum may feel disconnected from their daily experiences.

In response to these challenges, the Skin Cancer and Sun Awareness Program aims to enhance knowledge and understanding of skin cancer, the dangers of sun exposure, and the importance of incorporating sun protection practices into daily life, while also improving the interactive learning experience and increasing interest in biology among secondary school students.

Objectives

Three key objectives were established:

i. To improve students' knowledge of skin cancer and UV risks,
ii. To promote correct sunscreen, use and awareness of self-screening practices, and
iii. To stimulate interest in biology through creative STEM activities, game-based and AI-integrated learning experiences.

Novelty

This innovation is novel in its holistic, student-centered approach to science communication that blends AI tools, game-based learning, and experiential STEM education to tackle real-world health issues while enhancing digital literacy and interest in biology.

NALI Approach

The project adopted a comprehensive New Academia Learning Innovation (NALI) framework grounded in student-centered learning (SCL), integrating face-to-face instruction with interactive hands-on activities and digital technologies. It encompassed multiple pedagogical components, including authentic assessment, outcome-based education (OBE), edutainment, scenario-based learning, and game-based learning (Table 1). The project also embodied the principles of Service Learning, as students actively contributed to community health education by producing and disseminating digital content to raise awareness about skin cancer and sun safety. Their efforts not only enriched their own learning but also supported broader objectives of community engagement and public health advocacy. Therefore, the project demonstrated a clear advancement over traditional health education approaches.

Table 1: NALI model for each activity.

Method	NALI Model
Infographics & Expert Talks	Scenario-Based Learning
Hands-On Exploration (Play-Doh & UV Beads)	Student-centered learning/ Outcome-Based Education (OBE)
Game-Based Learning – *Bravery Quest*	Game-Based Learning
AI-Integrated Video Production	Authentic Assessment/ Digital Technology
Peer Teaching to Other Schools	Service Learning/ Edutainment

Research Methodology

This project was conducted in two stages. The first stage involved twenty-five Form 4 and Form 5 students from SMK Damai Jaya, who participated in a comprehensive educational intervention, which included expert-led sessions, hands-on activities, and AI-integrated video production to create a short creative video on the topics for a competition. In the second stage, four selected students from SMK Damai Jaya served as peer educators, transferring their acquired knowledge and skills on skin cancer, UV risks and sunscreen to students from SMK Mutiara Rini and SMK Sultan Ismail through a webinar and awareness videos shared on CAID's Instagram page. The students from both schools also participated in STEM-based activities, game-board challenges, and short creative video competitions to reinforce their understanding. In total, approximately 60 students across the three schools were involved in the program, supported by their respective teachers who facilitated student engagement.

i. *Infographics and Expert Talks*

The program began with the use of infographics to introduce foundational knowledge on skin anatomy, types of skin cancer, UV risk factors, and sunscreen. These sessions were facilitated by CAID experts, alongside a medical officer and a dermatologist, to strengthen students' understanding through professional insights and real-world relevance.

ii. *Hands-On Exploration of Skin Anatomy and UV Sensitivity Exploration Using UV Beads*

Students also participated in hands-on activities, including constructing skin layers using Play-Doh and conducting UV-sensitive bead experiments to explore UV radiation protection. The UV bead activity was designed to provide a visual and interactive investigation of how different materials block UV rays, based on the beads' color change when exposed to UV light. Students used 5 to 10 UV-sensitive beads arranged on a string and tested them under various conditions, including: direct sunlight (control), sunscreen with different SPF values, fabric or clothing, sunglasses, water coverage, artificial UV light (UV flashlight), and shaded environments.

As part of the scientific process, students completed worksheets in which they formulated hypotheses, recorded their observations, and analyzed results. This activity reinforced core scientific practices such as experimental design, data interpretation, and communication of findings. It also fostered experiential and OBE, aligning learning objectives with measurable outcomes like conceptual understanding and scientific literacy.

iii. *Game-Based Learning – Bravery Quest*

Bravery Quest, a board game designed by CAID experts, was used to promote awareness of skin cancer, UV protection, and healthy lifestyle practices. The game simulated real-life health scenarios, encouraging players to make decisions with health consequences. Each session involved 2 to 6 players navigating a board with:

- Positive tiles (e.g., sunscreen use, skin checks) that advanced players,
- Challenge tiles (e.g., unprotected sun exposure) with setbacks, and
- Neutral tiles offering motivational facts or quotes.

The interactive gameplay fostered engagement, critical thinking, and discussions on skin cancer prevention and early detection, supporting knowledge retention in a fun, collaborative setting.

iv. *Group Project: AI-Integrated Video Production for Science Communication*

A core highlight of the project was the integration of AI tools in the creation of student-produced videos on skin cancer and UV protection. As part of the authentic assessment strategy, students working in groups of four to five were tasked with developing informative videos that integrated scientific knowledge with digital informative content. To support this, they utilized a range of AI-powered platforms such as ChatGPT, Canva AI, CapCut, and Lumen5 for content generation, scriptwriting, narration, visual design, and video editing.

The video production process included the following components:

- Students developed video content on skin cancer and UV awareness based on the knowledge acquired during infographic, expert-led or webinar sessions. Their presentations reflected key concepts related to skin anatomy, types of skin cancer, UV radiation risks, and protective behaviors.
- Scriptwriting: Using AI tools like ChatGPT, students developed scientifically accurate.
- Design and visuals: Canva AI and similar tools were employed to create visual content, infographics, and transitions.
- Voiceover and editing: CapCut and Lumen5 assisted in voice generation, animation, and video editing.

Each group created a 1–2-minute video that synthesized their understanding of skin cancer types, UV risks, prevention strategies, and the importance of early detection. The videos were published on the official CAID Instagram platform as part of a competition initiative and served as a medium for disseminating knowledge and raising awareness about skin cancer and UV radiation among the broader public.

These videos served a dual purpose: deepening students' understanding through content creation and functioning as peer-education tools during the second phase of the project. In this stage, the videos guided students from other schools, facilitating knowledge transfer and collaboration. The process exemplified authentic assessment and fostered leadership, digital literacy, and science communication, aligning with NALI's Student-to-Student Edutainment through peer teaching and collaborative content.

v. *Assessment*

To evaluate the effectiveness of the Skin Cancer and Sun Awareness program, a combination of pre- and post-program questionnaire-based assessments was administered to participating students. The assessments were designed to measure changes in knowledge, attitudes, perceptions, and interest related to skin cancer, UV radiation, sunscreen usage, and the biology subject area.

In addition, qualitative data were collected through structured interviews to gain deeper insights into students' engagement, collaborative experiences, and overall perceptions of the program. The interviews focused on several key areas: (1) students' interest and level of involvement in the AI-integrated video competition; (2) their communication and teamwork skills during the video production process; (3) their ability to overcome challenges encountered while completing their videos; (4) the extent of their active participation in the skin cancer and sun awareness program; and (5) suggestions for improving the video competition in future iterations. Furthermore, students were asked whether they would be interested in participating in similar awareness programs or competitions in the future. Whereas videos were evaluated using a rubric that emphasized content accuracy, creativity, effective communication, appropriate use of AI, audience engagements and relevance to public health messaging.

Findings and Discussion

The skin cancer and sun awareness program at SMK Damai Jaya demonstrated a measurable improvement in knowledge, attitude, and preventive practices among secondary school students. Initial pre-assessment revealed limited knowledge of skin cancer, with only 37.5% answering correctly on its prevalence and less than half identifying correct symptoms and risk factors. Sunscreen usage was inconsistent, and misconceptions such as its impact on vitamin D absorption were prevalent. Only 19.4% reported regular sunscreen use, and protective behaviours like regular skin checks and dermatology visits were low.

Following the intervention, which included educational talks, hands-on activities, and a short video competition, post-assessment findings showed significant improvement. Correct knowledge about skin cancer prevalence increase to 84%, and understanding of cancer types, risk factors, and early signs improved markedly. All participants correctly defined SPF and acknowledged sunscreen's role in preventing skin cancer. Additionally, 100% expressed intent to use sunscreen more frequently and recommend it to others, reflecting a positive shift in behaviour and peer influence.

Students' attitudes also shifted; the majority felt more confident in choosing high-SPF sunscreen and demonstrated stronger awareness of consistent application. However, gaps remained in commitment to regular dermatology visits which only 36% confirmed future intent. Notably, interest in biology increased by 35%, with more students appreciating its real-life relevance and expressing greater willingness to engage in related academic activities.

Similarly, findings from the pre-program survey among SMK Mutira Rini and SMK Sultan Ismail indicated low baseline knowledge among participants. Only 13% were aware that skin cancer is prevalent in Malaysia, and just 30% could identify the different types of skin cancer. While 87% of participants reported having used sunscreen before, only 39% applied it consistently, and most applied it only to specific exposed areas. Moreover, only 42.5% understood the function of SPF in sunscreen, and just 31.1% could recognize early warning signs of skin cancer.

Post-program results revealed substantial improvements across all areas of knowledge and attitudes. A full 100% of participants correctly answered questions on risk factors, treatability of skin cancer, and the importance of sunscreen use. There was also an increase in the intention to adopt healthy behaviors, such as regular sunscreen application and routine skin checks, as well as a willingness to recommend these practices to others.

In-depth interviews indicated that all of the students found the program enjoyable, challenging, and eye-opening in terms of skin health awareness. The program also sparked greater interest in the subject of Biology, including among students from non-science streams.

The video quality scores, ranging from 80% to 98%, reflect students' strong engagement and solid understanding of skin cancer and UV protection. High performance indicates successful integration of scientific knowledge with digital storytelling using AI tools. The variation in scores suggests differences in creativity, teamwork, and digital proficiency. Additionally, Instagram analytics showed that videos featuring practical and creative elements recorded higher engagement most notably the video by SMK Sultan Ismail, which garnered over 1,100 views and 270 likes. The use of social media proved effective in broadening the reach and impact of health awareness messages.

Overall, the program successfully enhanced student knowledge, motivation, and advocacy related to skin cancer prevention. It demonstrated the effectiveness of integrating active learning, digital communication, and peer collaboration as a holistic approach to adolescent health education. The project also holds strong potential for Service Learning if expanded into broader school or community awareness campaigns using student-produced content. In essence, the activities were designed to cultivate scientific literacy, digital competency, and proactive health behaviors while fully embracing the pedagogical and technological pillars of the NALI framework.

Achievements

1. The Skin Cancer and Sun Awareness Project received a 5-Star Community Project Rating in 2024.
2. The project developed a copyrighted Skin Cancer and Sun Awareness Toolkit with strong commercialization potential for schools and public health campaigns.
3. The project received national media attention and was featured in The Star news article on 29 Oct 2024.

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ID36: Transforming Theory-based Courses: An AI-Supported, Student-Driven Learning Model

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Highlights: This innovation introduces an AI-assisted, student-centred learning model for theory-based courses. Instead of relying on traditional content delivery teaching methods, this innovation suggests students can actively contribute ideas on subtopics, which can be developed into learning materials through AI chatbots. Students can further engage by formulating questions and employing AI-generated quizzes and case studies to foster their understanding. This approach encourages active learning, critical thinking, and personalised exploration, while highlighting the potential of AI as a learning support to enhance student engagement and learning outcomes.

Keywords: Active learning, AI-integrated learning, Student-centred approach.

Introduction

Traditional teaching methods in theory-based courses typically adopt a teacher-centred approach, wherein the lecturer being the primary source of knowledge (Wang, 2022). The standard structure involves the lecturer delivering content through lectures, followed by group activities or discussions, and concluding with tutorials or case studies to reinforce understanding. While this method provides structured guidance, it often leads to passive learning, as students rely heavily on the lecturer for information and have limited opportunities to engage actively with the content. Consequently, this approach may restrict the development of critical thinking, creativity, and student ownership of the learning process (Ukwandu et al., 2025).

With the rapid advancement of technology and the increasing emphasis on student-centred learning today, there is a growing need to transform traditional pedagogical methods (Hidayat-ur-Rehman & Ibrahim, 2024). Passive content delivery alone is insufficient to promote critical thinking, problem-solving, and independent learning skills, which are essential for today's learners.

Objectives

To address this gap, the present innovation proposes an AI-supported, student-driven learning model designed to foster active participation of students in teaching content development. By integrating AI chatbots into the teaching process, students are encouraged to explore, question, and co-create learning materials, thereby facilitating a more engaging, interactive, and personalised learning experience (Wang et al., 2025).

The proposed AI-supported learning model consists of six key steps. First, the lecturer introduces a topic outline to give students an overview of the subject. Second, students are invited to share their initial opinions, ideas, or questions about the subtopics, which encourages active participation from the very beginning. Third, an AI chatbot generates detailed explanations and learning content based on student input, enabling the co-construction of knowledge (Wang et al., 2025). Fourth, students pose additional questions for deeper exploration (Darnell & Gopalkrishnan, 2024). Fifth, the AI chatbot offers immediate responses to these queries, supporting real-time learning and clarification. Finally, the AI chatbot produces multiple-choice questions or case studies, which are used to assess student understanding and reinforce key concepts. This iterative process encourages continuous interaction, critical thinking, and self-directed learning throughout the lesson.

NALI Approach

This learning model aligns with the NALI (New Academia Learning Innovation) framework by emphasising novelty, creativity, and student-centred learning through the integration of AI technology. The novelty of this innovation lies in its shift from traditional lecturer-led delivery to a collaborative, AI-supported environment in which students actively contribute to learning content creation (Bhojak et al., 2025). The creative application of AI chatbots as real-time learning partners enhances student engagement and facilitates deeper conceptual understanding. Moreover, the model's innovative design empowers students to drive the learning process, encourages critical questioning, and provides personalised learning pathways. Its adaptability across a variety of theory-based courses and suitability for different class sizes and levels further emphasise its potential. The anticipated outcomes include improved student motivation, strengthened critical thinking skills, and enhanced knowledge retention, demonstrating the capacity of this model to transform teaching practices within the NALI framework.

Research Methodology

Refer to Figure 1, this study adopts a student-centred, AI-supported learning model that consists of six sequential steps. First, the lecturer introduces the topic outline to provide students with a clear framework for discussion. Second, students are invited to express their ideas, prior knowledge, and opinions on the subtopics, promoting active participation and initial engagement. Third, an AI chatbot generates detailed learning content based on the students' input, enabling them to explore and verify information collaboratively (Rodway & Schepman, 2023). Fourth, students are encouraged to pose additional questions to the AI chatbot to support deeper inquiry and clarification. Fifth, the AI chatbot delivers instant, contextually relevant responses to these questions, creating an interactive, real-time learning environment. Finally, the AI chatbot automatically generates multiple-choice questions or case studies to assess students' understanding of the topic. This systematic process transforms the classroom into a dynamic, student-driven learning space, with AI as a supportive learning assistant.

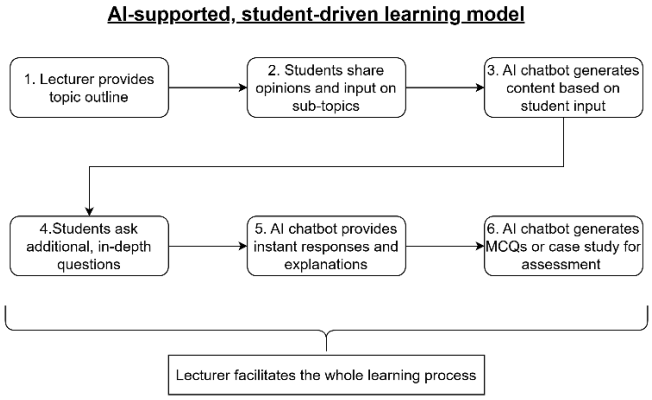


Figure 1 AI-supported, student-driven learning model

It was implemented in several theory-based classes to evaluate the effectiveness of the proposed AI-supported learning model. Upon completion of the lessons, a structured survey was distributed to 153 undergraduate students to gather their feedback and perceptions. A five-point Likert scale was used in this study, where one (1) denotes "strongly disagree" and five (5) denotes "strongly agree". The survey assessed key elements such as student engagement, perceived usefulness, critical thinking, assessment, and overall satisfaction with the learning process. The data collected from the survey provides valuable insights into the model's strengths and potential areas for refinement and wider application in future classes.

Findings and Discussion

Referring to Table 1, the survey findings reveal highly positive student perceptions of the AI-supported, student-driven learning model. In the dimension of student engagement (Bhatt & Muduli, 2024), students reported feeling more actively involved in the learning process (M = 4.14), encouraged to participate in class activities (M = 4.03), and enjoyed sharing ideas and opinions during lessons (M = 4.07). For perceived usefulness (Yeung et al., 2025), respondents agreed that the AI chatbot enhanced their understanding of content (M = 3.95), provided clear and useful explanations (M = 4.14), and effectively answered their questions (M = 3.98). The dimension of critical thinking (Schönberger, 2024) showed students felt motivated to ask more questions (M = 3.90), were encouraged to explore topics deeply (M = 4.12), and reported improved critical thinking abilities (M = 4.09). Regarding assessment (Schönberger, 2024), students valued AI-generated quizzes and case studies as helpful in testing understanding (M = 4.05), relevant and valuable for their learning (M = 4.01), and effective in reinforcing key lesson points (M = 4.03). Collectively, these results suggest that the AI model successfully enhanced student-centred learning, fostering active participation, critical inquiry, and overall satisfaction, supporting its potential as an innovative pedagogical approach (Al-Fraihat et al., 2025).

Table 1 Students' Feedback

No.	Question	Mean
	Student Engagement (Bhatt & Muduli, 2024)	
1	I felt more actively involved in the learning process using this AI-supported model.	4.14
2	The learning model encouraged me to participate more in class activities.	4.03
3	I enjoyed sharing my ideas and opinions during the lesson.	4.07
	Perceive usefulness (Yeung et al., 2025)	
4	The AI chatbot helped me understand the learning content more clearly.	3.95
5	The explanations provided by the AI chatbot were easy to understand and useful.	4.14
6	The AI chatbot was able to answer my questions effectively.	3.98
	Critical Thinking (Schönberger, 2024)	
7	I was motivated to ask more questions during the lesson.	3.90
8	This learning model encouraged me to explore the topic more deeply.	4.12
9	Using the AI chatbot improved my ability to think critically about the subject.	4.09

No.	Question	Mean
	Assessment (Schönberger, 2024)	
10	The AI-generated quizzes and case studies helped me test my understanding of the topic.	4.05
11	I found the AI-generated assessment items relevant and valuable for my learning.	4.01
12	The quizzes and case studies reinforced the key points of the lesson.	4.03
	Overall Satisfaction (Al-Fraihat *et al.*, 2025)	
13	I am satisfied with the AI-supported learning experience.	4.01
14	I want to experience more lessons using this learning model.	4.03
15	This learning approach is more engaging than traditional teaching methods.	4.00

Theoretical Contribution

This innovation extends constructivist learning theory, originally advanced by Piaget (1952) and later enriched by Vygotsky (1978), by embedding AI chatbots as a collaborative tool in the learning process. Piaget's theory positions learners as active constructors of knowledge through interaction with their environment. In contrast, Vygotsky's sociocultural theory emphasises the role of social interaction and the "zone of proximal development" in facilitating learning. By integrating AI chatbots as "more knowledgeable others", this model operationalises these principles, providing scaffolding and fostering co-construction of knowledge. The approach aligns with the NALI framework by combining active learning, personalised support, and social mediation, transforming traditionally passive theory-based courses into dynamic, student-centred environments.

Commercialisation Potential

The proposed AI-supported, student-driven learning model holds promising commercialisation potential, particularly as an innovative teaching solution for higher education institutions and corporate training providers. This model could be developed into a structured teaching framework, comprising customised AI chatbot scripts, adaptable learning templates, and comprehensive instructional guides. Such a package could be marketed to universities and training centres seeking to modernise their pedagogical approaches (Ukwandu et al., 2025). Additionally, the model may be integrated into existing Learning Management Systems (LMS) or offered as a subscription-based AI-enhanced teaching module (Al-Fraihat et al., 2025). Its versatility across various academic disciplines, particularly management and business education, increases its market appeal. Given the growing global interest in AI-enabled learning technologies, this solution presents opportunities for scaling, customisation, and commercialisation within local and international markets.

Conclusion

The AI-supported, student-driven learning model significantly advances traditional teacher-centred practices into a more interactive, student-centred pedagogy. By embedding AI chatbots into the learning process, students can co-create knowledge, engage actively with content, and develop critical thinking skills (Hidayat-ur-Rehman & Ibrahim, 2024). The survey findings underscore the positive impact of this model, with students demonstrating increased engagement, deeper understanding, and higher satisfaction with their learning experience. The AI's ability to provide instant feedback, generate personalised learning materials, and facilitate real-time assessments further enhances the educational process. This model aligns closely with the NALI framework and demonstrates considerable potential for broader implementation in diverse teaching contexts.

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ID37: Kit ExploreGeo: Pembelajaran Berasaskan Permainan dengan Integrasi Video bagi Meningkatkan Pencapaian dan Interaksi Sosial Pelajar dalam Subjek Geografi

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Sorotan: Kit ExploreGeo merupakan inovasi pembelajaran berasaskan permainan yang mengintegrasikan video pembelajaran interaktif melalui penggunaan aplikasi H5P bagi topik Arah Mata Angin dan Bearing Sudutan. Pelajar menjalankan aktiviti penerokaan berbentuk pencarian harta karun merentasi tujuh *checkpoint* dengan menggunakan peta serta bahan bantu pembelajaran untuk menyelesaikan tugasan secara berkumpulan. Setiap ahli kumpulan memainkan peranan aktif, termasuk sebagai pengawal permainan bagi menyelesaikan tugasan dan kuiz yang ditetapkan. Dua daripada *checkpoint* melibatkan penggunaan video pembelajaran sebagai panduan untuk menjawab kuiz. Kit ini menyokong pembelajaran kolaboratif, penerapan teknologi digital serta penglibatan pelajar secara aktif dalam suasana pembelajaran yang menyeronokkan dan bermakna.

Kata Kunci: Pembelajaran Berasaskan Permainan; Video pembelajaran; Teori Konstruktivisme; Interaksi Sosial; Geografi

Pengenalan

Pendidikan di Malaysia terus berkembang seiring kemajuan teknologi digital global, mendorong penggunaan alat teknologi dalam pengajaran dan pembelajaran (Othman & Mohamed, 2023). Salah satu pendekatan inovatif yang semakin mendapat perhatian ialah pembelajaran berasaskan permainan yang mengintegrasikan elemen multimedia seperti video, audio dan imej dalam persekitaran maya yang menyerupai dunia sebenar (Chen et al., 2019). Pendekatan ini bukan sahaja menyeronokkan, malah berkesan dalam membantu pelajar memahami, mempraktikkan dan menyelesaikan masalah (Assapun & Thummaphan, 2023; Budasi et al., 2020; Pramono et al., 2021).

Selain itu, video pembelajaran sebagai komponen multimedia berperanan penting dalam merangsang deria pelajar dan menyokong pemindahan maklumat ke ingatan jangka panjang (Abdulrahaman et al., 2020; Lange & Costley, 2020). Guru juga dapat mereka bentuk media pengajaran berasaskan video dengan bantuan ICT yang lebih berkesan berbanding pendekatan konvensional (Yusrizal et al., 2019). Di samping itu, interaksi sosial merupakan kemahiran abad ke-21 yang penting dan dapat dipupuk melalui permainan yang menyokong kolaborasi serta komunikasi pelajar (Hewett et al., 2020; Plass et al., 2015; Rauti et al., 2020). Oleh itu, penggabungan video pembelajaran dan pendekatan permainan sangat sesuai dalam pengajaran topik asas Geografi seperti Arah Mata Angin dan Bearing Sudutan di bawah Kurikulum Standard Sekolah Menengah (Surat Pekeliling Ikhtisas KPM Bil. 9/2016), bagi mencapai objektif kurikulum dan meningkatkan kefahaman serta interaksi sosial pelajar.

Objektif

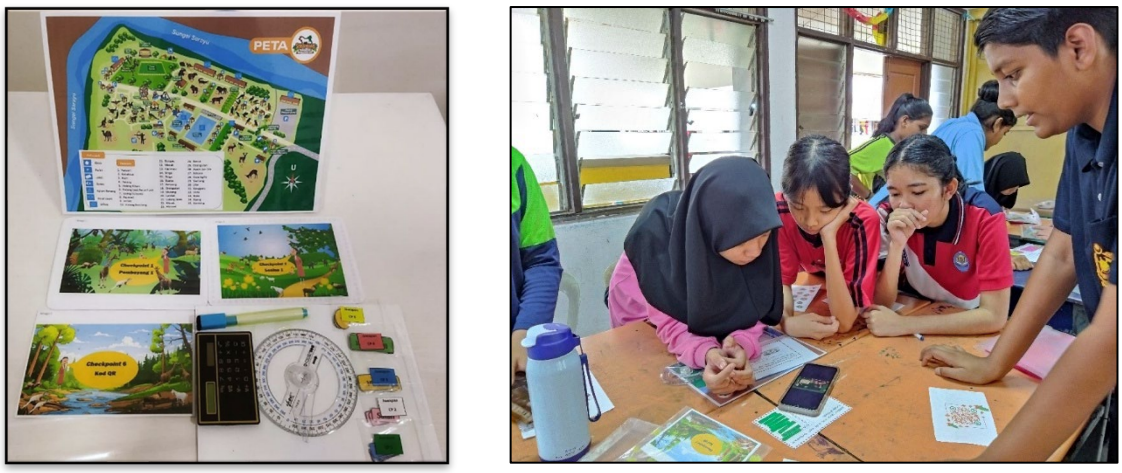
Objektif inovasi ini adalah untuk:

i. Mereka bentuk aktiviti pembelajaran berasaskan permainan yang mengintegrasikan video pembelajaran (Kit ExploreGeo) bagi pembelajaran topik Arah Mata Angin dan Bearing Sudutan bagi mata pelajaran Geografi tingkatan satu.
ii. Mengkaji kesan aktiviti pembelajaran berasaskan permainan yang mengintegrasikan video pembelajaran (Kit ExploreGeo) bagi meningkatkan pembelajaran topik Arah Mata Angin dan Bearing Sudutan bagi mata pelajaran Geografi tingkatan satu dalam aspek;
    a. Pencapaian
    b. Interaksi Sosial

Pendekatan NALI

Pendekatan *New Academia Learning Innovation Model* (NALI) yang diterapkan dalam inovasi ini menonjol dari segi keunikan, kreativiti, inovasi, kebolehgunaan dan impak terhadap pengajaran dan pembelajaran abad ke-21. Kit ExploreGeo memperkenalkan pendekatan baharu melalui integrasi video pembelajaran interaktif berasaskan H5P dengan aktiviti pembelajaran berasaskan permainan yang direka dalam bentuk pencarian harta karun merentasi tujuh *checkpoint*. Setiap *checkpoint* mengandungi tugasan yang memerlukan pelajar berfikir secara kritis, bekerjasama dan berkomunikasi secara aktif. Aspek keunikan dan kreativiti terserlah melalui penggabungan unsur permainan fizikal dan digital yang menjadikan proses pembelajaran lebih menyeronokkan, kontekstual dan bermakna. Dari sudut inovasi, kit ini bukan sahaja disesuaikan dengan kehendak Kurikulum Standard Sekolah

Menengah (KSSM), malah mengintegrasikan Teori Konstruktivisme Sosial secara langsung dalam reka bentuk aktiviti pembelajaran. Rajah 1 di bawah menunjukkan eksplorasi pelajar menggunakan Kit ExploreGeo.



Rajah 1: Eksplorasi pelajar menggunakan Kit ExploreGeo

Selain itu, Kit ExploreGeo juga menepati ciri kebolehgunaan tinggi kerana mudah dilaksanakan dalam tempoh masa 45 hingga 60 minit, tidak memerlukan ruang khas, boleh digunakan secara kendiri tanpa pengawasan guru dan lengkap dengan alat bantu seperti jangka sudut, kalkulator dan papan putih mini. Dari sudut impak, dapatan kajian membuktikan bahawa penggunaan Kit ExploreGeo memberikan peningkatan yang signifikan terhadap pencapaian akademik pelajar dan memperkukuh kemahiran interaksi sosial pelajar, khususnya dalam domain Kerjasama dan Penglibatan. Produk ini juga telah menerima pengiktirafan melalui penganugerahan *Silver Award* di SIRIS IV 2024 dan berpotensi tinggi untuk dikomersialkan secara atas talian. Secara keseluruhan, pendekatan NALI yang diterapkan dalam inovasi ini bukan sahaja menyokong amalan pedagogi berasaskan teknologi, malah turut memperkaya pengalaman pembelajaran yang lebih interaktif, reflektif dan inklusif selaras dengan keperluan pendidikan abad ke-21.

Metodologi Kajian

Kajian ini menggunakan pendekatan kuantitatif dengan reka bentuk pra-eksperimen bagi menilai kesan Kit ExploreGeo terhadap pencapaian dan interaksi sosial pelajar dalam topik Geografi Tingkatan 1: Arah Mata Angin dan Bearing Sudutan. Reka bentuk kajian yang digunakan adalah reka bentuk satu kumpulan praujian-posujian (One Group Pretest-Posttest Design) sebagaimana dicadangkan oleh Campbell dan Stanley (1963) yang membolehkan penyelidik membincangkan pencapaian pelajar sebelum dan selepas intervensi tanpa kumpulan kawalan. Pendekatan ini sesuai digunakan kerana pemilihan sampel tidak dilakukan secara rawak dan mengambil kira situasi bilik darjah sebenar.

Reka bentuk kajian ini dilaksanakan secara berfasa. Fasa I melibatkan analisis keperluan bagi mengenal pasti subtopik yang sukar dan isu pembelajaran Geografi. Fasa II memberi tumpuan kepada pembangunan instrumen kajian yang terdiri daripada ujian pencapaian dan soal selidik interaksi sosial pelajar. Fasa III pula menjalankan kajian rintis terhadap instrument kajian bagi memastikan kesahan dan kebolehpercayaan instrumen. Seterusnya, Fasa IV melibatkan reka bentuk dan pembangunan Kit ExploreGeo berasaskan model ADDIE yang merangkumi lima fasa: Analisis, Reka Bentuk, Pembangunan, Pelaksanaan dan Penilaian. Kit ini mengintegrasikan elemen pembelajaran berasaskan permainan serta video pembelajaran secara interaktif bagi meningkatkan penglibatan pelajar. Fasa V ialah pelaksanaan intervensi selama empat minggu, manakala Fasa VI menilai kesan intervensi melalui perbandingan skor pra dan pos serta soal selidik interaksi sosial pelajar.

Data dikumpul menggunakan ujian pencapaian dan instrument berkaitan interaksi sosial pelajar iaitu soal selidik interaksi sosial pelajar. Instrumen ini mengukur keberkesanan pendekatan pembelajaran berasaskan permainan yang diintegrasikan dalam Kit ExploreGeo. Data kuantitatif dianalisis untuk mengenal pasti perubahan skor pencapaian pelajar sebelum dan selepas intervensi. Soal selidik interaksi sosial pelajar diberikan kepada pelajar selepas intervensi untuk mendapatkan maklum balas refleksi berkaitan tahap interaksi sosial pelajar sepanjang pelaksanaan intervensi. Seiring dengan Teori Konstruktivisme Sosial dan pendekatan pembelajaran berasaskan permainan, reka bentuk dan pelaksanaan kajian ini dapat memberikan bukti empirik terhadap keberkesanan penggunaan Kit ExploreGeo dalam meningkatkan pencapaian akademik dan interaksi sosial pelajar dalam Geografi.

Dapatan Kajian dan Perbincangan

Hasil kajian menunjukkan bahawa penggunaan Kit ExploreGeo, iaitu pendekatan pembelajaran berasaskan permainan yang diintegrasikan dengan video pembelajaran telah memberikan kesan positif yang signifikan terhadap pencapaian akademik dan interaksi sosial pelajar dalam topik Arah Mata Angin dan Bearing Sudutan bagi

subjek Geografi Tingkatan 1. Berdasarkan ujian pra dan pos, purata markah pelajar meningkat daripada min 11.35 (SP = .354) kepada min 18.25 (SP = 5.159) daripada jumlah maksimum 27 markah. Perbandingan nilai minimum dan maksimum antara kedua-dua ujian juga menunjukkan peningkatan daripada markah minimum 2 kepada 5 dan markah maksimum daripada 20 kepada 26. Kekerapan skor dalam ujian pra menunjukkan bahawa majoriti pelajar mencatatkan skor antara 7 hingga 15 markah, manakala selepas intervensi kebanyakan pelajar mencatatkan skor antara 16 hingga 26 markah. Selain itu, analisis inferensi yang dijalankan melalui Ujian *Wilcoxon Signed-Rank* menunjukkan terdapat perbezaan yang signifikan secara statistik antara markah ujian pra dan ujian pos (Z = -3.923, p = 0.000). Keputusan ini secara jelas membuktikan bahawa intervensi pembelajaran yang dilaksanakan menerusi Kit ExploreGeo berkesan dalam meningkatkan pencapaian pelajar dalam topik yang dikaji.

Dari aspek interaksi sosial pelajar, dapatan soal selidik yang merangkumi tujuh domain utama iaitu Komunikasi, Kerjasama, Penegasan, Tanggungjawab, Empati, Penglibatan dan Kawalan Diri turut menunjukkan kesan yang positif hasil pelaksanaan intervensi. Purata keseluruhan interaksi sosial pelajar selepas pelaksanaan intervensi mencatatkan min sebanyak 1.84 dengan sisihan piawai 0.84 yang menunjukkan wujudnya variasi sederhana dalam kalangan pelajar. Jadual 1 memperincikan kesan pelaksanaan Kit ExploreGeo terhadap interaksi sosial pelajar berdasarkan tujuh domain utama yang dikaji.

Jadual 1: Kesan pelaksanaan Kit ExploreGeo terhadap interaksi sosial pelajar berdasarkan tujuh domain utama

Domain Interaksi Sosial Pelajar	Min	Sisihan Piawai
Komunikasi	1.78	0.96
Kerjasama	2.11	0.74
Penegasan	1.74	0.92
Tanggungjawab	1.89	0.85
Empati	1.41	0.86
Penglibatan	2.05	0.79
Kawalan Diri	1.80	0.78

Bedasarakan Jadual 1, analisis deskriptif menunjukkan bahawa penggunaan Kit ExploreGeo memberikan kesan yang berbeza-beza terhadap interaksi sosial pelajar mengikut domain yang dikaji. Antara domain yang menunjukkan kesan paling ketara ialah domain Kerjasama (min = 2.11; SP = 0.74), diikuti oleh domain Penglibatan (min = 2.05; SP = 0.79) dan Tanggungjawab (min = 1.89; SP = 0.85). Dalam domain Kerjasama, sebanyak 65% pelajar menyatakan mereka "amat kerap" mendengar arahan guru, manakala 50% pula "amat kerap" mematuhi arahan yang diberikan semasa aktiviti permainan dijalankan. Begitu juga dalam domain Penglibatan, 50% pelajar menjawab "kerap" dan 40% "amat kerap" bermain Kit ExploreGeo bersama rakan, sekali gus mencerminkan tahap penyertaan yang tinggi dalam kalangan pelajar. Walau bagaimanpun, domain Empati (min = 1.41) dan Penegasan (min = 1.74) mencatatkan skor min yang paling rendah. Keadaan ini menunjukkan bahawa pelajar masih memerlukan bimbingan dalam aspek kepekaan emosi dan keberanian menyuarakan pandangn. Sebagai contoh, bagi item berkaitan empati, sebanyak 40% pelajar menyatakan mereka "tidak pernah" berasa sedih apabila rakan mereka berada dalam keadaan sedih, manakala hanya 10% sahaja yang menyatakan mereka "amat kerap" menunjukkan empati dalam situasi sedemikian.

Secara keseluruhanya, dapatan kajian ini membuktikan bahawa penggunaan Kit ExploreGeo bukan sahaja berkesan dalam meningkatkan pencapaian akademik pelajar, malah turut berperanan dalam memperkukuh interaksi sosial mereka, khususnya dalam aspek Kerjasama dan Penglibatan aktif dalam pembelajaran. Namun demikian, pelaksanaan intervensi pada masa hadapan disarankan agar memberi tumpuan yang lebih khusus terhadap pemupukan empati dan keberanian menyuarakan pendapat. Pendekatan ini penting bagi memastikan keseimbangan yang holistik antara perkembangan kognitif dan sosial pelajar dapat dicapai secara menyeluruh dan berkesan.

Maklumat Lain

Produk Kit ExploreGeo mempunyai potensi pasaran yang tinggi kerana ia menawarkan pendekatan inovatif yang menggabungkan video pembelajaran interaktif H5P dengan pembelajaran berasaskan permainan yang merupakan suatu pendekatan yang masih kurang diterokai dalam konteks pengajaran Geografi di sekolah menengah Malaysia. Kit ini direka bentuk berdasarkan keperluan sebenar pengguna di sekolah dan menepati ciri kebolehgunaan yang tinggi, antaranya mudah digunakan di mana-mana lokasi, tidak memerlukan ruang besar serta boleh digunakan secara kendiri oleh pelajar tanpa pengawasan guru. Tempoh penggunaan kit hanya mengambil masa 45 minit hingga 60 minit, bersesuaian dengan dua waktu pengajaran dalam bilik darjah. Pendekatan permainan berbentuk simulasi mencari harta karun menjadikan pengalaman pembelajaran lebih menyeronokkan tanpa perlu aktiviti luar kelas yang rumit. Tambahan pula, kit ini ringan dan senang dibawa ke mana-mana dan dilengkapi dengan alat seperti jangka sudut, kalkulator, pen marker dan papan putih mini.

Malah, pada tahun 2024, inovasi bertajuk "Design and Development of ExploreGeo Kit: Integrating Social Constructivism Theory in Game-Based Learning to Enhance Geography Concept Mastery" telah dipertandingkan dalam Semarak *International Research Innovation Symposium* IV (SIRIS IV) dan berjaya meraih *Silver Award* bagi kategori Sains Sosial. Inovasi ini juga telah diterbitkan sebagai artikel dalam jurnal *Progress in Computers and Learning*, Jilid 4, Nombor 1 (2025), halaman 1-17, terbitan *Karya Ilham Publishing*. Selain itu, artikel berkaitan turut diterbitkan dalam beberapa jurnal lain seperti *Innovative Teaching and Learning Journal*, Jilid 7, Nombor 2 (2023), halaman 25 – 40 – MyCite, melalui artikel bertajuk "A Review on The Use of Video in Education: Advantages and Disadvantages" serta *International Journal of Academic Research in Progressive Education and Development*, Jilid 13, Nombor 4 (2024), halaman 2086 – 2012 – *Open Access Publishing*, dengan artikel bertajuk "A Systematic Literature Review on the Use of Technology Tools Used in Game-Based Learning". Pengiktirafan dan penerbitan ini membuktikan bahawa

Kit ExploreGeo memberikan impak yang signifikan dalam memperkasa amalan pedagogi inovatif melalui penerapan teknologi pendidikan yang efektif, khususnya dalam meningkatkan penguasaan konsep Geografi dalam kalangan pelajar sekolah menengah. Dari sudut pemasaran, produk ini berpotensi dipasarkan secara atas talian melalui platform seperti *Shopee*, *Lazada*, *Instagram*, *Facebook* dan *TikTok*, di samping melalui pameran dan promosi di sekolah-sekolah menengah. Kos pengeluaran yang rendah membolehkan produk ini dijual pada harga yang berpatutan, iaitu sekitar RM 60 hingga RM 80. Harga ini sesuai dan mampu dimiliki oleh sekolah untuk digunakan secara meluas dalam pengajaran dan pembelajaran.

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ID38: BrainBoom X: The Ultimate Card Game

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Highlights: BrainBoom is a groundbreaking innovation designed to personalise English learning for Year 2 primary pupils, addressing their diverse cultural and educational needs. By integrating fun, trendy visual cards with AI-driven interactive games, BrainBoom transforms language learning into an engaging experience aligned with CEFR standards. The playful use of nonsensical words and character combinations captures learners' interest while fostering creativity and repetition. As an inclusive tool, BrainBoom ensures equal access to quality education, supporting SDG 4 by catering to learners from varied backgrounds and promoting meaningful, enjoyable, and personalised English language development.

Keywords: Artificial Intelligence; Gamification; Learning personalization; Student-centred learning; English language teaching

Introduction

Generation Alpha (children born from the early 2010s to mid-2020s) is the first generation to grow up fully immersed in digital technology. They are often described as "born digital," using tablets and smartphones from an early age, with learning preferences that differ significantly from earlier generations. Studies show that they favor visual, interactive, and self-directed learning over linear, teacher-centered approaches, and they are highly responsive to short, engaging stimuli similar to the content they consume on social media (Cimene et al., 2024; Höfrová, 2024; Swargiary, 2024). Traditional classroom methods, which rely heavily on rote learning and passive reception, often fail to maintain their attention and motivation.

In response to these shifts, the Malaysian Ministry of Education launched the Digital Education Policy (DEP) in 2023 to accelerate the integration of digital learning tools and innovative pedagogy. This policy aims to bridge the digital divide, improve teacher readiness, and align education with the nation's move toward a knowledge-based, technology-driven economy (Ministry of Education Malaysia, 2023; Ramli & Alias, 2025). DEP's vision aligns closely with United Nations Sustainable Development Goal (SDG) 4: Quality Education, which emphasizes inclusive, equitable, and lifelong learning opportunities for all by 2030. By incorporating technology and creativity into learning, DEP supports the global effort to ensure learners acquire skills relevant to a rapidly changing world (United Nations, 2015).

BrainBoom directly addresses these educational gaps through an AI-enhanced language learning kit tailored for Generation Alpha learners. The innovation taps into trendy, playful, and autonomous learning experiences, reflecting the generation's engagement with humour and nonsensical wordplay, such as "ballerina capuccina." Pupils can combine AI-generated animal characters to create imaginative new creatures, then use these creations to practice target language content such as adjectives, verbs, and sentence construction. This approach aligns with CEFR learning outcomes prescribed in the Standards-Based English Language Curriculum (SBELC), promoting communicative competence, vocabulary expansion, and learner autonomy.

Research supports the value of visual and playful language learning for Gen Alpha. Visual aids support dual-coding theory, where information presented both verbally and visually enhances retention and recall. Morita et al. (2025) found that AI-generated visual aids improved learners' comprehension scores by 7–8% compared to text-only materials. Furthermore, allowing learners to create content fosters student agency, a core principle in 21st-century learning frameworks, and has been linked to higher engagement and intrinsic motivation (Swargiary, 2024).

The BrainBoom kit also addresses teacher workload and resource constraints, as AI-generated imagery allows rapid personalization and reduces preparation time. This capability is particularly valuable in the Malaysian context, where infrastructure and digital readiness vary between urban and rural schools (Ismail, 2025; Ramli & Alias, 2025). By leveraging AI for creativity and engagement, the innovation supports DEP's emphasis on future-ready skills, promotes SDG 4's quality education objectives, and provides a sustainable model for digital-era language learning.

In summary, BrainBoom bridges the gap between traditional instruction and Generation Alpha's digital culture. By combining AI-enhanced visuals, playful learning, CEFR-aligned language outcomes, and Malaysia's DEP framework,

the project not only improves engagement and learning outcomes but also advances SDG 4: Quality Education, ensuring that today's learners are equipped for a future that demands creativity, digital literacy, and lifelong learning.

Objectives

This extended abstract addresses the objectives of the innovation - BrainBoom, the NALI approach implemented, research methodology, anticipated findings and patent of product.

These are the objectives of BrainBoom:

i. To leverage AI-powered personalised learning tools in BrainBoom that adapt vocabulary, grammar, and reading tasks according to learners' CEFR A1–A2 progression, ensuring structured language development.
ii. To increase learner engagement and motivation in English by using AI-driven visual cards and game-based activities that align with CEFR descriptors for young learners, focusing on listening, speaking, and early reading skills.
iii. To promote inclusive and equitable language learning by utilising AI features that analyse diverse learner needs and provide differentiated activities aligned with CEFR outcomes, supporting SDG 4 (Quality Education).

NALI Approach

BrainBoom's novelty lies in its integration of playful language learning with AI-generated images to directly address the needs of Generation Alpha learners. Unlike conventional language kits that rely on repetitive drills and static flashcards, BrainBoom introduces dynamic, student-driven character creation, allowing pupils to combine multiple animal cards to invent new characters with humorous and nonsensical names. This approach is rooted in dual-coding theory, which demonstrates that learning improves when verbal and visual information are presented together. The novelty is also strengthened by its cultural alignment with digital-native learners, who respond to short, engaging, and visually rich content.

Creativity is at the core of BrainBoom's design. Pupils are given the freedom to imagine and generate whimsical animal hybrids using AI-generated character cards, which encourages creative storytelling, descriptive language, and playful vocabulary development. This hands-on process taps into Generation Alpha's preference for personalized, gamified learning experiences. From a pedagogical standpoint, BrainBoom fosters student agency by allowing learners to take ownership of content creation, shifting the teacher's role toward a facilitator of creativity rather than a sole knowledge provider. This approach is consistent with 21st-century skills frameworks, which emphasize creativity, communication, and collaboration as core competencies for future-ready learners.

BrainBoom's innovativeness lies in its synergistic use of AI technology and gamified language pedagogy. While AI is increasingly discussed in education, BrainBoom applies it in a practical and learner-centered way, using AI to instantly generate diverse visual stimuli that are adaptable to various language topics. This not only supports CEFR-based language outcomes such as vocabulary expansion and sentence construction but also reduces teacher workload by minimizing the need for time-intensive material preparation. By embedding trend-sensitive elements like humorous words, student-driven combinations, and digital imagery, BrainBoom reimagines how traditional learning kits can evolve in the digital age. In the Malaysian context, this innovation is particularly timely as it aligns with DEP's objective of fostering a creative, tech-integrated learning ecosystem, while also contributing to SDG 4's mission of equitable, high-quality education that is relevant to the 21st-century knowledge economy.

BrainBoom demonstrates broad applicability across diverse educational contexts. Its design supports primary and lower secondary language classrooms, after-school programs, and enrichment activities for learners at CEFR A2 to B1 proficiency levels. The kit can be used in both digital and low-tech environments: cards can be printed for offline settings, while AI-generated visuals and expanded character sets can be accessed online in digitally equipped classrooms. Teachers can integrate BrainBoom into lessons on adjectives, verbs, storytelling, and sentence construction, providing learners with a practical application of language in context. Additionally, its modular nature allows adaptation for other subjects, such as science, where hybrid creatures can introduce discussions about animal traits and habitats.

The potential impact of BrainBoom is multidimensional, addressing learner engagement, educational quality, and policy alignment. For learners, BrainBoom increases motivation, autonomy, and language retention, leveraging humor and visual play to enhance cognitive and emotional engagement. For teachers, it reduces material preparation time and introduces a future-ready tool that aligns with Malaysia's DEP goals of fostering innovative, technology-driven classrooms. On a systemic level, BrainBoom supports SDG 4: Quality Education by promoting inclusive, engaging, and creative learning environments that prepare learners for the demands of the digital economy. The innovation also carries long-term potential for scaling and cross-subject adaptation, allowing schools to integrate AI-assisted creativity into various domains. Ultimately, BrainBoom's impact is seen not only in enhanced language learning outcomes but also in shaping a new model of classroom innovation, where digital creativity, learner agency, and curriculum alignment intersect to create meaningful, future-ready education.

Research Methodology

This study employs a quasi-experimental intervention design to evaluate the effectiveness of the BrainBoom language learning kit in improving vocabulary, sentence construction, and learner engagement among Year 2 pupils. Pre- and post-tests, combined with observations and student feedback, will capture both academic progress and

engagement levels. A mixed-methods approach is adopted, integrating quantitative measures such as test scores and engagement ratings with qualitative insights from teacher field notes and classroom interactions.

Ninety Year 2 pupils will be purposely selected from three primary schools in Malaysia to ensure diverse representation. Parental consent will be obtained in line with Ministry of Education ethical protocols. The intervention will use the BrainBoom kit, which features AI-generated animal character cards in print and digital formats, activity sheets for naming and creating hybrid characters, and mini language tasks targeting vocabulary and simple sentence structures. Supporting instruments include CEFR-aligned pre- and post-tests, a Student Engagement Checklist, and teacher field notes.

The intervention will run for four weeks, with two weekly sessions of 40–60 minutes. Each session will include a warm-up activity, group-based BrainBoom tasks, sharing and reflection, and a mini-assessment to check vocabulary retention. Week 1 will be devoted to familiarization and baseline testing, Weeks 2–3 to the intervention activities, and Week 4 to post-testing and reflection. Teachers will facilitate activities while researchers observe engagement and interaction patterns. Free AI image generators may also be integrated to enhance creativity and visual appeal.

Data will be collected through tests, engagement checklists, and teacher field notes. Quantitative data will be analyzed using inferential statistics, while qualitative data will be thematically coded to identify patterns of engagement, creativity, and autonomy. By integrating both data types, the study will provide a comprehensive understanding of BrainBoom's potential to enhance language learning and engagement in Malaysia's diverse primary school settings.

Findings and Discussion

Table 1 displays that there are measurable improvements in terms of pupils' vocabulary, sentence construction, and development of ideas. Pre- and post-test results show statistically significant gains in vocabulary retention, sentence construction and development of ideas but also in overall language skills. These improvements contribute to better reading comprehension, as pupils are able to recognize and understand a wider range of vocabulary and sentence structures. Enhanced vocabulary and sentence formation also support pupils' writing skills, enabling them to express their thoughts more clearly and coherently. Furthermore, the development of ideas and improved language usage aid in speaking skills, as pupils gain greater confidence and fluency in articulating their thoughts. This indicates that the intervention positively impacted pupils' reading, speaking, and writing abilities.

Based on Table 2, the engagement ratings are projected to increase steadily over the four-week period. This upward trend suggests that pupils initially show growing interest and curiosity as they are introduced to the *BrainBoom* intervention. During the early stages, the novelty of the approach likely captures their attention, motivating them to participate more actively. As the weeks progress, this curiosity transforms into sustained active participation, with pupils becoming more comfortable and confident in engaging with the activities. They begin to interact more deeply with the content, demonstrating a consistent commitment to learning. By the final week, the engagement ratings reach their highest point, reflecting peak engagement and enjoyment. At this stage, pupils are not only familiar with the intervention but also find it meaningful, fun, and rewarding. The steady increase in ratings indicates that *BrainBoom* effectively maintains pupils' motivation and fosters a positive learning environment over time.

According to Table 3, the qualitative findings from teacher field notes are anticipated to reveal heightened pupils' creativity, collaboration, autonomy and motivation after the implementation of BrainBoom. One notable observation is that pupils were able to generate imaginative hybrid animal characters, showcasing their creativity and ability to think outside the box. In addition, pupils actively engaged in group-based discussions, sharing ideas, giving feedback to peers, and collaborating effectively to complete tasks. BrainBoom also encouraged pupils to take more ownership of their learning, as many took the initiative to form sentences independently without needing teacher prompts. This shift in behavior had positively impacted pupils by increasing their enthusiasm compared to regular English lessons. Pupils are noted to be more motivated and also looked forward to English lessons after the implementation of BrainBoom.

Table 1: Anticipated Pre- and Post-Test Scores (Vocabulary, Sentence Construction & Development of ideas)

Test Component	Pre-Test Mean Score (SD)	Post-Test Mean Score (SD)	Anticipated Gain
Vocabulary (20 items)	10.5 (3.2)	16.8 (2.5)	+6.3
Sentence Construction (10 sentences)	4.2 (1.6)	7.9 (1.4)	+3.7
Development of ideas (5 ideas)	7.3	10.6	+3.3

Note: Gains are expected to be statistically significant at $p < .05$ (paired t-test).

Table 2: Anticipated Engagement Ratings Over Four Weeks (Scale 1–5)

Week	Mean Engagement Rating	Anticipated Trend
Week 1	2.8	Initial adjustment period
Week 2	3.6	Increased interest & curiosity
Week 3	4.1	Sustained active participation
Week 4	4.5	Peak engagement and enjoyment

Table 3: Anticipated Themes from Teacher Field Notes

Theme	Description of Anticipated Observation
Creativity	Students generate imaginative hybrid animal characters.
Collaboration	Pupils engage actively in group-based discussions.
Autonomy	Students take initiative in forming sentences independently.
Motivation	Increased enthusiasm compared to regular English lessons.

Overall, the anticipated findings suggest that the BrainBoom kit will effectively enhance vocabulary learning, sentence construction skills, and development of ideas which will indirectly improve in their English language skills. The integration of visual, game-based tasks is expected to foster both cognitive and affective gains, positioning BrainBoom as a practical and innovative tool for enriching English language learning in Malaysian primary schools.

Other Information

BrainBoom is designed to be used for Year 2 Primary ESL learners who are struggling with phonics and a lack of foundation in the English language. It is a comprehensive learning kit aimed at tackling the typical classroom boredom. BrainBoom is highly commercializable due to its visual art which stimulates the young minds and piques their interests in learning and inquiring more. This is an entirely new innovation borne from our analysis of educational issues, ready to unfold and change the education landscape across the nation. In addition, our learning kit is in the process of attaining a patent from MyIPO.

Acknowledgement

We are extremely grateful for the opportunity to represent our respective schools and institute for this year's NALI, while also expressing immense gratitude to our team members, lecturer, parents, teachers and participants who had contributed to the research and development of our innovation.

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ID39: The Personality Game: Discover, Reflect, and Connect

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Highlights: The Personality Game: Discover, Reflect, and Connect is an interactive, student-developed digital tool designed to enhance understanding of personality by incorporating multiple psychological frameworks, including the Big Five Personality Traits, the Myers-Briggs Type Indicator (MBTI), and humanistic perspectives. This innovation blends psychological learning with gamification, creating an engaging and accessible experience that reaches beyond the classroom. Through self-exploration, reflection on behavior, and connection with others, users are encouraged to internalize complex theories in a fun, interactive way. The game also supports the goals of the New Academia Learning Innovation (NALI) framework by fostering student creativity, real-world application, and immersive digital learning. As a tool for both educational and public engagement, it promotes psychological literacy and empowers learners across diverse settings.

Keywords: Personality Traits; Gamification; Big Five; MBTI; Humanistic Psychology

Introduction

Personality plays a critical role in shaping individual behavior, relationships, academic performance, career development, and overall mental well-being (Roberts et al., 2007; McCrae & Costa, 2008; Zhang & Zhou, 2023). Understanding personality is therefore a key component in psychological education and personal development. However, traditional methods of teaching and assessment, often limited to paper-and-pencil tests, may fail to engage learners or provide opportunities for personalized exploration and reflection (Schraw & Olafson, 2008). With the growing shift toward digital and experiential learning, there is a clear need for innovative, web-based tools that make psychological concepts more interactive, accessible, and meaningful (Lee et al., 2023).

To meet this need, The Personality Game: Discover, Reflect, and Connect was developed as a gamified learning innovation that promotes self-awareness while connecting psychological theory to real-life applications. It is based on the Big Five Personality Traits (OCEAN model), a widely accepted framework that categorizes personality into five dimensions: openness, conscientiousness, extraversion, agreeableness, and neuroticism (John & Srivastava, 1999). The game also acknowledges the widespread interest in other personality models, such as the Myers-Briggs Type Indicator (MBTI), which focuses on cognitive preferences, and humanistic theories, which emphasize self-growth, meaning, and individual potential (Jung, 1921; Rogers, 1961).

Recent studies highlight the effectiveness of serious games and gamification in educational and psychological contexts. Gamified tools have been shown to enhance motivation, deepen engagement, improve retention of knowledge, and even provide valid forms of assessment when thoughtfully designed (Connolly et al., 2012; Boyle et al., 2016; Wang & Nguyen, 2023). In line with the New Academia Learning Innovation (NALI) framework, this game incorporates novelty, creativity, applicability, and student empowerment, offering a more engaging and impactful alternative to conventional personality instruction.

Objectives

To foster meaningful learning and personal growth, this innovation aims to bridge psychological theory with experiential learning through game design. By leveraging gamification, it not only enhances engagement but also offers broad accessibility for both academic and public use. The objectives of The Personality Game are as follows:

i. To transform personality theory learning into an engaging, interactive experience.
ii. To design a scalable digital game applicable both in and beyond academic environments.
iii. To improve understanding of psychological traits through reflective gameplay.
iv. To promote self-discovery and peer connection through shared game results.

NALI Approach

This interactive game was created as a group project, where students collaborated to design an engaging way to help others learn about personality traits. Rather than using traditional tools like pen-and-paper tests or plain online forms, the group decided to develop a game that is fun, meaningful, and easy to understand. Throughout the project, students contributed ideas, explored psychological theories, designed the storyline, and tested the game with others. The teamwork process itself was enjoyable and educational, and the students were excited to see their ideas turn into a working product. This project aligns with the New Academia Learning Innovation (NALI) framework in the following ways:

i. ***Novelty***
The game offers a fresh way to learn about personality by placing players in relatable situations where their choices reflect their traits. It moves away from textbook-style learning and allows users to experience the theory in action.

ii. ***Creativity***
The students created unique storylines, visuals, and outcomes based on personality theory. They used creative thinking to design realistic situations, making the experience more meaningful and enjoyable for players.

iii. ***Innovativeness***
This project combines game design and psychology in a way that helps users learn by doing. It encourages interaction and reflection, turning abstract theory into something personal and practical.

iv. ***Applicability***
The game was designed using accessible and creative platforms such as Genially, Google Slides, Canva, Gamely, and other free tools. This makes it easy to use and adapt in various settings, including classrooms, training programs, public exhibitions, and outreach events. Its flexibility means it can benefit a wider audience beyond just students.

v. ***Impact on Students' Learning***
Working as a team, the students gained a deeper understanding of personality theory while also improving their collaboration and communication skills. The game allows players to reflect on their own traits, connect with others, and engage in meaningful discussions. It transforms learning into a fun and shared experience.

Research Methodology

A design-based research approach was adopted to guide the creation and improvement of the interactive personality game. This method focuses on applying theory to real-world practice through a step-by-step process. The development was carried out in four main phases:

i. ***Game Design***
The game began with mapping the Big Five personality traits; Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, to situations, questions, and possible player decisions. Each personality trait influenced how the game scenario responded to the user's choices.

ii. ***Development***
The game was built using free and accessible platforms including Genially, Google Forms, Canva, and Gamely. These tools helped the group design a visually engaging and interactive experience. Twine was used for branching narratives, while Canva and Google Slides added visual elements.

iii. ***User Testing***
To ensure the game was clear, engaging, and educational, each group's game was tested by at least 25 students in the class, including both classmates and individuals outside the respective development teams. Testers provided feedback on the ease of use, the accuracy of trait matching, and their overall learning experience.

iv. ***Refinement and Presentation***
Based on the user feedback, improvements were made to the game's language, storyline flow, and result interpretation. The final version was presented in class through a live demonstration, supported by screenshots, a brief explanation, and user reflections.

Findings and Discussion

During the user testing phase, each group's game was tested by at least 25 students in the class, including both classmates and individuals outside the respective development teams. The students, as the creators, were eager to observe how others engaged with their work and to see whether the game could genuinely enhance understanding of personality theory in a more enjoyable and interactive way.

Feedback from users revealed a high level of engagement. Many participants expressed that the interactive and storyline-based approach made learning more enjoyable compared to traditional pen-and-paper assessments. Majority of the users shared that they found the game more fun and relatable, with one commenting that it felt like "being part of a personality story" rather than just answering questions (Refer Table 1).

Table 1: Student's feedback (n=120)

Questions	Percentage (%)
Do you think this game relate to your personality? Yes	73.3%
Do you think this game engaging?	100.0%
Rating 4 to 5 stars for the games	88.8%
List of feedback	
Other feedbacks	The game more fun and relatable The game is best and interesting The game is productive

Questions	Percentage (%)
	The game is creative and interesting to play Cool game

In terms of comprehension, the post-game reflections indicated a better grasp of not only the Big Five model, but also other personality theories such as Self-Actualization and the MBTI. Users reported that the real-life scenarios helped them understand and remember the meaning of each trait and concept more clearly. They appreciated how their choices were linked to specific personality outcomes, making the theories feel more applicable to everyday life.

Another positive outcome was the social interaction sparked by the game. After playing, users often shared their results and discussed their traits with others. These conversations created opportunities for self-reflection and connection, which added value beyond individual learning.

Lastly, we found that the game has strong potential for scalability. Since it was developed using accessible and flexible tools such as Twine, Canva, Google Forms, and Gamely, it can be easily reused or modified by educators, students, or facilitators in different settings. This makes the innovation adaptable and relevant for broader educational use beyond our classroom.

Other Information

The commercialization and future expansion of this program present exciting opportunities for broader impact and sustainability. With its engaging and educational format, the program holds strong potential for integration into university orientation sessions, corporate personality development workshops, and counseling or mental health awareness campaigns. Looking ahead, development plans may include a mobile app version to enhance accessibility, the introduction of multiplayer features to assess and strengthen group dynamics, and the addition of gamified learning paths or career matching tools based on personality outcomes. Future enhancements could also explore alternative interactive approaches such as using image-based assessments, scenario-based decision-making games, or virtual simulations to help users engage more deeply with personality concepts in creative and intuitive ways.

Acknowledgement

Special thanks to the students for their commitment, teamwork, and creativity in creating, designing, and refining the game. Their efforts brought the idea to life, and the in-game visuals and screenshots helped capture the user experience and enrich the project presentation.

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ID51: From Prompt to Puzzle: Leveraging ChatGPT and Crossword Generators for Active, Gamified Learning

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Highlights: This innovation integrates generative AI (ChatGPT) with free online crossword puzzle generators to transform traditional topic review sessions into engaging, gamified learning experiences. Piloted in HRM648: Compensation and Benefits, the Prompt–Refine–Play model rapidly generated customised puzzles aligned with learning outcomes. Delivered both as in-class collaborative challenges and self-paced revision tools, the approach encouraged active participation, peer learning, and application of concepts in a playful yet purposeful format. Aligning with NALI principles, the model demonstrated its potential for enhancing motivation, knowledge retention, and engagement while being adaptable to various disciplines and educational levels.

Keywords: Crossword puzzles; ChatGPT; Gamification in education; Instructional design

Introduction

The use of AI in education has rapidly expanded, with advanced artificial intelligence technologies like OpenAI's ChatGPT gaining significant traction across various disciplines (Miah et al., 2024). This integration offers a transformative approach to traditional pedagogical practices, particularly by fostering active learning environments (Phua et al., 2025). Within this evolving landscape, this paper details an innovative pedagogical approach that leverages ChatGPT and crossword puzzle generators to foster active learning. This novel method focuses on developing a class activity that not only captivates student interest but also reinforces subject matter through an engaging and interactive format. Specifically, this paper presents the design, implementation, and evaluation of a classroom activity where ChatGPT was employed to generate content for educational crossword puzzles, thereby transforming passive review into an active, problem-solving exercise (Deep et al., 2025). Through the integration of course content into crossword puzzles, the activity employs gamification strategies to reframe revision as a playful yet purposeful challenge, stimulating learner motivation, fostering collaboration, and reinforcing subject mastery. This approach addresses the increasing demand for innovative teaching strategies that can adapt to the digital competencies of contemporary students, offering a unique blend of artificial intelligence and traditional pedagogical tools to enhance comprehension and retention (El-Seoud et al., 2023). This initiative aligns with the growing trend of integrating AI into educational frameworks to optimize student learning outcomes.

The innovation was piloted in the HRM648: Compensation and Benefits course, where it was embedded into a topic review session. Crossword puzzles generated via ChatGPT and refined by the instructor were used both as an in-class collaborative activity and as an asynchronous revision tool. Students responded positively to the course, as reflected in high scores across evaluation criteria such as clarity of content delivery, engagement in the learning process, creation of an interactive learning environment, and the lecturer's ability to present content in an engaging and intellectually stimulating manner. The activity transformed a terminology-heavy topic into an engaging challenge that created opportunities for peer learning, as students collaborated to solve clues. This course-level application demonstrates the innovation's practicality within a specific discipline while aligning with New Academia Learning Innovation (NALI) principles of student-centred, technology-enhanced, and collaborative learning.

Objectives

This innovation enhances engagement and knowledge retention in HRM648: Compensation and Benefits by transforming traditional reviews into interactive, game-based activities using ChatGPT and online crossword generators. The objectives are as follows:

i. To increase student engagement by replacing passive review sessions with collaborative, puzzle-based activities that encourage active participation and discussion.
ii. To reinforce key concepts and terminology through retrieval practice, enabling students to recall, apply, and connect course content in an engaging format.
iii. To foster peer learning and collaboration by designing activities that require students to work together, debate possible answers, and apply critical thinking in solving clues.
iv. To integrate technology-enhanced and student-centred approaches aligned with NALI principles by leveraging AI tools for content generation and online platforms for delivery.

NALI Approach

This project applies the NALI framework by transforming a lecture-heavy, terminology-intensive HRM648 topic into an AI-enhanced, student-centred learning experience. The key dimensions are as follows:

Novelty

The most novel aspect of this innovation is the integration of generative AI (ChatGPT) with online crossword puzzle generators to transform content-heavy review sessions into engaging, problem-solving activities. This dual use of AI and gamification allows for rapid development of customised puzzles aligned with course learning outcomes, offering an experience that is both academically rigorous and enjoyable for students. By embedding puzzles into a topic review session, the activity transforms passive revision into an active, collaborative process — a departure from conventional lecture-based or static quiz formats.

Creativity

Creativity is embedded in the Prompt–Refine–Play design process. Course materials were used to generate clue–answer pairs via ChatGPT, which the instructor then refined to ensure accuracy and relevance. The clues were integrated into online puzzle generators to produce both digital and printable versions, enabling multiple modes of delivery. In-class sessions encouraged collaborative problem-solving, while online access allowed students to revisit the puzzles for self-paced revision. By embedding course concepts into crossword puzzles, the activity applies gamification principles, transforming revision into a challenge-based, game-like experience that promotes motivation, sustained engagement, and deeper content retention. This flexible delivery not only accommodated different learning preferences but also created opportunities for students to engage with the material in varied and imaginative ways.

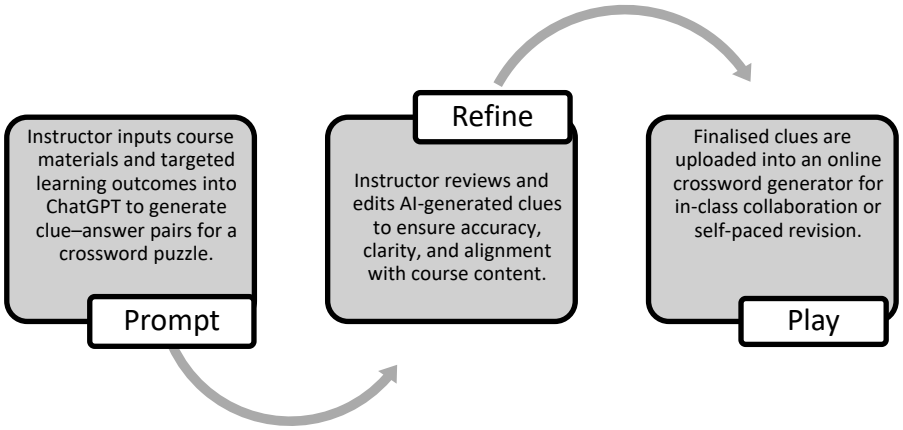


Figure 1. Prompt–Refine–Play design process

Innovativeness

The innovation departs from traditional review strategies by shifting the instructor's role from sole content creator to facilitator of AI-assisted learning experiences. The approach harnesses AI's capacity to quickly generate and adapt content, enabling puzzles to be customised for different difficulty levels, topics, and learning needs. This agility supports continuous improvement and responsiveness to student progress, while the gamified format enhances motivation and promotes deeper engagement with complex HRM concepts. The combination of advanced digital tools with active learning techniques represents a significant step forward in technology-enhanced pedagogy.

Applicability

This model is easily adaptable across disciplines where mastery of terminology and conceptual understanding is essential, such as law, medicine, engineering, and language learning. The core framework, integrating AI-driven content creation, instructor-led refinement, and gamified delivery, can be replicated in both undergraduate and postgraduate courses, as well as in professional training contexts. Because it aligns with national higher education priorities for technology-enhanced, student-centred, and outcome-based learning, the model supports broader institutional teaching innovation goals and the Malaysian Higher Education Strategic Plan.

Impact

While the crossword activity itself was not evaluated separately, overall student feedback for the HRM648 course during the semester of implementation was highly positive. Satisfaction scores ranged from 97.22% to 99.07% across teaching and learning evaluation criteria, including clarity of content delivery, engagement in the learning process, creation of an interactive environment, and lecturer's ability to deliver content in an engaging and intellectually stimulating manner. In-class observations also indicated high levels of collaboration, peer discussion, and critical thinking as students worked together to solve clues and connect them to real-world HRM contexts. This suggests that the innovation contributed to creating a more interactive, engaging, and empowering learning experience in line with NALI principles.

Research Methodology

This innovation was implemented in HRM648: Compensation and Benefits, an undergraduate Human Resource Management course offered in Semester 4 to 51 students. The aim was to enhance engagement and retention in a

terminology-heavy subject by embedding AI-assisted, gamified learning activities into topic review sessions. The design followed a Prompt–Refine–Play model: course content was used to prompt ChatGPT to generate clue–answer pairs, which were refined by the instructor for accuracy and relevance, then integrated into an online crossword generator. The resulting puzzles were delivered as collaborative in-class challenges and made available online for self-paced revision, aligning with NALI's principles of student-centred, technology-enhanced, and experiential learning. Students' feedback was measured from Students' Feedback Online (SuFO) platform, which gathers student perceptions across multiple teaching and learning dimensions.

Findings and Discussion

Analysis of SuFO responses indicated that students evaluated the course highly across multiple teaching and learning criteria, reflecting strong engagement and perceived relevance of the learning activities. While SuFO scores reflect the overall course experience, in-class observations suggest that the crossword activity directly contributed to heightened collaboration, peer discussion, and content mastery. The crossword activity promoted a dynamic learning environment where students could apply their knowledge in a novel and engaging format, thereby reinforcing comprehension and retention (Domènech, 2023). Its challenge-based structure applied gamification principles to maintain student engagement and foster a deeper understanding of the course material (Yıldız, 2023). The integration of AI-assisted crossword puzzles in HRM648: *Compensation and Benefits* demonstrated the value of combining emerging technologies with gamification strategies to enhance engagement, collaboration, and knowledge retention in a terminology-heavy subject. By applying the Prompt–Refine–Play model, the activity transformed a passive review session into a dynamic, student-centred learning experience, supported by both strong student feedback via SuFO and positive in-class observations. The approach is adaptable across disciplines and educational levels, particularly in courses requiring mastery of technical terminology or conceptual frameworks. In alignment with NALI's principles of technology-enhanced and experiential learning, this model offers educators a scalable, flexible, and time-efficient tool for enriching the learning environment and fostering deeper, more active student participation.

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ID52: Produk 'Career 24/7' Sebagai Alat Bimbingan Kerjaya Bagi Murid Sekolah Rendah Daerah Pasir Gudang

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Sorotan: Produk 'Career 24/7' bertujuan bagi memudahkan penyampaian bimbingan kerjaya dalam kalangan murid sekolah rendah. Murid *Student Leaders Board (SLB)* serta guru bimbingan dan kaunseling berperanan sebagai fasilitator bagi mengendalikan sesi bimbingan kelompok kerjaya. Produk ini mengandungi elemen AI iaitu, penggunaan kaedah robotik berserta aktiviti meneroka bidang kerjaya dengan penggunaan Myer-Briggs Type Indicator (MBTI). Myer-Briggs Type Indicator (MBTI) telah diterjemahkan dalam bahasa melayu mengikut standard pemahaman murid sekolah rendah oleh pakar bahasa seperti dilampirkan. Kaedah yang digunakan bagi menggerakkan *robort* adalah dengan menggunakan sistem '*coding*.' Produk ini berkonsepkan bermain sambil belajar. Tambahan pula, produk ini dihasilkan dengan penggunaan bahan kitar semula. Murid akan memahami personaliti kendiri dengan bidang kerjaya yang boleh diceburi pada masa akan datang. Akhir sekali, projek ini meningkatkan kefahaman hala tuju kerjaya murid sejajar dengan tema "*Accelerating innovation in teaching and learning with AI*"

Kata Kunci: Student Leaders Board (SLB); bimbingan kelompok kerjaya; fasilitator;kaedah robotik; Myer-Briggs Type Indicator;personaliti

Pengenalan

Menurut McCrindle (2019), generasi Alpha dikenali sebagai generasi milenial yang lahir setelah tahun 2010. Mereka merupakan golongan yang paling akrab dengan penggunaan internet. Bagi hasil produk 'Career 24/7' bersasarkan murid sekolah rendah yang terdiri daripada tahap 1 dan tahap dua, terutamanya murid-murid tahun 3, tahun 4, tahun 5 dan tahun 6. Produk ini dibina berdasarkan model Addie dan penggunaan model 5P ketika menguji produk ini bersama kumpulan sasaran. Sebelum menguji produk ini, maklum balas guru bimbingan dan kaunseling telah dibuat bagi melihat pendapat mereka mengenai produk ini. Berdasarkan pandangan mereka, terdapat beberapa pengubahsuaian dan penambahbaikan produk agar dapat melihat produktivitinya kelak.

Objektif

Objektif kajian ini secara umum adalah untuk memperkenalkan produk 'Career 24/7,' kepada para Guru Bimbingan dan Kaunseling serta murid sekolah rendah supaya mereka dapat mengendalikan sesi bimbingan kelompok dengan lebih berkesan.

Objektif produk 'Career 24/7,' adalah seperti berikut:

i. Menyediakan satu garis panduan bimbingan kerjaya kepada Guru Bimbingan dan Kaunseling dan murid SLB.
ii. Memahami kerjaya yang sesuai dengan diri.
iii. Meningkatkan keyakinan diri murid dari aspek jasmani, emosi, rohani, intelek dan juga sosial.
iv. Memupuk minat murid sekolah rendah dalam pelbagai bidang yang diceburi (kerjaya).
v. Membantu Guru Bimbingan dan Kaunseling dalam membina aktiviti pengajaran dan pembelajaran yang mampu menarik perhatian murid dan lebih berfokus.
vi. Mencungkil bakat murid yang intrinsik dan ekstrinsik.
vii. Membina semangat koperatif dan kolaboratif.
viii. Menggalakkan murid berfikir secara kritis, kreatif dan inovatif serta merangsang kemahiran berfikir aras tinggi dengan memikirkan jawapan teka teki yang disediakan.
ix. Menjadi garis panduan guru dengan murid dan boleh diubah suai mengikut kreativiti dan keselesaan masing masing kerana produk ini bersifat fleksibel.
x. Meluaskan penggunaan modul tanpa mengira sosio budaya serta mampu meluahkan perasaan masing-masing tanpa batasan (kaunseling silang budaya).

Pendekatan NALI

Permasalahan yang dihadapi sehingga mencetus idea bagi membina produk 'Career 24/7,' ini adalah disebabkan keperluan bahan ketika pelaksanaan bimbingan kerjaya di sekolah rendah. Dengan penggunaan bahan, barulah murid sekolah rendah akan lebih tertumpu kepada penyampaian maklumat yang diberi berbanding hanya melalui kaedah lisan. Edisi pertama NALI telah dianjurkan pada tahun 2018. Ia terdiri daripada falsafah yang berpusatkan warga pendidik dengan penggunaan pelbagai jenis bahan pembelajaran ke arah mencapai akademik

keusahawanan. Produk yang dihasilkan membantu warga pendidik dalam meningkatkan usaha mengajar dan membimbing dari askpek kemahiran menyelesaikan sesuatu permasalahan, pemikiran positif, kemahiran sosial dan mengekalkan emosi yang stabil serta kuat dalam menangani situasi yang mencabar. Dengan adanya produk ini guru bimbingan dan kaunseling berserta murid sekolah rendah dapat meningkatkan usaha penyampaian maklumat berkaitan dengan bidang kerjaya yang boleh diceburi dengan mudah dan berkesan. Aspirasi Rancangan Malaysia Kedua Belas (RMKe-12) yang menetapkan visi untuk menjadikan Malaysia sebuah negara keusahawanan yang unggul menjelang 2030. Kanak-kanak dapat meningkatkan kemahiran pendigitalan seiring dengan memahami kepentingan keusahawanan dalam diri mereka sekiranya dibimbing bermula dari sekolah rendah. Mereka akan lebih menerapkan ciri keusahawanan seperti mempunyai keyakinan diri, kreatif dan inovatif, akauntabiliti, berani mengambil risiko, kreatif dan inovatif, berupaya bekerja secara berpasukan, berkebolehan untuk menyelesaikan masalah dan mengambil keputusan segera dalam membentuk minda keusahawanan yang mantap (Nurazmaliza, 2020).

Spesifikasi Produk 'The Dreamers'

Model Inovasi (Model ADDIE : Analisis, Reka bentuk, Pembangunan, Pelaksanaan dan Penilaian)
Model ini sangat sesuai untuk membangunkan produk pendidikan yang berstruktur dan berkesan, terutamanya apabila melibatkan teknologi dan pendekatan digital. Produk 'Career 24/7,' telah direkabentuk dengan adanya liputan fasa model pengajaran ADDIE. Sebagai fasa pertama, analisis dibuat berdasarkan beberapa persoalan sejurus dengan keperluan sasaran produk, iklim pengajaran dan pembelajaran serta matlamat bimbingan yang ingin diberikan kepada murid sekolah rendah. Produk 'Career 24/7,' menjadi panduan kepada guru bimbingan dan kaunseling (GBK) dan juga membuka ruang kepada murid dalam pembelajaran praktikal menjadi seorang fasilitator bermula dari sekolah rendah. Produk ini direka bentuk atas dasar kepentingan pendedahan bidang kerjaya di Malaysia. Sejurus dengan perkara ini, penggunaan kaedah robotik digunakan agar murid sekolah rendah dapat didedahkan dengan penggunaan kecerdasan buatan *(artificial intelligence)*. Tempoh projek ini adalah selama tiga bulan. Hasil cipta robot menarik minat murid sekolah rendah dalam mengeksplorasikan pergerakannya dengan mempelajari bidang-bidang kerjaya yang boleh diceburi pada masa akan datang.

Model Pedagogi (Model 5P: Penglibatan, Penerokaan, Penerangan, Pengolahan dan Penilaian)
Model pedagogi 5P membawa penerangan bahawa individu membina penetahuan berdasarkan pengalaman. Model ini bertujuan untuk memastikan pembelajaran lebih holistik, inklusif dan berkesan, sesuai dengan keperluan murid yang berbeza latar belakang dan tahap penguasaan. Menerusi aktiviti yang disediakan, murid dapat menghubungkait pengetahuan baru dengan pengalaman. Murid dapat meneroka pelbagai perkara dengan penegtahuan baharu(Garderen, Decker, Juergensen & Abdelnaby, 2020). Model ini membantu guru bimbingan dan kaunseling serta murid *Student Leaders Board (SLB)* yang dilantik sebagai fasilitator bagi memberi pengenalan mengenai dunia kerjaya secara umum sehingga terperinci kepada kumpulan sasaran. Mereka juga akan berkongsi kandungan produk 'Career 24/7' yang meliputi penggunaan kaedah robotik. Konsep yang ingin disampaikan menerusi produk ini adalah sejajar dengan motif SLB iaitu dari murid kepada murid *(by student, for student.)* Akhir sekali, guru juga dapat menilai penglibatan murid SLB sepanjang sesi bimbingan kerjaya berlangsung.

Deskripsi Produk 'The Dreamers' dari Segi Kandungan dan Strategik pelaksanaan
Pembentukan produk berasaskan kepada:

a. Permainan robot yang menarik minat belajar murid sekolah rendah.
b. Permainan yang berkonsepkan belajar sambil bermain.
c. Reka bentuk yang bercirikan masa 'cuckoo clock' serta halangan yang perlu dihadapi sebelum bermain permainan teka teki yang disediakan.
d. Kad teka teki yang disediakan berdasarkan empat elemen Myer-Briggs Type Indicator (MBTI).
e. Soalan-soalan teka teki mengambil kira kriteria Kemahiran Berfikir Aras Tinggi (KBAT) tahap kefahaman dan aplikasi.

Langkah Pelaksanaan Modul
Satu inventori personaliti telah diubahsuai (alih bahasa) dengan mengekalkan konstruk asal instrumen untuk mengukur personaliti kanak-kanak di sekolah kebangsaan. Inventori ini telah diubahsuai berdasarkan Keirsey Temperament sorter oleh June E. Millet (310) 277-7518. Skor daripada ujian ini akan menentukan jenis personaliti kanak-kanak. Skor yang diperolehi daripada alat ujian ini akan dikira secara manual. Kemudian temperament (ciri-ciri asas dan semula jadi seseorang) akan ditentukan.

Jadual 1: Ciri utama,jenis MBTI terkait, gaya komunikasi dan tindakan *Keirsey Temperament Sorter*

Temperament	Ciri Utama	Jenis MBTI Terkait	Gaya Komunikasi & Tindakan
Artisan	Kreatif, spontan, suka kebebasan dan pengalaman langsung	ESTP, ESFP, ISTP, ISFP	Komunikasi konkrit, tindakan utilitarian (berkesan).
Guardian	Bertanggungjawab, stabil, suka struktur dan tradisi	ESTJ, ESFJ, ISTJ, ISFJ	Komunikasi konkrit, tindakan koperatif (ikut peraturan).
Idealist	Empati tinggi, introspektif, mencari makna dan hubungan mendalam	ENFJ, ENFP, INFJ, INFP	Komunikasi abstrak, tindakan koperatif.
Rational	Analitik, logik, berwawasan, fokus pada sistem dan penyelesaian masalah	ENTJ, ENTP, INTJ, INTP	Komunikasi abstrak, tindakan utilitarian.

Murid-murid yang telah menjalani ujian Keirsey Temperament Sorter akan diberi pendedahan tentang bidang kerjaya dengan produk 'Career 24/7,' yang dihasilkan. Guru Bimbingan dan Kaunseling serta murid SLB yang dilantik sebagai

fasilitator akan menggunakan modul 'Career 24/7,' yang dihasilkan berasaskan kepada temperament. Permainan dicipta khusus berdasarkan temperament iaitu, *artisan, guardian, idealist dan rational.*

Kelebihan Produk 'Career 24/7'

Produk ini menjadi garis panduan kepada Guru Bimbingan dan Kaunseling serta memudahkan urusan menyusun aktiviti bimbingan kelompok. Modul ini bersifat fleksibel kerana ianya memudahkan Guru Bimbingan dan Kaunseling serta murid SLB (fasilitator) untuk mengubah suai bentuk permainan mengikut keselesaannya berdasarkan panduan, kad-kad teka teki dan motif yang disediakan. Guru Bimbingan dan Kaunseling serta murid SLB dapat mengenal pasti dan mempelajari ciri-ciri asas dan semula jadi seseorang dengan lebih tepat. Kekuatan produk ini bergantung kepada kad teka teki dan board penerangan yang disediakan. Kad-kad teka teki yang disediakan berdasarkan empat elemen *Keirsey temperament sorter*. Permainan teka teki yang disediakan ini berupaya menarik minat murid dalam menjawab soalan serta membina semangat koperatif dan kolaboratif dan menggalakkan murid berfikir secara kritis, kreatif dan inovatif serta merangsang kemahiran berfikir aras tinggi. Aktiviti permainan dalam produk ini berupaya meningkatkan keyakinan diri murid dari aspek jasmani, emosi, rohani, intelek dan juga sosial. Di samping itu, dapat memupuk minat murid dalam pelbagai bidang yang diceburi (kerjaya).

Dapatan Kajian dan Perbincangan

Keberkesanan Produk 'Career 24/7' dalam Sesi Penerokaan Bimbingan Kelompok Murid Tahap Satu dan Tahap Dua Melalui Pemerhatian Guru Adalah amat jelas. Melalui pemerhatian, didapati murid-murid melaksanakan permainan ini dengan perasaan yang amat gembira dan seronok. Setiap murid amat responsif, koperatif dan ceria ketika bermain (100%). Dapatan daripada pemerhatian terhadap kemahiran dalam memberikan pendapat dan tingkah laku bersemangat ialah (80.3%). Dengan ini, *rappo* bersama murid dan Guru Bimbingan dan Kaunseling akan berterusan dan berkekalan selepas pelaksanaan modul kerana selepas modul ini terlaksana, terdapat hubungan yang memudahkan guru bimbingan dan kaunseling untuk memperkembangkan bakat dan personaliti seseorang murid. Namun begitu, dapatan ini menunjukan terdapat murid yang kurang proaktif (75%). Hal ini memberi isyarat bahawa kebanyakan murid memerlukan bimbingan terarah daripada Guru Bimbingan dan Kaunseling. Melalui dapatan temu bual bersama Guru Besar, Guru Bimbingan dan Kaunseling dan juga murid iaitu merangsang pemikiran, mengenal diri, pemikiran rasional dan tindak balas positif telah dikendalikan.

Jadual 2: Analisis Tingkah laku Murid Melalui Pemerhatian Guru Bimbingan dan Kaunseling

Murid	Responsif	Koperatif	Memberi Cadangan	Proaktif	Bersemangat	Ceria	Fokus
1	√	√	√		√	√	√
2	√	√	√	√	√	√	√
3	√	√	√	√	√	√	√
4	√	√	√	√		√	√
5	√	√	√		√	√	√
6	√	√		√	√	√	
7	√	√	√		√	√	√
8	√	√	√	√		√	√
9	√	√		√	√	√	√
10	√	√	√		√	√	√
11	√	√	√	√	√	√	
12	√	√		√	√	√	√
13	√	√	√	√		√	√
14	√	√	√	√	√	√	√
15	√	√	√	√	√	√	√
16	√	√	√	√	√	√	√
Peratus	**100%**	**100%**	**81.3%**	**75%**	**80.3%**	**100%**	**87.5%**

Tambahan pula, temu bual dibuat bagi melihat pandangan guru besar, guru bimbingan dan kaunseling serta murid sekolah yang disasarkan. Pandangan Guru Besar terhadap produk ini adalah, produk ini berkesan kerana dapat meningkatkan keyakinan diri Guru Bimbingan dan Kaunseling di samping aktiviti dalam modul ini memberi tindak balas yang amat positif. Beliau berpendapat, permainan ini perlu melibatkan setiap murid di sekolah, agar mereka benar-benar dapat mengenal diri. Hal ini demikian kerana, dengan mengenali diri, mereka mampu mengubah masa hadapan mereka. Beliau berpendapat, di samping murid Tahap Dua ini, murid tahap satu juga memerlukan pendedahan bagi mengenali diri lebih awal, kerana dengan mengenal diri, mampu membangkitkan semangat diri mereka untuk bersedia bagi pentaksiran dalaman sekolah yang terakhir di sekolah rendah sebelum menjejak kaki di sekolah menengah. Tuntasnya, persepsi ketiga-tiga pihak memiliki persamaan seperti diringkaskan dalam jadual di bawah.

Jadual 3: Ringkasan Analisis Persepsi Guru Besar, Guru Bimbingan & Kaunseling dan Murid Terhadap Produk 'Career 24/7'

Peserta	Tema			
	Merangsang Pemikiran	MengenalDiri	PemikiranRasional	Tindakbalas Positif
Guru Besar	√	√	√	√
Guru Bimbingan danKaunseling	√	√	√	√
Murid	√	√	√	√



Produk 'Career 24/7' ini dilaksanakan berdasarkan panduan yang telah disediakan.

Murid SLB yang terlatih, dilantik sebagai fasilitator.

Selepas murid menjawab Soalan Keirsey Temperament Sorter, murid akan diberikan peluang untuk bermain bersama fasilitator.

Langkah pertama: Pemain akan diberikan remote control kereta untuk bermain sehingga kereta berkenaan sentuh tanda buzzer yang ditunjukkan oleh fasilitator.



Langkah kedua: Murid akan dibimbing untuk bermain permainan yang bercirikan Boling.

Pemain dikehendaki menekan butang yang telah di'coding' agar dapat menjatuhkan pin.

Setelah menjatuhkan pin, murid akan diberikan peluang untuk menjawab teka-teki yang telah disediakan.





Langkah ketiga: Murid akan menjawab teka teki yang disediakan dengan memilih kad teka teki.Sebanyak 60 kad teka teki bidang kerjaya yang telah dihasilkan.

Murid akan diberikan warna pilihan dan pendedahan mengenai warna yang perlu diambil semasa bermain.

Warna tersebut, adalah berdasarkan soalan Keirsey Temperament Sorter yang murid jawab sebelum bermain.







Langkah keempat: Murid diberikan pendedahan mengenai beberapa kerjaya berdasarkan temperament yang diketahuinya.

Murid akan menekan butang kerjaya yang disediakan.

Fasilitator yang akan menerangkan tentang bidang kerjaya kepada pemain.







Tambahan: Buku Panduan disediakan bagi kegunaan guru.

Guru boleh membimbing dan menyediakan bahan berdasarkan buku panduan yang disediakan.

Bahan ini juga boleh digunakan dalam nilai pengkomerselan

Potensi Pengkomersialan

Sebanyak 608 buah sekolah rendah yang terdapat di negeri Johor. Sasaran perkomersilan produk ini adalah guru bimbingan dan kaunseling sekolah rendah. Produk 'Career 24/7' ini akan dibentangkan kepada pihak PPD dan JPN agar dapat membuat pertimbangan tentang penggunaan produk ini dalam kalangan generasi terkini. Justeru itu, pegawai berkenaan akan menilai dan dengan ada bantuan dari sektor psikologi dan kaunseling, dapat menerima galakkan daripada guru bimbingan dan kaunseling sekolah rendah. lanya akan memudahkan bagi pengkomersialan pada peringkat Negeri.

Kesimpulan

Secara keseluruhan, produk 'Career 24/7' akan menyokong untuk mencapai matlamat ketiga dari 'Sustainable Development Goals'. 'Sustainable Development Goals' adalah rangka tindakan untuk mencapai masa depan yang lebih baik dan lestari untuk semua. Pembangunan produk kerjaya yang sihat secara psikologi, dengan membantu murid mengenal pasti minat dan potensi mereka. Tambahan pula, pendidikan berasaskan personaliti dan minat, yang dapat mengurangkan tekanan akademik dan meningkatkan kesejahteraan murid sekolah rendah. Produk ini dapat membantu generasi Alpha bagi meningkatkan ilmu pengetahuan mengenai penggunaan kaedah robotik dalam meneroka personaliti yang seiring dengan bidang kerjaya. Cadangan penambahbaikannya pula, produk ini perlu dipelbagaikan lagi aktiviti dan bentuk hasilnya. Guru bimbingan dan kaunseling perlu digalakkan bagi melaksanakan Program Kerjaya di Sekolah Rendah (terutamanya, bagi murid tahap 1 dan 2 yang terdiri daripada tahun 3,4, 5 dan 6). Berdasarkan dapatan pendapat dapat disimpulkan bahawa, produk ini sangat menarik, releven, mudah difahami, mudah diakses dan juga produk ini mampu memberikan impak yang positif kepada murid sekolah rendah. Sebagai kesimpulan, produk 'Career 24/7' dapat memastikan pemahaman "Generasi Madani: Terokai STEM, Terajui Kerjaya Bertaraf Global."

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ID 53: Sirah-in-Motion

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Sorotan: Bahan bantu mengajar (BBM) ini memperkenalkan pendekatan baharu dalam pengajaran Sirah Rasulullah SAW melalui penggunaan replika interaktif yang menggabungkan elemen suara (Voice over AI), pencahayaan dan naratif visual. Inisiatif ini dibangunkan sebagai usaha menangani cabaran dalam pengajaran Sirah yang sering dianggap membosankan dan sukar difahami oleh pelajar. Meneruskan idea asas daripada pendekatan garis masa yang diperkenalkan sebelum ini, Replika Sirah-in-Motion dikembangkan bagi merangkumi pelbagai peristiwa penting dalam kehidupan Rasulullah SAW. Melalui paparan tiga dimensi dan aktiviti secara langsung (hands-on), pelajar berpeluang melihat, mendengar dan mengalami semula peristiwa sirah dengan cara yang lebih dekat dan berkesan. Lebih menarik, penjelasan terhadap perjalanan replika sirah ini akan dibantu dengan voice over AI. Pendekatan ini bukan sahaja membantu pelajar memahami fakta sirah, tetapi juga menggalakkan mereka menghayati mesej dan nilai yang terkandung dalam kisah-kisah sirah. Kaedah ini menyokong pembelajaran yang aktif, menyeronokkan dan lebih memberi kesan kepada jiwa pelajar.

Kata Kunci: Sirah; Interaktif; Replika Sirah in Motion; Voice Over AI

Pengenalan

Pendidikan Islam hari ini menjadi perhatian yang penting dalam memberikan penghayatan kepada pelajar dan Masyarakat. Justeru, bidang sirah menjadi medium yang musthaka bagi melihat al-Quran dan as-Sunnah itu diterapkan secara praktikal. Namun, yang menjadi cabaran bukan input sirah, namun kepada kaedah pengajaran sirah tersebut disampaikan. Pengajaran sirah Rasulullah SAW merupakan komponen penting dalam pendidikan Islam. Namun, kaedah pengajaran tradisional sering kali dianggap kurang menarik dan kurang mengesani dalam kalangan pelajar dan Masyarakat hari ini (Talhah Ajmain & Kamaru Salam, 2025). Sebagai tambahbaik terhadap cabaran ini, inovasi "Sirah-in-Motion" telah dibina oleh sekumpulan penyelidik dari Fakulti Sains Sosial dan Kemanusiaan, Universiti Teknologi Malaysia.

Inovasi pembelajaran ini memperkenalkan pendekatan baharu dalam pengajaran Sirah dengan membangunkan "Replika Peristiwa Rasulullah SAW", satu bahan bantu mengajar (BBM) yang menggabungkan elemen visual fizikal, penerangan naratif dan maklumat sirah yang sahih. Pendekatan ini dibina untuk memperkukuh pemahaman pelajar terhadap peristiwa penting dalam Sirah, misalnya peristiwa Hijrah yang dimulakan dahulu dalam inovasi NALI 2025 kali ini, dengan memberi penekanan kepada lokasi, perjalanan dan cabaran yang dihadapi oleh Rasulullah SAW dan para sahabat Radhiyallahhu Anhum (RA). Replika ini membolehkan pelajar menelusuri perjalanan peristiwa Sirah secara lebih nyata dan kontekstual dengan dibantu *Voice Over AI*, sekaligus memberi pengalaman pembelajaran yang bersifat ilmiah yang menarik dan mengesani.

Tujuan utama inovasi ini adalah untuk meningkatkan kefahaman pelajar terhadap kehidupan Rasulullah SAW, mendorong penggunaan teknologi, AI dan bahan visual dalam pengajaran Sirah, serta memupuk minat dan penghayatan mendalam terhadap sejarah Islam. Dengan inovasi ini, diharapkan pembelajaran Sirah tidak lagi bersifat pasif dan tekstual, sebaliknya menjadi pengalaman yang menghidupkan kembali sejarah Islam secara bermakna dalam bilik darjah.

Objektif

Inovasi ini bertujuan untuk meningkatkan pemahaman pelajar mengenai peristiwa sirah Rasulullah SAW dengan membangunkan satu bahan bantu mengajar (BBM) berbentuk *Replika Sirah Interaktif*. Pendekatan ini mempersembahkan fakta sejarah secara visual dan AI, membolehkan pelajar menelusuri perjalanan Sirah melalui paparan replika laluan, lokasi penting dan peristiwa-peristiwa utama. Objektif utama inovasi ini adalah untuk memperkukuh kefahaman pelajar terhadap konteks dan makna peristiwa dalam Sirah, menggalakkan pendekatan visual dan *voice over AI* dalam pembelajaran Sirah, serta memupuk minat dan penghayatan mendalam terhadap sejarah Islam. Melalui pengalaman pembelajaran yang bersifat fizikal, interaktif dan naratif, Replika sirah ini diharapkan dapat membantu pelajar mengaitkan fakta sejarah dengan realiti secara lebih berkesan.

Pendekatan NALI

Replika "Sirah-in-Motion" mengaplikasikan pendekatan *New Academia Learning Innovation* (NALI) dengan menggunakan peristiwa sirah yang menggabungkan visual, *3D printing*, teks dan *Voice Over AI* untuk mendengar audio. Kaedah ini menangani cabaran seperti kurangnya minat pelajar terhadap pengajaran tradisional sirah yang sering bergantung kepada buku, teks, syarahan dan hafalan tanpa pemahaman mendalam. Keunikan inovasi ini

adalah penggunaan teknologi seperti Voice over AI untuk menghubungkan pelajar kepada kandungan tambahan, sekali gus mewujudkan suasana pembelajaran yang interaktif. Kreativiti dalam penggunaan warna yang ceria dan ikon yang berbentuk *3D* yang relevan menjadikan replika interaktif sirah ini lebih menarik, memudahkan pelajar memahami peristiwa-peristiwa sejarah yang kompleks. Pendekatan ini memberikan impak yang signifikan terhadap cara pelajar berhubung dengan sirah dan juga Sejarah Islam yang lebih fleksibel dan mesra.

Metodologi Kajian

Metodologi inovasi ini melibatkan mereka bentuk dan membangunkan *Replika sirah Interaktif* berdasarkan kajian kualitatif pada pengkajian kitab tentang perjalanan kehidupan Rasulullah SAW. "Garis masa Inetraktif" yang telah dibangunkan lebih awal pada NALI 2024 telah dikembangkan lagi dalam kajian NALI 2025 kali ini dengan rujukan kitab Sirah ke atas 20 buah sumber yang diiktiraf seperti *Ar-Raheequl Makhtum* (1996); *Biografi Muhammad bin Abdullah: Perjalanan hidup seorang nabi* (2010); *Sirah Nabi Muhammad SAW: Pengajaran & pedoman* (2001); *Nurul Yakin: Kitab sirah Rasulullah SAW* (1999); *Ini sejarah kita* (2015); *Muhammad: His life based on the earliest sources* (2006); Fiqh Sirah (2008); *Al-sirah al-nabawiyyah* (2010); *As-Syamail Muhammadiah* (2014); *Kelahiran teragung Junjungan mulia Muhammad* (2019); *Kisah ringkas kehidupan Rasulullah SAW* dan karya-karya ilmiah lain. *Voice over AI* yang disertakan membolehkan Pelajar memahami dengan dibantu sumber digital tambahan.

Dapatan Kajian dan Perbincangan

Penggunaan *Replika Sirah Interaktif* telah menunjukkan peningkatan ketara dalam penglibatan pelajar serta kefahaman mereka terhadap sejarah Islam. Penyampaian kandungan pembelajaran dalam bentuk yang moden dan interaktif membantu pelajar memahami susunan peristiwa secara lebih teratur dan berkesan. Gabungan visual, elemen fizikal dan AI, maklumat berfakta menjadikan proses pembelajaran lebih menarik dan mudah difahami. Pendekatan ini turut membuka ruang kepada penambahbaikan kaedah pengajaran Pendidikan Islam, khususnya dalam menjadikan topik sirah lebih dekat di hati pelajar dan relevan dengan keperluan pendidikan masa kini.

Maklumat Lain

Bahan pengajaran ini mempunyai potensi tinggi untuk dikomersialkan, sesuai untuk sekolah, institusi pendidikan, dan pusat komuniti seperti masjid dan NGO, baik di dalam mahupun luar negara. Inovasi awal dalam bentuk "garis masa inetraktif" sebelum ini, telah menerima pengiktirafan melalui beberapa anugerah, termasuk Pingat Emas atas pelaksanaan kemahiran berfikir aras tinggi (HOTs) dalam pengajaran sirah. Inovasi kali ini yang dipanggil Sirah-in-Motion adalah lanjutan daripada kajian sebelum ini. Hasil inovasi ini juga boleh diperluaskan ke bidang pengajian Islam yang lain, menjadikan pengajaran sejarah Islam lebih menarik dan mudah capai serta mesra pengguna.

Anugerah Diterima

Gold Medal Award. Garis Masa Sirah Interaktif. New Academia Learning Innovation (NALI) 2024.

Silver Medal Award. Sirah Navigator. Virtual Innovation Competition Exhibition (VICE), 2024

Gold Medal Award. Implementation of Sirah Teaching Composition on Higher Order Thingking Skills (HOTs). Bulan Penyelidikan FSSH. 2023

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ID 54: Leading the Scene: AI-Supported Role-Play for Process Safety Learning in Chemical Engineering

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Highlights: This project transforms traditional written reports and presentations into immersive, role-based simulations inspired by real industrial accidents. Students assume key professional roles such as process engineer, safety officer, plant manager, and regulatory representative to perform HAZOP (Hazard and Operability) analyses. AI tools assist in generating realistic scripts and facilitating the exploration of root causes, consequences, and preventive measures. The assessment integrates feedback from industry professionals to enhance relevance and authenticity, while promoting ethical awareness, regulatory compliance, complex problem-solving, and a strong safety culture in chemical engineering education.

Keywords: AI-supported; role-play; process safety; HAZOP; chemical engineering

Introduction

The SMJC 4353 Process Safety and Health course aims to equip chemical engineering students with practical skills in hazard identification, risk assessment, and ethical decision-making to prevent industrial accidents. This is crucial because catastrophic incidents such as the Bhopal Gas Tragedy, BP Texas City Refinery Explosion, and Deepwater Horizon disaster have highlighted the severe human, environmental, and economic consequences of safety failures. To ensure graduates are industry-ready, engineering education must go beyond theoretical instruction and provide authentic, practice-oriented experiences in process safety and risk management (Qian et al., 2023). However, traditional assessment methods such as written reports and conventional presentations, often fail to replicate the complexity and dynamism of real-world industrial safety decision-making (Capuyan, 2025). These approaches tend to emphasize knowledge reproduction rather than fostering critical thinking, collaboration, and ethical reasoning, the major competencies that are fundamental for solving complex engineering problems and are strongly emphasized in the Engineering Accreditation Council Standard 2024 (EAC, 2024) and the graduate attributes outlined by the International Engineering Alliance (IEA, 2021). Furthermore, conventional assessments rarely capture the interdisciplinary and interactive nature of actual process safety reviews, where engineers must negotiate technical, economic, and regulatory considerations under pressure.

Objectives

To address these gaps, active learning strategies have emerged as effective alternatives for enhancing engagement, problem-solving skills, and professional readiness in engineering education. Techniques such as role-play, simulation-based training, and problem-based learning encourage students to assume professional roles, engage in decision-making, and negotiate trade-offs in a controlled environment. In chemical engineering education, studies have reported successful integration of virtual reality (VR) simulations for process safety training, where students navigate hazardous plant environments and practice emergency responses (Lampropoulos et al., 2024). Similarly, HAZOP workshops using digital simulators have shown positive outcomes in improving risk analysis skills and reinforcing process safety culture (Lee, 2022). Other innovative approaches include serious games for chemical hazard identification and accident scenario analysis, which gamify safety concepts to increase motivation and retention (Kanade et al., 2025). Despite these encouraging examples, the adoption of active learning strategies in process safety remains limited due to time constraints, lack of resources, and the high preparation workload for instructors (Neto & Amaral, 2024). This creates an opportunity for technology-enhanced solutions, particularly those leveraging Artificial Intelligence (AI), to make immersive learning experiences scalable and sustainable.

NALI Approach

Project Novelty and Innovativeness

The innovation in this project lies in transforming a traditional assessment structure into an AI-supported, immersive role-play simulation. Instead of static written reports and standard presentations, students engage in dynamic simulations that replicate industrial safety review meetings and accident investigation discussions. Students assume professional roles such as Plant Manager, Process Engineer, Safety Officer, and Regulatory Representative to collaboratively perform HAZOP (Hazard and Operability) analyses on real-world industrial accident cases. Unlike conventional methods, this strategy captures the complexity and uncertainty of real decision-making processes, requiring negotiation between conflicting objectives (safety vs. productivity), compliance with regulatory standards, and ethical accountability. The novelty is further enhanced through AI integration, which supports:

- Generation of realistic scripts and dialogues, reflecting authentic industrial communication styles; and
- Scenario customization, enabling students to explore multiple accident outcomes and root causes; and

- Prompting critical analysis, guiding learners through advanced safety considerations without overburdening instructors.

Additionally, industry expert feedback is embedded into the evaluation process, ensuring authenticity and alignment with professional expectations. This hybrid approach of AI-enhanced simulation, active learning, and professional input offers a scalable model for developing complex problem-solving, ethical reasoning, and safety leadership skills which are among the core attributes demanded by global engineering accreditation frameworks.

This innovation is underpinned by the Constructivist Learning Theory, which emphasizes that learners actively construct knowledge by engaging with meaningful, context-rich tasks rather than passively receiving information (Piaget, 1972; Vygotsky, 1978). Constructivism promotes learning environments that encourage social interaction, collaborative meaning-making, and the co-construction of knowledge through authentic, problem-based experiences. In the context of the process of safety education, this translates into assessment activities that simulate the complex and collaborative nature of real industrial settings, where engineers, managers, and regulators must work together to identify hazards, assess risks, and make critical decisions under uncertainty. This role-based engagement fosters the negotiation of diverse viewpoints, ethical reasoning, and communication skills, which are essential competencies in chemical engineering

It also aligns with Kolb's Experiential Learning Theory, which frames learning as a cyclical process of transformation through experience (Kolb, 1984). This innovation operationalizes Kolb's four stages as follows:

- Concrete experience: Students participate in AI-enhanced role-play simulations of safety review meetings or accident investigations, providing an immersive and hands-on experience.
- Reflective observation: Teams engage in structured discussions to evaluate decisions made during the role-play presentation, identifying strengths, weaknesses, and alternative strategies.
- Abstract conceptualization: Students synthesize their observations into structured analyses, such as HAZOP tables, and connect findings to theoretical frameworks of process safety, ethics, and regulatory compliance.
- Active experimentation: Students propose preventive measures, operational improvements, and safety strategies, applying conceptual knowledge to practical recommendations that are applicable for future scenarios.

The integration of AI amplifies the application of these theories by enabling adaptive, realistic, and context-sensitive simulations without imposing excessive instructor workload. AI tools generate authentic scripts, simulate diverse accident scenarios, and provide guided prompts that scaffold critical thinking and ethical decision-making. This not only ensures scalability but also personalizes the learning experience, aligning with constructivist principles of learner-centered education.

Research Methodology

The AI-supported role-play project was integrated into the 14-week SMJC 4353 Process Safety and Health course, offered to third-year undergraduate students in the Bachelor of Chemical Process Engineering program at MJIIT, UTM. Table 1 summarizes the course learning outcomes (CLOs) and assessment distribution, while Figure 1 presents the visual representation of the implementation flow.

Table 1: Mapping of CLOs to assessment components and their respective weightage for this project.

Course Learning Outcomes (COs)	Assessment Component	Marks Weightage (%)	Evaluator
CLO 2: Evaluate various hazard identification and risk assessment methods and their applications in the chemical process industry	Role-play Presentation	5	Industry Experts (GTS/PD&T, PETRONAS)
	Written Report	5	Course Instructors
CLO 4: Elaborate the functions of ethics, safety, and health in the engineering profession	Role-play Presentation	5	Industry Experts (GTS/PD&T, PETRONAS)

In the first four weeks, students built foundational knowledge of process safety, legislation, and ethics through lectures. In Week 5, groups of four were formed with diversity in gender and nationality, and each team selected a real-life industrial accident case. Members assumed specific roles such as Plant Manager, Process Engineer, Safety Officer, and Regulatory Representative to simulate an authentic safety review meeting. From Weeks 6 to 9, students prepared HAZOP analyses and engaged in weekly consultations while familiarizing themselves with AI tools for scenario planning.

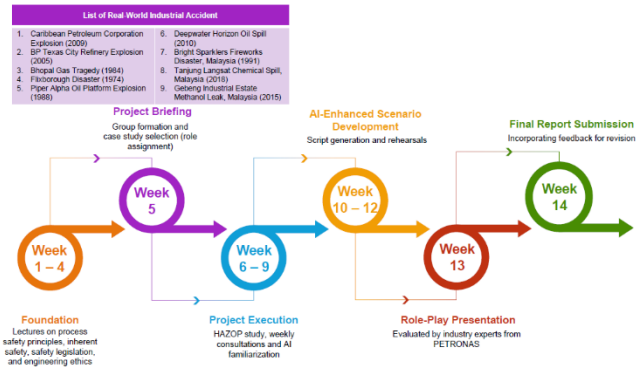


Figure 1: Overview of the AI-Assisted Role-Play Project Implementation for SMJC 4353 Process Safety and Health

During Weeks 10 to 12, teams utilized AI to generate realistic role-play scripts, prompts for hazard discussions, and communication strategies, ensuring authenticity and complexity. In Week 13, groups delivered a 15-minute role-play presentation evaluated by a panel of industry experts from Petronas, replicating decision-making processes under real-world conditions. Finally, in Week 14, students revised and submitted a written report incorporating feedback from experts and instructors. This phased approach ensured progressive learning, integrating technical knowledge, ethical reasoning, and professional communication within an AI-enhanced experiential framework.

Feedback was collected using a Google Form at the end of the semester to evaluate the implementation of the project. The survey achieved a 100 % response rate, with all 45 students (43 locals and 2 internationals) completing the questionnaire. The instrument was designed to capture insights on multiple dimensions, including students' ability to grasp real-world safety scenarios through role-play compared to traditional presentations, their use of AI tools and how these tools were applied, the need for modification of AI-generated outputs, and the perceived value of feedback from industry professionals. Additionally, students rated various aspects of the project on a 5-point scale, including learning effectiveness, the ease of completing the project with AI, the overall engagement and meaningfulness of the role-play experience, and their interest in incorporating AI tools in future projects. An open-ended question was included to identify challenges faced during the project and gather suggestions for improvement. This feedback provides important evidence of the project's effectiveness in fostering active, authentic learning experiences in chemical engineering education.

Findings and Discussion

Feedback from the students revealed overwhelmingly positive perceptions of the AI-supported role-play project in this course. A large majority (95.6 %) agreed that role-play helped them better understand real-world safety scenarios compared to traditional presentations, demonstrating the effectiveness of authentic learning experiences as supported by Constructivist theory (Piaget, 1972; Vygotsky, 1978). Students highlighted how role-play fostered deeper engagement and understanding, with comments such as "*Understanding safety stuff was way easier when we acted it out instead of just reading about it*" and "*Role-play helped me see safety decisions from different angles, something not from writing a normal report*". This aligns with research by Rezai et al. (2025) that active learning strategies enhance conceptual understanding and motivation.

A key feature of this project was the integration of AI tools, with 100 % of students confirming AI usage. Common platforms included ChatGPT, Deepseek, Claude.ai, Perplexity, and Grok, which were primarily employed for script generation, scenario development, and refining discussion points. While students valued this support, many emphasized the need for modification of AI-generated content to ensure technical accuracy and natural language. Representative comments include: "*Not all the response from AI is valid and practical*", "*AI sometimes gave very idealistic answers; we had to adjust them to fit realistic plant conditions*", and "*I changed the answer because the language is too advance for me, so I put it in my own words*". This iterative process reflects Kolb's Experiential Learning Cycle (1984), where learners transition from concrete experience to reflection and active experimentation. Overall, students rated the usefulness of AI positively, with an average score of 4.33/5 for 'AI helped me complete the project more easily', echoing recent findings that AI can enhance efficiency and creativity when integrated into project-based learning (Ruiz Viruel et al., 2025).

The involvement of industry professionals as evaluators further enriched the experience, with 95.6 % of students agreeing that their feedback reinforced the relevance of process safety to industrial practice. Comments such as "*Hearing feedback from Petronas engineers made me realize safety reviews are important*" illustrate the value of authentic assessment, consistent with previous research emphasizing the importance of linking academic exercises to real-world contexts (Chueh & Kao, 2024). Students also rated the overall learning experience highly, reporting an average of:

- 4.47/5 for 'I learned more by doing this project than from a normal assignment';
- 4.36/5 for 'The role-play project made learning fun and meaningful'; and
- 4.53/5 for 'I would like more projects that allow AI tools in future classes'.

These results confirm that active and technology-enhanced strategies not only improve learning outcomes but also increase engagement and motivation, aligning with findings by Shloul et al. (2024).

Despite the overwhelmingly positive reception, several challenges emerged during the implementation of this project. One commonly reported issue was the difficulty in effectively prompting AI tools to produce contextually accurate and technically sound outputs. Some students found the AI responses too generic or lacking depth. As one student noted, "*AI sometimes gave too generic answers, so I had to refine my prompts several times*". Another shared, "*AI answers were too idealistic and not specific to our case, so we had to make adjustments to make it sounds real*". This reflects the need for AI literacy training, focusing on crafting precise prompts and critically evaluating AI-generated content for relevance and accuracy.

In addition to AI-related issues, students highlighted challenges in group coordination and collaboration, particularly in aligning schedules and integrating individual contributions into a coherent role-play performance. Comments such as "*It was hard to find time to practice together*" and "*Some group members were less confident in speaking during the role-play*" suggest that group dynamics and equitable participation required additional support. These observations echo concerns raised in previous research on collaborative learning environments, where coordination and accountability are critical for project success (Zhang et al., 2023).

Performance anxiety during the live presentation was another recurring theme, particularly for students who were less confident in acting or public speaking. One respondent expressed, "*Roleplay is too difficult for me (I mean need to be dramatic)*" while another wrote, "*I was nervous about performing my role because I didn't want to make mistakes in front of the experts*". These findings highlight the importance of providing scaffolding for communication skills and confidence-building strategies, such as rehearsal sessions, role-play workshops, and clear expectations for professional tone rather than theatrical performance.

Collectively, these insights point to actionable improvements for future iterations of the project, including structured AI literacy support, strategies for effective group collaboration, and activities to reduce performance-related anxiety. Such enhancements would not only strengthen the implementation of AI-supported learning but also further align the project with experiential learning principles, ensuring students gain confidence and competence in applying process safety concepts in realistic professional contexts.

Project Applicability and Impact

This AI-supported role-play project demonstrates significant potential to enhance engineering education and prepare graduates for real-world challenges. By integrating authentic, scenario-based learning with AI technology, the project addresses critical gaps in traditional assessment approaches, fostering higher-order skills such as critical thinking, teamwork, ethical reasoning, and professional communication. These competencies are essential for tackling complex engineering problems, as emphasized by the EAC and IEA graduate attributes. The flexibility of this approach makes it highly adaptable beyond the Process Safety and Health course. Similar methodologies can be applied to courses requiring hazard analysis, ethical decision-making, or stakeholder engagement, such as Chemical Process Design and Environmental Engineering. Beyond chemical engineering, other engineering disciplines such as civil, mechanical, and electrical, can leverage this model to strengthen competencies related to safety management and regulatory compliance. Furthermore, its applicability extends to professional development programs and short courses aimed at cultivating a strong safety culture in industry.

Survey results confirm that this innovation has a positive impact on student engagement and learning. High satisfaction ratings and qualitative feedback indicate that students found the project both meaningful and relevant. Many highlighted how the approach enabled them to view safety issues from multiple perspectives and engage more deeply with the subject matter than traditional methods allow. The inclusion of industry professionals as evaluators strengthened the authenticity of the experience and reinforced its relevance to industrial practice. Students acknowledged that feedback from practitioners provided insights into real-world expectations, validating the skills and knowledge developed through the project.

The integration of AI was particularly valued for enhancing efficiency, while still requiring critical judgment to refine outputs for technical accuracy and realism. These experiences reflect the principles of experiential learning, where authentic tasks drive reflection, conceptual understanding, and practical application. By incorporating AI literacy into the project, students developed familiarity with emerging tools that are increasingly integrated into industrial processes. This exposure not only supports academic achievement but also equips graduates with future-ready skills aligned with the ongoing digital transformation of engineering practice. The success and scalability of this project positions it as a model for broader implementation across programs, supporting institutional strategies to integrate innovative and AI-driven pedagogies in line with the Malaysia Education Blueprint 2015-2025 (Higher Education).

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ID 55: Sahabat Maya Pelajar: Pensyarah Applications (SMa2P apps)

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Highlights: Enhancing students' performance is not a simple process. This is mirrored in the assessment results, especially particular courses that have a high failure rate. The high failure rate is defined as the proportion of students' batch who fail a subject that exceeds threshold of 25 % which deemed incapable of meeting the academic quality objective. Thus, an innovation 'Sahabat Maya Pelajar:Pensyarah' applications (SMa2P app) been introduced and integrated into the student campus life. It is crucial to improve students' performance by using digital tools as this platform able to incorporate interactive learning approaches whether inside or outside classroom activities.

Keywords: Psychomotor domain; assessment; laboratory; field

Introduction

Educators encounter several obstacles in the teaching and learning process including student attitudes, the degree of student success and the location and atmosphere of learning spaces (Sengupta, 2022). One of the greatest obstacles is to increase students' level of performance so they may earn high exam scores and most importantly be able to graduate on time (Mostafavi et al., 2021). However, difficulties may develop particularly in challenging courses which require a high level of understanding and a solid basic foundation technical knowledge. As a result, these courses are consistently exposed to a higher failure rate which ultimately results in recurrent postponement of graduation and is harmful to the image of educational institutions. In addition, this issue is one of the key sources of other difficulties such as financial and disciplinary issues that have arisen among a large number of students (Almaiah et al., 2022).

Evidently, in today's society contemporary technology is advancing at a quick rate and establishing a new, limitless platform that has influenced almost every element of modern life including education. Presently, the use of an application for teaching and learning process or even in campus life has been extensively debated and researched. According to studies, these applications were able to both improve students' learning experiences, develop their interest in relevant areas and motivation during their study period. Consequently, this might improve the teaching and learning process as well campus life and increase the productivity of educators and students (Scaringella et al., 2022).

Improving student understanding during teaching and learning activities is a difficult endeavour. It requires a high degree of commitment and constant work from both educators and learners. Educators at the elementary, secondary, and tertiary levels have employed a variety of activities and strategies to enhance students' comprehension. However, the question of student comprehension remains unanswered. This is due to the fact that each learner has a unique degree of proficiency and needs individualized attention. Therefore, it is necessary to seek solutions to guarantee that students' knowledge and motivation continue to keep growing.

'Sahabat Maya Pelajar:Pensyarah' applications (SMa2P app) are offered in two distinct versions which are for the lecturer usage and the other one is for student. These two versions are connected each other's in order to facilitate the efficient two-way communications between student and lecturer. Besides two versions, SMa2P app also been developed according to the location in the campus and academic activities inside and outside campus. SMa2P edition are SMa2P: Personal, SMa2P: Faculty, SMa2P: Class, SMa2P: Laboratory and SMa2P: Industry. All SMa2P editions are equipped with materials and functions to be adaptable in the learning and teaching process at the location. In addition, also to facilitating self-adaptation while being there. SMa2P: Personal is for personal use which tends to be a tool of self-management of life on campus and motivation. SMa2P: Faculty is for self-management while at the faculty. Meanwhile, SMa2P: Class, SMa2P: Laboratory and SMa2P: Industry are for managing the teaching and learning process while in the classroom, laboratory and undergoing industrial training respectively. This application places a great deal of focus on the efficiency of virtual and digital communication between lecturers and students, since it is one of the most important aspects in the educational teaching and learning process. In addition, it offers precise information on the performance and grade of each student thus enabling the lecturer to determine the strengths and shortcomings of all elements involves in the process.

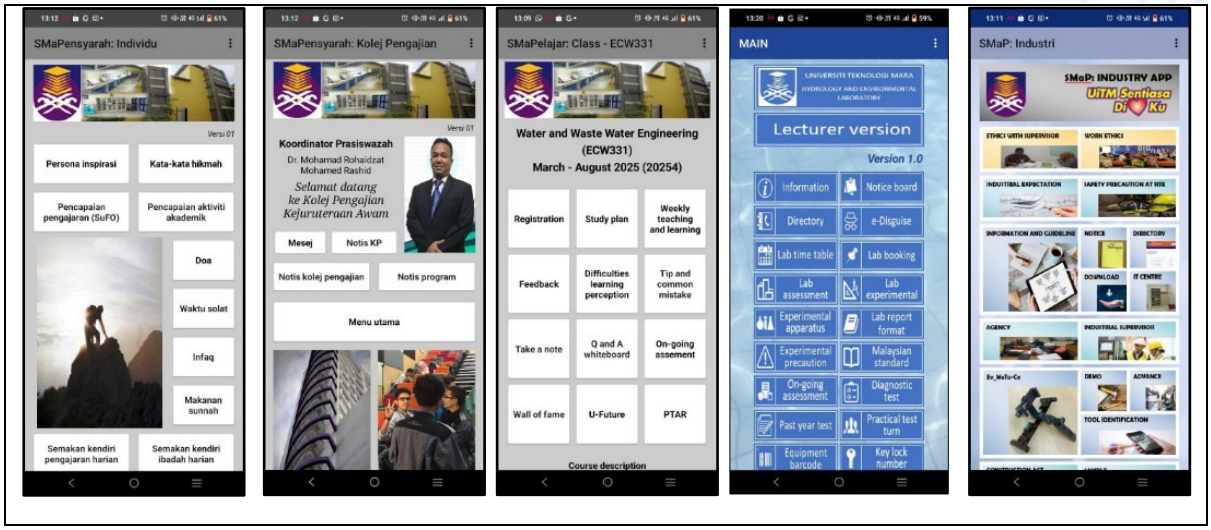


Figure 1: Main screen of 'Sahabat Maya Pelajar:Pensyarah' Applications (SMa2P apps)- SMa2P: Personal, SMa2P: Faculty, SMa2P: Class, SMa2P: Laboratory and SMa2P: Industry

Objectives

The main objective of this application was developed is to facilitate students' self-management while at campus and in the learning process throughout their studies so that an organized life with high motivation and an efficient learning process can assist their academic achievement, especially in dealing courses that have a high failure rate. Likewise, for lecturers is to facilitate the teaching process for effective teaching in assisting students in academic achievement.

NALI Approach

Novelty

An application that has been developed according to the needs of self-management and adaptation in the teaching and learning process depending on user location in campus. Versions for students and lecturers for each SMA2P edition, so that continuous communication between the two parties can be carried out to enable the effectiveness of academic activities, whether inside or outside the classroom. Several accessories for mobile phone equipment have also been developed for use in the learning and teaching process. This application is also integrated with information obtained from the faculty system which is powered by artificial intelligence (AI) algorithms.

Creativity

The creativity of this application can be seen through the integration between the editions of this application. When students or lecturers are in the campus, they only need to change the edition of the application on their mobile phone or tablet according to their location, so that they can adapt easily and the learning and teaching process could run smoothly. Relevant materials for guidance and reference from various sources are collected locally and are easily accessible. Various functions are programmed in this application to facilitate self-management at the location.

Applicability

SMa2P apps can be used by students and lecturers in any faculty at higher education institutions.

Innovativeness

Students and lecturers are no longer needed to search for various sources of material for reference or even guidance and self-management of any process while at the faculty because all the material has been placed in this application, as well as the functions for self-management. In addition, the development of two versions allows various information to be shared quickly and easily between students and lecturers for the purpose of discussion or analysis of recording data for further action including data determined by artificial intelligence (AI) algorithms. Mobile phone accessories have also been developed to facilitate the use of the application and maximize its useful functions.

Impact

After two semesters of implementation, it has contributed to several positive impacts as shown in Table 1.

Table 1: Positive impacts after implementation of SMa2P apps

Impact	Before	After	Remark
Decrease of course with high failure rate	3	0	- 3
Decrease of student failure of course with high failure rate	25 %	13 %	- 12 %
Increase of student obtained grade A in civil engineering courses	9 %	17 %	+ 8 %
Increase in Key Performance Index (KPI) academic achievement	2 out of 5 (40 %)	4 out of 5 (80 %)	+ 2 (40 %)
Increase of student confident level of teaching and learning process	4.1 (Good)	4.8 (Very good)	+ 0.7
Increase of lecturer confident level of teaching and learning process	4.3 (Good)	4.8 (Very good)	+ 0.5

Research Methodology

The first step is to determine the underlying root causes of the problem. In this study, there are four elements which considered to be key components, namely humans, strategies, equipment, and environment. Then, brain-storming sessions for identifying possible solutions that may be employed in solving causes of failure were derived. Each possible solution to address the problem's root causes via solution process analysis (pros and cons). Next, tree diagram solutions have been adapted to determine a solution proposal to the issue. Using the root cause identification approach, a tree diagram of the issue solution proposal was built to assess the merits and downsides of the offered possible solutions. It is then matched to the identified sources of the issue before a test to assess its effectiveness is conducted. The testing procedure consists of two distinct phases. The first step is to assess the solution's suitability and sufficiency for achieving its objectives. The aesthetic value and intricacy of implementation of offered solutions are the focus of the second stage. Based on the techniques, it indicates that the development of application is the most appropriate response. This is owing to the fact that applications may successfully aid students in communicating with their individual lecturer, serving as an additional learning resource and facilitating their virtual or physical learning processes. Once the proposed solution has been determined, the development of application is conducted. The application was built using an open-source platform, namely App Inventor 2 and was guided by the Software Development Life Cycle (SDLC). Last step was distributing a survey to determine the satisfaction of respondents who are using the applications. The purpose is to determine the effectiveness of the applications in achieving the objective, well-functioned and user-friendly.

Findings and Discussion

The problem of students' academic achievement in any courses, especially courses with high failure rate may be addressed if the faculty management able to identify the fundamental causes of poor student's accomplishment. In order to address previous problems, it is also possible to develop specific solution recommendations. The testing technique is required to guarantee that the chosen proposal is effective and efficient in order to assess the effectiveness of the proposed solution. Evidently, the origins of the problem have been identified, and realistic solutions have been presented, so that the issue of poor academic performance may be handled in a more systematic approach. As an alternative to overcome the issue, a SMa2P apps has been developed and proposed. The implementation of SMa2P apps has shown positive implications in academic students' performance such as lowering the number and failure rate of students. This novel learning technique not only is able to identify the poor student achievement but also can be expanded and updated from time to time as an alternative of smart and user-friendly application in the teaching and learning process also for adaptable campus life. This is important to ensure students throughout the study period at the campus is flexible in facing the challenges posed by the current Industrial Revolution 4.0 (IR 4.0) and Education Revolution 5.0 (ER 5.0) which comprehensively reinforced the learning setting through the use of digital tools.

Other Information

SMa2P apps has been granted copyright (CRLY2023J01074) and Won Best Teaching and Learning Project, UiTM National KIK Convention 2021. Gold medal at Penang International Invention, Innovation and Design 2023 (PIID 2023), UiTM and Silver medal at International Educational Design, Games, Invention and Innovation 2024 (iEDGII 2024), UiTM.

Acknowledgement

We would like to express our appreciation to the management of UiTM Johor Branch, Pasir Gudang Campus and the staff of the Faculty of Civil Engineering for their assistance and support in making this innovation project a success.

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ID 57: Psychomotor Assessment Box (PsyMentBox)

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Highlights: Two program outcomes in the diploma-level engineering curriculum focus on psychomotor domain. These two program outcomes are assessed in laboratory courses, accounting for a total of 480 marks. Despite the emphasis on psychomotor skill, discrepancies arise between students' performance and their industrial training evaluations indicated that the teaching and learning processes in laboratory courses are not effectively implemented. The primary cause of this issue is the lack of precise and systematic psychomotor domain assessments. The PsyMentBox was developed as a tool to improve assessment methods and grading rubrics while incorporating reference materials.

Keywords: Psychomotor domain; assessment; laboratory; field

Introduction

Graduates in technical fields must master the three domains of Bloom's Taxonomy—cognitive, affective, and psychomotor—to meet industry demands. A competent and competitive graduate is one who achieves all the program outcomes (POs) designed under an outcome-based education (OBE) system. This competency enables them to secure employment, advance in their careers, and succeed professionally (Romgens et al., 2019). Engineering students must master. Failing to acquire any program outcomes may negatively impact graduates, educational institutions, industries, and the nation. Graduates may struggle to secure jobs, institutions may suffer reputational damage, and industries may receive under-skilled workers, affecting productivity and national progress. Consequently, employability has become a critical issue that requires attention from employers, higher education institutions, and graduates themselves (Natalia et al., 2015).

Psychomotor domains are the domains where balance and coordination of combination between movement and thinking. Its ability refers to a wide range of actions involving physical movement related to conscious cognitive processing. Learning the domain is through demonstration of physical skills such as movement, coordination, manipulation, dexterity, grace, strength, speed and actions including fine motor skills such as use of precision instruments or tools. In contrast with cognitive and affective domain domains which developed through classroom instruction, students' psychomotor skills commonly developed in the laboratory and on site while conducting the experiments (Shahrizan et. al, 2015). Therefore, regardless of various techniques in implementing the psychomotor domain should be precisely demonstrated, a proper assessment approach also needs to be planned and carried out to ensure the students would beneficially experience from learning process.

The issue of inaccurate and unsystematic assessment must be addressed, as its persistence may result in a misalignment between graduates' skills and industry requirements. In contrast, accurate assessment enables the identification of students with weak proficiency in the psychomotor domain, allowing for the development and implementation of intervention programs to enhance their skills prior to industrial training and graduation. A mismatch between acquired skills and industry demands not only leads to the production of unskilled labour, which exacerbates unemployment, but also results in significant declines in organizational performance and reduced competitiveness (Nazron et al., 2017).

Psychomotor assessment box (PsyMentBox) comprises two primary components: a portable hardware assembled and a dedicated software suite. It incorporates a range of technological elements, including audio-visual capture devices (CCTV and body-worn cameras), data storage and transmission peripherals (memory cards and USB drives), and user interface components (monitor and mouse). This hardware configuration supports the acquisition of objective performance data. The accompanying software system provides a structured framework for psychomotor domain assessment. Instructors utilize this platform to define and input evaluation criteria, which are then algorithmically translated into quantifiable performance metrics. The integration of audio-visual recordings from the hardware component provides supplementary, objective observational data, enhancing assessment validity. Furthermore, a dedicated application manages logistical aspects of the PsyMentBox system, including equipment loan and rental, standardized setup and repackaging procedures, and inventory tracking. User access necessitates prior installation of this application. Consequently, PsyMentBox functions as a pedagogical tool, providing instructors with a standardized and reliable framework for improving the efficacy of the teaching and learning process.

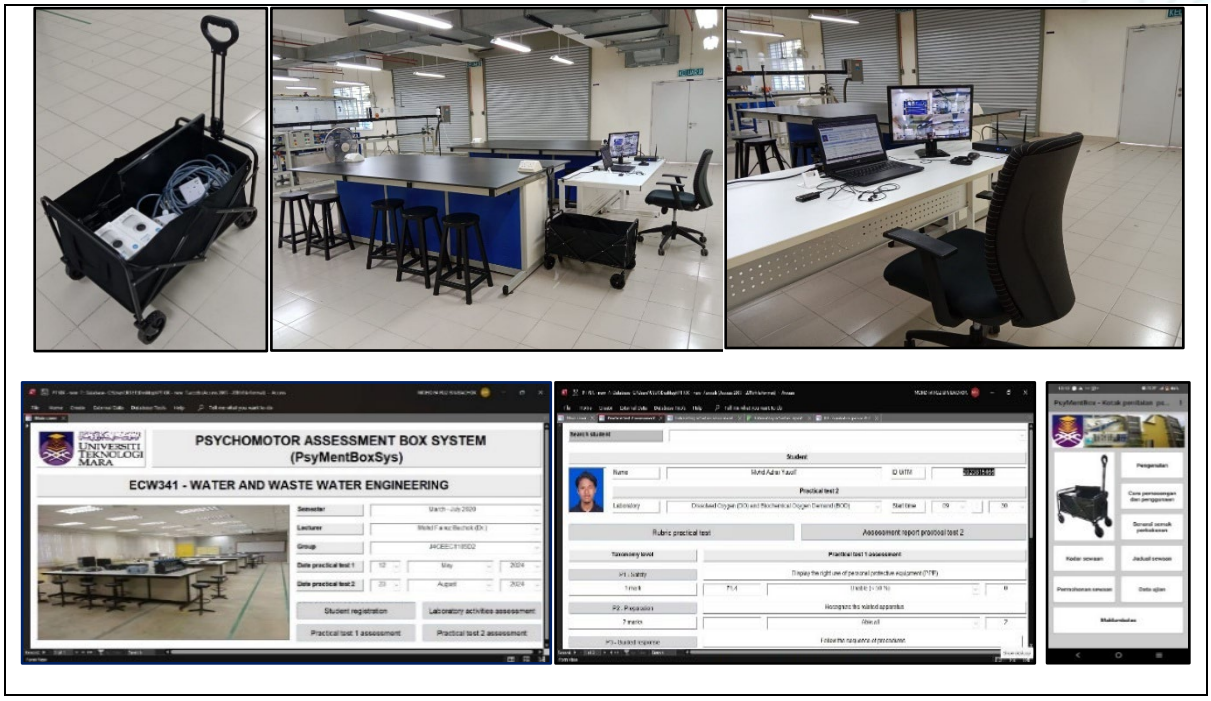


Figure 1: PsyMentBox, PsyMentBox assessment system and PsyMentBox application

Objectives

The central objective of PsyMentBox is to enhance the precision and objectivity of psychomotor skill assessment through the implementation of an objective, rubric-aligned scoring mechanism.

NALI Approach

Novelty

PsyMentBox represents a technological innovation designed to enhance the teaching and learning process for psychomotor domain assessment through the integration of specialized hardware and information technology. This system facilitates a holistic and systematic assessment approach, emphasizing refined assessment methodologies, standardized scoring rubrics, and the incorporation of objective review references. The implementation of precise psychomotor assessment techniques ensures that students are incentivized to attain the proficiency levels demanded by industry standards and sustainable national development.

Creativity

PsyMentBox introduces a series of methodological refinements to traditional psychomotor domain assessment. These refinements are articulated across three distinct domains:

i. Methodological and rubric standardization: Comparative analysis which demonstrates the systematic advantages of the PsyMentBox methodology over conventional assessment practices, specifically highlighting improvements in assessment methodologies and scoring rubric standardization.
ii. Integration of objective review references: The introduction of video-based review references constitutes a significant innovation. These recordings facilitate a comprehensive review process involving multiple stakeholders, including instructors, course coordinators, students, and potential employers.
iii. Development of supporting documentation: To ensure procedural transparency and accountability, a suite of stakeholder-specific documentation has been developed. This documentation supports the effective utilization of the review reference system.

Collectively, these enhancements contribute to the establishment of a more rigorous, objective, and transparent assessment framework for evaluating student psychomotor competencies.

Applicability

PsyMentBox was developed specifically for use by lecturers to assess students' psychomotor domains during practical tests and laboratory activities whether in the laboratory or field. This tool can be used in any higher education institutions that have technical programs.

Innovativeness

Innovativeness on assessment method and rubric which enhancement of current practice:

i. Assessment method: More than one student can be assessed at one time; students are free in the laboratory to conduct the experiments; assessment criteria are safety and health, tool identification and handling, operation procedures, data results, tidiness and reporting; lecturers assess using a simulated criteria domains score system based on via live cctv cameras and video recordings.

ii. Assessment rubric: Assessment is specific to one criterion domain only; objectively criterion domain; criterion domain assessment subjects to all parts of the experiment.

Impact

Following the implementation of PsyMentBox over two academic semesters, the primary achievement was establishment of a holistic and systematic psychomotor domain assessment framework, facilitated by enhancements to assessment methodology, scoring rubrics, and the introduction of objective review references. A comprehensive impacts assessment revealed positive outcomes for lecturers, students, and the educational institution (Table 1).

Table 1: Positive impacts after implementation of PsyMentBox

Impact	Remark
Difference in psychomotor domain assessment marks among team teaching	Decrease from 6.4 to 2.3 mark
Student PO4 and PO5 assessment by industrial supervisor	Increase from 65.2 % to 85.7 %
CSI value between laboratory with industrial supervisor assessment	Increase from 0.48 to 0.83
Conducting the psychomotor assessment	Increase from 4.0 (Good) to 4.7 (Very good)
Matching psychomotor assessment according to domain criteria	Increase from 3.4 (Moderate) to 4.8 (Very good)
Confidence level in assessing psychomotor domain	Increase from 4.5 (Very good) to 4.9 (Very good)
Saving cost	RM 4600.00
Income generation	RM 860.00

Research Methodology

The development of PsyMentBox was carried out in four phases. The first phase involved analyzing the background of the problem using the 5W1H analytical technique, ensuring a comprehensive understanding of the issue. The second phase focused on the design and development of PsyMentBox, following a step-by-step approach based on the Design Thinking quality model. This model incorporated insights from the problem's background, root causes, and current practices, serving as a guideline for prototype development and project testing. Another key objective was to ensure that PsyMentBox meets its intended goals, remains practical, and is user-friendly. The third phase of development involved the creation of supporting tools, specifically the development of a scoring simulation system and a management application. The system development was carried out using Microsoft Access, while the application was built using an open-source platform, namely App Inventor. Both developments were guided by the Software Development Life Cycle (SDLC). Subsequently, the final phase involved conducting a User Acceptance Test (UAT) to facilitate continuous improvement. The testing process, including both trial runs and pilot studies, was carried out in stages, consisting of six phases: four trial run phases and two pilot study phases.

Findings and Discussion

The implementation of PsyMentBox has yielded both economic and pedagogical benefits. Economically, the system has generated cost savings through the consolidation of assessment sessions. By enabling the simultaneous evaluation of a larger student cohort, the need for supplementary assessment sessions has been eliminated, resulting in reduced lecturer and assistant engineer time commitments, as well as decreased utility consumption (electricity and water). Furthermore, PsyMentBox presents a revenue generation opportunity through its rental, contributing to the educational center's fund for future psychomotor domain intervention programs and system expansion. Additionally, installation and re-installation fees provide supplementary income for assistant engineers and industrial training students. Pedagogically, PsyMentBox has fostered enhanced student engagement and focuses on psychomotor skill development. The holistic and specific nature of the assessment process, which necessitates both procedural knowledge and accurate equipment operation, has compelled students to strive for proficiency. The availability of detailed psychomotor domain achievement reports for potential employers has further incentivized students to excel, enhancing their employability and mitigating the need for remedial intervention programs.

Other Information

PsyMentBox has been granted copyright (CRLY2024J04503) and won Best Teaching and Learning Project, UiTM National KIK Convention 2024.

Acknowledgement

We would like to express our appreciation to the management of UiTM Johor Branch, Pasir Gudang Campus and the staff of the Faculty of Civil Engineering for their assistance and support in making this innovation project a success.

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ID 58: Papan Pemuka Pengurusan Keputusan (Tiga-P_(Keputusan))

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Sorotan: Keputusan yang dibuat oleh pihak pengurusan perlu berasaskan maklumat yang lengkap, jelas serta dipercayai bagi memastikan pengoperasian organisasi berjalan dengan efisien dan sistematik. Namun, realitinya banyak keputusan masih dibuat tanpa merujuk input yang mencukupi, sekaligus menimbulkan pelbagai isu pengurusan. Papan Pemuka Pengurusan Keputusan (Tiga_P-(Keputusan)) dibangunkan sebagai satu mekanisme sokongan pintar membuat keputusan secara bersepadu, pantas dan tepat kerana ianya direkabentuk untuk menjadi pusat operasi keputusan melalui penyediaan maklumat lengkap, pengaturcaraan input responsif bersama algoritma kecerdasan buatan (AI) dan rekod pemantauan keberkesanan keputusan. Papan pemuka ini bukan sahaja meningkatkan tahap kecekapan pengurusan, malah menjadi landasan kepada transformasi budaya kerja berasaskan data.

Kata Kunci: Papan pemuka; pengurusan; keputusan; pengoperasian; berasaskan data

Pengenalan

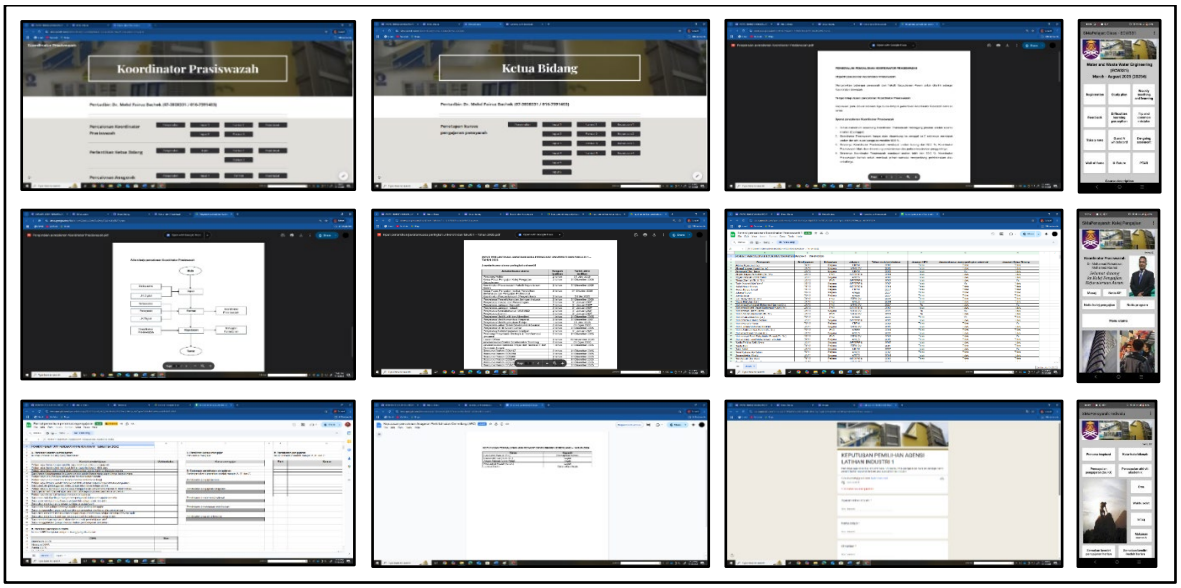
Tidak dapat dinafikan bahawa sesuatu keputusan yang berkesan adalah berpandukan kepada penekanan penggunaan data yang relevan, mengcukupi, mudah dicapai, jelas dan difahami (Mandinach & Schildkamp, 2021). Bagi organisasi dalam bidang pendidikan, data-data dapat membantu pihak organisasi memberi maklumat mengenai strategi instruksional, merancang program intervensi, sebagai penanda aras, memperkembangkan profesionalisma para pengajar, memantau pencapaian pelajar dan mempertingkatkan prestasi organisasi (Custer dll., 2018). Walaupun jelas menunjukkan bahawa keputusan berpandukan data adalah suatu mekanisma yang efektif di dalam memberikan keputusan rasional dan berkesan serta membawa pelbagai kesan kebaikan kepada organisasi, namun, pihak pentadbir organisasi sering membuat keputusan mengikut naluri dan gagal membezakan antara keputusan penting dan tidak penting. Akibatnya bukan sahaja membawa kepada kegagalan penyelesaian isu yang berlarutan tetapi juga tahap kegembiraan bekerja yang rendah di mana mendorong kepada pengurangan komitmen terhadap organisasi, penurunan prestasi bekerja, peningkatan penyelewengan dan tahap tekanan psikologi yang tinggi (Behery dll., 2018). Pentadbir organisasi yang hanya menggunakan data untuk memenuhi syarat tanpa memanfaatkannya sepenuhnya meskipun data telah tersedia adalah antara faktor yang turut menyumbang kepada keputusan yang lemah (Starkey & Eppel, 2019).

Masalah kurang keberkesanan dalam membuat sesuatu keputusan untuk pengoperasian di Fakulti Kejuruteraan Awam, UiTM Cawangan Johor, Kampus Pasir Gudang telah menimbulkan pelbagai isu yang merencatkan pengoperasian fakulti. Permasalahan ini sering dibangkitkan serta dibincangkan semasa mesyuarat fakulti. Keputusan yang sering menimbulkan situasi ketidakpuashatian di kalangan warga fakulti antaranya adalah penetapan kursus pengajaran pensyarah, perlantikan pembuat penilaian kursus, pencalonan Anugerah Perkhidmatan Cemerlang (APC), perlantikan jawatankuasa peringkat universiti dan lain-lain lagi. Penandarasan permasalahan ini telah dilakukan di Fakulti Kejuruteraan Awam di tiga kampus lain mendapati bahawa organisasi mereka turut menghadapi permasalahan yang sama. Kesinambungan dari penandarasan permasalahan, pihak fakulti mengambil tindakan lanjutan dengan menjalankan kajian tinjauan terhadap pelbagai kumpulan responden di kalangan warga fakulti. Seramai 45 orang responden dari pihak pentadbir dan ditadbir turut serta dalam tinjauan tersebut. Hasil dapatan tinjauan mendapati bahawa secara puratanya tahap kepuashatian dan kepercayaan ketelusan terhadap keputusan yang dibuat pada masa kini adalah di bawah 50 %. Manakala, Indek Kegembiraan hanya pada 62.5 % sahaja. Ini menunjukkan bahawa atmosfera situasi, keadaaan dan suasana kerja di fakulti adalah negatif dan tindakan pembetulan perlu dilakukan.

Amalan penggunaan data dan data raya di dalam membuat keputusan masih baru di Malaysia. Oleh kerana kepentingannya, penggunaan data ini telah mula meningkat di kebanyakan sektor awam sejak tahun 2013. Peningkatan ini disebabkan oleh perhatian yang diberikan oleh pihak kerajaan di dalam hasrat memodenkan sistem pendidikan negara di bawah Pelan Transformasi Digital ICT. Selain itu, ianya selaras sepertimana teras ke-8 Strategi Pendidikan Digital 2020 – 2025 iaitu melibatkan pembangunan teknologi di dalam sistem pendidikan (KPM, 2019). Oleh yang demikian, adalah perlu mekanisma penyampaian perkhidmatan yang menyokong proses pembuatan keputusan berasaskan penggunaan data bagi membolehkan kelemahan dalam proses ini dapat diminimumkan, seterusnya memastikan pengoperasian organisasi berjalan pada tahap optimum.

Papan pemuka pengurusan keputusan (Tiga-P_(Keputusan)) menempatkan proses-proses keputusan untuk memudahkan warga fakulti di dalam membuat keputusan. Berfalsafahkan keputusan yang berkesan memerlukan input rujukan yang mengcukupi dan jelas serta diatur secara sistematik. Justeru itu, Tiga-P_(Keputusan) dilengkapkan dengan input rujukan yang mencukupi dan jelas bersama mekanisme pengaturcaraan input responsif yang bertindak sebagai sokongan kepada proses membuat keputusan. Teknologi terkini dimanfaatkan iaitu beberapa aliran proses keputusan dikuasakan dengan algoritma kecerdasan buatan (AI) dalam memperkukuh keberkesanan keputusan

serta merekod pemantauan pelaksanaannya. Proses keputusan ini dibahagikan mengikut kumpulan pengguna. Hanya kumpulan pengguna yang berkaitan sahaja dibenarkan untuk membuka proses keputusan tertentu. Capaian kepada papan pemuka memerlukan sambungan internet. Merangkumi sebanyak 48 komponen proses keputusan untuk kegunaan pelbagai lapisan warga fakulti termasuk Koordinator Prasiswazah, Ketua Bidang, penyelaras, penasihat akademik, pensyarah, penolong jurutera, pelajar, agensi latihan industri, ibu bapa, serta Kumpulan Inovatif dan Kreatif (KIK). Penglibatan menyeluruh ini memastikan keputusan yang dibuat lebih inklusif, holistik dan berpaksikan keperluan semua pihak berkepentingan.



Rajah 1: Tipikal skrin dan templet Tiga-P_(Keputusan)) (pengenalan, input, format dan keputusan) bersama alatan sokongan (aplikasi)

Objektif

Objektif inovasi ini adalah memastikan keputusan yang dibuat oleh warga fakulti adalah berkesan dan tepat supaya kelemahan keputusan diminimakan dan seterusnya perencatan pengoperasian fakulti dapat dielakkan.

Pendekatan NALI

Novelti

Inovasi ini menempatkan semua proses keputusan yang melibatkan warga fakulti (kumpulan pengguna) pada satu platform dan diintegrasikan dengan input rujukan dari pelbagai sumber yang dikemaskini dari masa ke semasa. Beberapa aliran proses dikuasakan oleh algoritma kecerdasan buatan (AI). Bagi memastikan keputusan adalah sentiasa pada keberkesanan yang tinggi, inovasi ini turut dilengkapkan dengan rekod keputusan untuk semakan.

Kreativiti

Kreativiti inovasi ini dapat dilihat pada aliran kerja proses keputusan di mana setiap aliran kerja ini disusun secara sistematik di mana dimulakan dengan pengenalan, kemudian input rujukan, seterusnya format dan diakhiri dengan membuat keputusan. Pengguna perlu merujuk dahulu pengenalan proses keputusan supaya dapat mengetahui tujuan, tempoh dan syarat keputusan tersebut dibuat. Input rujukan untuk mengetahui maklumat-maklumat tambahan supaya proses keputusan itu lebih jelas. Format adalah templet pengumpulan data untuk dianalisa dan dicerakin supaya pelbagai keputusan yang dikehendaki oleh pengguna dapat ditentukan. Templet keputusan adalah templet untuk direkodkan keputusan muktamad dan diserahkan kepada pihak yang berkaitan.

Inovasi

Mempertingkatkan kaedah membuat keputusan dari kaedah sedia ada yang tidak bersistematik iaitu tiada aliran kerja, input rujukan bagi mendapatkan input relevan sebagai panduan, tempoh ditetapkan untuk memuktamadkan keputusan dan sebahagian keputusan direkodkan kepada kaedah bersistematik dengan adanya piawaian aliran kerja, input rujukan yang relevan, tempoh membuat keputusan dan rekod keputusan. Beberapa keputusan dari papan pemuka ini diintegrasikan dengan beberapa aplikasi lain yang dibangunkan untuk kegunaan dalaman fakulti.

Kebolehgunaan

Tiga-P_(Keputusan) dibangunkan untuk dikhususkan oleh kegunaan semua warga fakulti samada di fakulti seperti pihak pengurusan, pensyarah, penolong jurutera atau pelajar, mahupun luar fakulti seperti ibu-bapa dan agensi latihan industri. Pihak pengurusan menggunakan papan pemuka ini untuk urusan pengoperasian fakulti, pensyarah untuk urusan pengajaran, penolong jurutera menguruskan makmal dan pelajar pula untuk urusan pembelajaran. Ibu-bapa menggunakannya untuk pemantauan prestasi pelajar, manakala agensi latihan industri untuk mencari pelatih latihan industri yang berpotensi. Dalam erti kata lain, papan pemuka ini boleh digunakan di fakulti yang ada di mana-mana institusi pengajian tinggi.

Impak

Setelah beberapa bulan dilaksanakan penggunaannya, ianya telah membawa kepada beberapa impak positif sepertimana yang ditunjukkan pada Jadual 1.

Jadual 1: Impak positif setelah Tiga-P_(Keputusan) dilaksanakan penggunaannya

Impak	Sebelum	Selepas	Catatan
Peningkatan Indek kegembiraan	62.5 %	91.5 %	+ 29.0 %
Peningkatan tahap kepuashatian	53.3 %	88.4 %	+ 35.1 %
Peningkatan kepercayaan ketelusan	47.0 %	93.5 %	+ 46.5 %
Penurunan Keputusan lewat	14 kes	3 kes	- 11 kes
Peningkatan pencapaian KPI	2 dari 5	4 dari 5	+ 40 %
Penurunan aduan	13 kes	2 kes	- 11 kes
Peningkatan muat-turun aplikasi fakulti	585 kali	1053 kali	+ 468 kali
Penjimatan kos	RM 182.00/keputusan	RM 19.50/keputusan	- RM 162.50/keputusan

Metodologi Kajian

Pembangunan prototaip adalah dengan mengadaptasikan konsep 'Software Development Life Cycle' (SLDC) di mana langkah awal membabitkan sesi pencambahan idea di kalangan ahli kumpulan dan pemegang taruh. Setelah menerima input dari bakal pengguna iaitu bagaimana projek ini harus dibangunkan, langkah seterusnya adalah pengumpulan maklumat dari sumber seperti buku, produk yang hampir serupa dan manual bagi mengetahui pengoperasian dan fungsi prototaip supaya efektif, efisien dan mampu dibangunkan. Kemudian, bagi memastikan prototaip mencapai objektifnya dan mesra pengguna, dua fasa ujilari dan satu ''User Acceptance Test' (UAT) dijalankan terhadap bakal pengguna. Prototaip turut diujilari oleh pihak bertauliah iaitu pihak yang berkemahiran dalam pembangunan prototaip dan juga pihak berkuasa untuk kebenaran penggunaan di fakulti. Tujuan ujilari adalah untk mnedapatkan maklumbalas bagi penambahbaikan prototaip. Langkah terakhir adalah membuat analisa SWOT untuk sasaran potensi penggunaan. Perisian yang digunakan di dalam pembangunan prototaip adalah dari 'platform open source' iaitu 'Google Application' seperti 'Google Sites', 'Google Drive' dan 'Google Form'. 'Entity-Relationship Diagram' (ERD) pula adalah sebagai panduan rangka pembangunan prototaip.

Dapatan Kajian dan Perbincangan

Tiga-P_(Keputusan) telah memberikan hasil (outcome) dan impak positif kepada warga fakulti secara khusus, serta kepada fakulti secara keseluruhan selepas penggunaannya. Ini menunjukkan bahawa input rujukan yang mencukupi dan jelas, bersama mekanisme pengaturcaraan input yang responsif, amat penting dalam menyokong proses membuat keputusan. Tambahan pula, penggunaan teknologi seperti kecerdasan buatan dapat dimanfaatkan dalam memperkukuh keberkesanan keputusan serta merekod pemantauan pelaksanaannya. Secara tidak langsung, pembangunan inovasi turut menyumbang kepada fungsi organisasi di dalam melahirkan graduan yang berdaya-saing, memenuhi kehendak pelanggan melalui penyampaian khidmat efisien, mencapai matlamat nasional dengan reformasi perkhidmatan awam dan mempertingkatkan ekosistem semasa kepada kampus digital. Disamping itu, perlaksanaan penggunaannya telah mewujudkan situasi dan keadaan yang menyokong ke arah Revolusi Industri 4.0 (IR 4.0), Revolusi Pendidikan 5.0 (ER 5.0), 'Sustainable Development Goal (SDG) dan ESI-iDART.

Maklumat Lain

Tiga-P_(Keputusan) telah didaftarkan hakcipta (LY2025J06785).

Penghargaan

Pihak kami ingin merakam penghargaan kepada pihak pengurusan UiTM Cawangan Johor, Kampus Pasir Gudang dan warga Fakulti Kejuruteraan Awam di atas bantuan dan sokongan di dalam menjayakan projek inovasi ini.

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ID 59: From Silent to Curious: Empowering Rural Learners through GARA Scaffolding Framework

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Highlights: The GARA (Game, AI, Role-play, Assess) Scaffolding Framework is an innovative classroom approach developed at Pusat Tuisyen Budak Rajin (PTBR), Bertam, Pulau Pinang to boost rural students' confidence in answering questions and expressing ideas. By combining gamification, AI role-play, and assessment, GARA engages learners in active participation across multiple subjects. It has shown significant success in encouraging shy students, especially from rural areas, to communicate and collaborate more effectively.

Keywords: scaffolding; gamification; role-play; artificial intelligence

Introduction

Students from rural areas often experience low confidence in responding to questions during lessons, primarily due to anxiety about making mistakes. This leads to silence, reduced participation, and missed opportunities to develop communication skills. According to Zulkefly and Razali (2019), the decrement of rural student's engagement in oral communication also happened especially for the English subject. Due to that, to address this challenge, the GARA (Game, Ask AI, Role-play, Assess) Scaffolding Framework was developed at Pusat Tuisyen Budak Rajin (PTBR), Bertam, Pulau Pinang. GARA is a complete approach that combines gamification, artificial intelligence, role-play, and assessment to help students engage more actively in learning. The GARA scaffolding process was tested and implemented across multiple subjects offered in PTBR. This approach applied a systematic process that guided teachers in structuring classroom activities using three integrated steps.

At first, the GARA module began with a game designed to introduce students to the topic or subtopic of the activity. This engaging opening activity helped spark interest and provided context for the lesson. In the second step, students interacted with Artificial Intelligence (AI) through role-play. Using ChatGPT, the AI took on various personas such as a science teacher, an ancient Pharaoh, or an animal researcher. Based on the topic obtained during the game phase, students either asked questions to the AI role-play or responded to questions posed by the AI. This interactive exchange generated a series of questions and answers that acted as learning prompts for the students. Following this, the activity naturally progressed into the assessment stage. Throughout the AI role-play, all conversations were projected onto the classroom whiteboard for the whole class to see. Students reviewed and addressed the AI-generated questions and answers directly on the whiteboard. The teacher then verified these responses, ensuring their accuracy and guiding further discussions. This collaborative review allowed the entire class to learn and reflect together, reinforcing both understanding and engagement.

The outcome of this technique revealed that students who were initially shy and uncertain about their answers began to gain confidence. They became more willing to ask and respond to questions. The prompts generated by the AI role-play sparked their curiosity, making them eager to engage in the activity. This positive impact was not limited to students alone. For teachers, the presence of clearly structured, step-by-step phases ensured that each stage of the activity was organized and purposeful. As a result, the activity not only facilitated learning but also allowed for student assessment at the end, providing a comprehensive teaching and learning experience.

Objectives

The objectives of this project are to:

i. Enhance Student Confidence – Foster an encouraging environment where previously reserved students feel motivated to voice their ideas and respond to questions.
ii. Promote Active Engagement – Integrate interactive games and AI-driven role-play to stimulate curiosity and participation.
iii. Facilitate Progressive Learning – Implement a step-by-step learning sequence that transitions students from initial interaction to active role-play and reflective assessment.
iv. Strengthen Teacher Delivery – Equip educators with a structured, adaptable strategy that promotes creativity in lesson design while enabling formative assessment.

NALI Approach

The GARA strategy aligns closely with the principles of the New Academia Learning Innovation (NALI) framework by integrating gamification, generative AI, and role-play to create an engaging, student-centred learning experience.

This approach demonstrates creativity as it lies in positioning AI as a "character" in role-play activities, transforming question-and-answer sessions into dynamic interactions that reduce anxiety for shy or hesitant learners. The strategy also reflects strong innovativeness through its structured three-phase learning cycle; Game, AI Role-play and Assess which systematically scaffolds student participation and enhances learning outcomes. Its applicability is evident in the potential for adaptation across subjects, age groups, and various learning settings, whether physical classrooms or hybrid environments. The impact of the intervention was clearly observed: students who had been passive listeners became more confident, with some actively initiating questions during AI role-play sessions. Teachers also reported smoother lesson delivery and more consistent opportunities for formative assessment.

Application: Constructivism Elements Application in GARA

Constructivism theory is the theory where learning occurs as learners actively construct meaning rather than passively receive information. The playful yet purposeful engagement prepared students for deeper exploration and fostered an environment conducive to collaborative learning. The intervention then progressed to the AI Role-Play Phase (AR), in which ChatGPT assumed specific personas aligned with the lesson content. Guided by the teacher, students posed questions to the AI or responded to AI-generated prompts, creating opportunities to practise both questioning and answering skills. This phase exemplified social constructivist approaches by enabling students to co-construct knowledge through dialogue, while the teacher provided scaffolding to ensure that interactions remained purposeful and aligned with learning objectives. As students engaged in simulated conversations, they developed greater confidence, fluency, and curiosity, demonstrating how generative AI can function as an interactive learning partner that supports incremental knowledge building.

Research Methodology

This study adopted a qualitative action research design, involving iterative planning implementation, observation, and reflection over multiple class sessions at PTBR. According to Kemmis, S., & McTaggart, R. (2005), action research is a systematic, participatory, and iterative approach to studying real-world problems with the goal of understanding and improving practice. It blends qualitative research methods with the action research cycle.

Participants and Project Location

The study involved 15 PTBR primary school students from rural backgrounds who lived near the tuition centre, including areas such as Kampung Tasek Gelugor, Pokok Sena, and residential neighborhoods around Bertam Perdana and Bertam Putra. In addition, two teachers from Pusat Tuisyen Budak Rajin (PTBR) also participated in the study. These teachers, who specialized in science, mathematics, and English, were actively engaged in guiding the intervention and supporting the students throughout the process.

Procedure

The intervention was structured according to the GARA scaffolding framework designed by a group of PTBR teachers and a lecturer from Universiti Teknology Malaysia. The GARA scaffolding framework consisting of three sequential phases as shown in Figure 1:

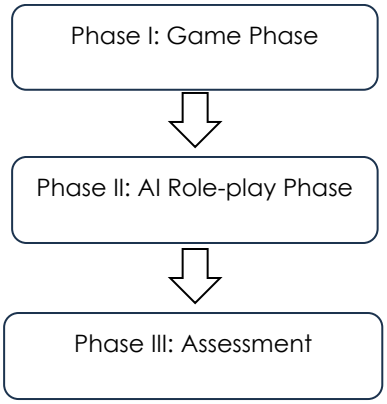


Figure 1: GARA Phases

In Phase 1, the Game Phase (G), a brief game was introduced to present the topic or subtopic of the lesson. This served as a low-pressure icebreaker designed to activate prior knowledge and create a relaxed atmosphere. By beginning with playful yet meaningful engagement, students were encouraged to participate actively and became better prepared for deeper exploration of the lesson content.

The process then moved into the AI Role-Play Phase (AR), where ChatGPT was used to assume specific personas relevant to the topic. Guided by the teacher, students either posed questions to the AI or responded to questions generated by it. These simulated dialogues provided opportunities to practise both questioning and answering skills, fostering greater confidence, fluency, and curiosity. This stage not only scaffolded students' understanding but also illustrated how generative AI can function as an interactive learning partner.

The final stage, the Assessment Phase (A), involved projecting the AI–student exchanges onto the classroom whiteboard for collective review. Students collaborated to refine and improve their responses while the teacher verified correctness and offered further clarification. To consolidate learning, short performance assessments were

administered, and peer feedback sessions were facilitated, enabling students to evaluate each other's comprehension and communication skills in a supportive environment.

Data were gathered using multiple qualitative sources to capture the depth of the intervention at *Pusat Tuisyen Budak Rajin, Bertam, Pulau Pinang*. Classroom observation and semi-structured interviews were conducted with selected students to obtain direct feedback on their learning experiences and the perceived impact of the activities on their confidence and communication skills. Finally, thematic analysis was employed to identify patterns of behavioural change, engagement, and confidence levels across the intervention period.

Findings and Discussion

The implementation of the GARA framework yielded several notable positive outcomes for both students and teachers. One of the most significant findings was the increase in student confidence. Learners who were typically quiet and hesitant to answer questions became more willing to participate in class discussions. The game phase acted as a gentle and engaging entry point, while the AI role-play provided a non-judgmental platform that encouraged students to practise speaking without fear of making mistakes. The intervention also resulted in enhanced engagement. Students showed genuine excitement when interacting with AI-generated questions and answers, often displaying curiosity and eagerness to pose additional questions to the AI personas.

This heightened level of interest not only sustained their attention but also deepened their understanding of the lesson content. Another key outcome was the promotion of collaborative learning. Projecting the AI–student conversations onto the whiteboard allowed learners to review, discuss, and refine their responses together. This collective approach fostered peer correction, encouraged shared ownership of learning, and created an environment where students supported one another in improving their communication and comprehension skills. The structured nature of the GARA sequence also benefited teachers. By providing a clear step-by-step flow, the framework ensured lessons were delivered in an organized manner that combined interactivity with assessment. This design enabled teachers to evaluate students' understanding immediately after each activity, making instruction more purposeful and responsive to learners' needs.

Overall, the integration of gamification, generative AI, and collaborative assessment supported active learning and facilitated formative assessment in real time. This approach aligns with the principles of 21st-century education, where digital tools are leveraged to enhance rather than replace human interaction in the classroom. The GARA framework demonstrated how thoughtful integration of technology can empower students, support teachers, and create a dynamic, student-centred learning experience.

Conclusion

The GARA demonstrates the potential of combining game-based learning, AI-powered interaction, and collaborative assessment to improve student confidence, engagement, and understanding. Beyond its impact on learners, the approach also provides educators with a practical, adaptable teaching scaffold that can be replicated across different educational contexts.

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ID 60: Empowering Postgraduate Leadership Skills through Multi-Modal Active Learning

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Highlights: This innovation empowers postgraduate students by embedding a multi-modal active learning approach into the Seminar in Leadership Development course. The course integrates scenario-based learning, peer-led mini workshops, leadership poster competition, personalized leadership development packets that includes reflective journaling and the Industry Leadership Talk fully organized and moderated by students. These activities are assessed through course self-assessment surveys, structured reflection journals, peer and instructor evaluation rubrics, and facilitator observation notes. Collectively, these elements foster leadership skills including emotional intelligence, conflict resolution, communication and confidence. Grounded in the NALI framework, the innovation shifts students from passive recipients to active, engaged leaders, enhancing their readiness for leadership roles in diverse organizational contexts.

Keywords: *postgraduate leadership; experiential learning; industry engagement; reflective practice; active learning*

Introduction

Postgraduate leadership education should move beyond theoretical understanding to develop real-world competencies essential for the 21st-century workplace. An innovative redesign of the Seminar in Leadership Development (MHMR1133) course has been implemented through a structured, multi-modal active learning approach that aligns with the New Academia Learning Innovation (NALI) framework. This course incorporates scenario-based learning, student-led workshops, a leadership poster competition, personalised leadership development packets that include reflective journaling and portfolio-making, and an industry leadership talk organised and moderated by students. These elements are evaluated through pre- and post-course self-assessment surveys, structured reflection journals, peer and instructor evaluation rubrics, and facilitator observation notes, ensuring measurable outcomes in leadership skills, professional identity, and workplace readiness. This innovation addresses a major gap in postgraduate leadership learning, which is the lack of meaningful, applied leadership experiences. By engaging students as planners, moderators, and presenters, the course shifts learners from passive recipients of knowledge to active constructors of leadership identity and capability. These changes foster more profound student engagement and build core competencies in emotional intelligence, communication, conflict resolution, and self-leadership. The structured reflection and assessment design provide measurable outcomes aligned with Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs). This model not only enhances individual learning but is scalable and replicable across postgraduate and professional development programmes. The integration of academic theory with experiential practice positions this innovation to be used as a benchmark for future-orientated leadership education in higher learning institutions.

The multi-modal active learning designed in this course is underpinned by Kolb's Experiential Learning Cycle (Kolb, 2015) and enriched through elements of Transformative Learning Theory (Mezirow, 1997). This multi-modal approach ensures that each activity connects to a distinct stage of the learning process while promoting leadership development and transformation as presented in Figure 1. Figure 1 illustrates this transformation whereby students begin with scenario-based learning to immerse themselves in authentic leadership contexts (concrete experience), followed by meta-reflection activity and peer-led mini workshops that encourage peer-to-peer feedback and critical exchange (reflective observation). They then engage with Personalised Leadership Development Packets that build their leadership portfolio to synthesise insights and align them with their own leadership trajectories (Abstract Conceptualisation). The Industry Leadership Talk and Leadership Poster Competition bridge conceptual understanding with public communication and real-world engagement, culminating in Reflective Journaling as a platform for critical self-assessment and ongoing improvement (Active Experimentation). The cyclical nature of the model ensures a continuous loop of applied practice and reflection, reinforcing skill mastery and more profound learning over time.

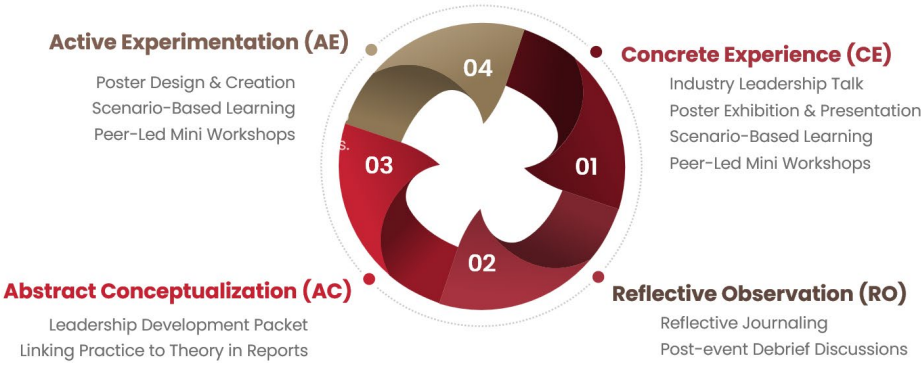


Figure 1: Multi-modal approach linking activities to Kolb's Experiential Learning Cycle for leadership development.

Objectives

This innovation was developed to transform postgraduate leadership education from a novel experience for the students with a theory-driven, lecture-based model into a dynamic, experiential learning environment. The objectives are as follows:

i. To empower students as active leaders by involving them in the full cycle of leadership activities, including planning, organizing, moderating, and presenting through the Industry Leadership Talk and mini workshops.
ii. To develop key leadership competencies such as emotional intelligence, public speaking, conflict resolution, and stakeholder communication through personalized Leadership Development Packets and reflective journaling.
iii. To strengthen student engagement, ownership of learning, and theory–practice integration by applying NALI's active and experiential learning dimensions and exposing students to authentic leadership challenges through direct interaction with industry leaders.
iv. To evaluate the impact of multi-modal learning strategies on students' leadership development using structured assessments, peer feedback, and reflective analysis.

NALI Approach

This project operationalizes the New Academia Learning Innovation (NALI) framework by reimagining postgraduate leadership education as a multi-modal, student-led, and industry-engaged learning experience. Implemented in MHMR1133, the approach integrates NALI's pedagogical and digital innovation objectives with high-impact educational practices. The key dimensions are as follows:

Novelty: The innovation's most novel feature lies in its integration of real-world leadership experiences through student-led Industry Leadership Talks, where students independently plan, coordinate, and moderate sessions with invited industry leaders. This direct engagement offers authentic exposure to leadership realities and decision-making practices in professional contexts which is rare in conventional classroom settings. In addition, the Leadership Development Packet is a customized reflective tool designed to scaffold each student's self-awareness, emotional growth, and leadership strategy development across the semester. This dual approach of external engagement and internal reflection positions the learning as both intellectually rigorous and emotionally resonant.

Creativity: A whole new landscape of teaching and learning is used by creatively embedding the design of multi-layered learning activities that intertwine Scenario-Based Learning, Peer Instruction, and Experiential Learning modes. Students are not only participants but also event creators, moderators, and workshop facilitators. For instance, the mini-workshop assessment requires students to design and deliver an original leadership module to their peers, drawing from both theory and experience. The Industry Leadership Talk further pushes boundaries by assigning students the role of event organizers, directly responsible for professional communication, agenda development, and engagement with external stakeholders. These varied roles cultivate diverse leadership perspectives and creative expression.

Innovativeness: The innovation departs from traditional content delivery by transforming the seminar structure into a leadership learning laboratory. Hence, redefine the traditional teaching and learning tasks to create a unique learning experience for the students. This learning environment encourages repetitive learning through action, reflection, and adaptation, which are core principles in CDIO (Conceive-Design-Implement-Operate) and Outcome-Based Learning. The course replaces instructor-led content with student-driven initiatives, where students become responsible for their learning outputs. Leadership is not just discussed, it is enacted, observed, reflected upon, and refined. This reversal of roles from passive listener to proactive leader encourages deeper responsibility, accountability, and self-efficacy, aligning with UTM's identity as an entrepreneurial university.

Applicability: The multi-modal active learning approach integrates various NALI learning modes effectively and consistently by using scenario-based learning, peer instruction, High-Impact Educational Practices (HIEPs), Outcome-Based Learning. This model is highly adaptable and scalable across disciplines and learning levels. The core framework of combining leadership insight, poster competition, reflection, scenario planning, and public engagement can be implemented in business, education, engineering, and health sciences postgraduate programs. Its supporting tools,

such as the Leadership Packet template, event planning checklist, and peer review rubrics, are replicable and customizable for Continuing Professional Development (CPD), executive education, and industry training. By aligning learning outcomes with national and international graduate attributes (including communication, leadership, and ethics), the model supports the Malaysian Higher Education Strategic Plan and meets MQA outcome-based education standards, ensuring relevance and sustainability. Table 1 below showed the mapping of the course activities and NALI Learning mode.

Table 1: Mapping of the course activities and NALI Learning mode.

Course Activity	NALI Learning Mode (Pedagogy/Andragogy)	Justification
Peer-Led Mini Workshops Scenario-Based Learning (students work on realistic leadership situations and make decisions)	Peer Instruction & Scenario-Based Learning	Encourages collaborative learning where students teach and facilitate discussions, enhancing mastery through teaching others. Immerses students in authentic leadership challenges, fostering decision-making and problem-solving aligned with real-world contexts.
Leadership Poster Competition	High-Impact Educational Practices (HIEPs) & Outcome-Based Learning	Provides an authentic assessment platform for students to showcase leadership theories and applications; develops communication, critical thinking, and visual presentation skills.
Personalized Leadership Development Packet Reflective Journaling	High-Impact Educational Practices (HIEPs) & Outcome-Based Learning	Promotes metacognition, self-assessment, and deeper learning through structured meta-reflection and leadership portfolio building. Directly aligns learning outputs to measurable competencies and graduate attributes.
Industry Leadership Talk (organized and moderated by students)	Service-Community Based Learning & High-Impact Educational Practices	Engages with industry professionals, bridging academic learning with community/industry insight; enhances networking, public speaking, and event management skills.

Impact: The innovation produced significant and measurable impact on student engagement and empowerment through consistent application of multiple NALI learning modes. The findings showed significant improvements in leadership skills such as communication, emotional intelligence, and conflict resolution. The meta-reflective learning and leadership portfolio-making process support their leadership development journey. The integrated framework yielded high participation rates and active involvement among students throughout the semester. Its adaptable structure and evidence-based outcomes demonstrate both immediate learning gains and long-term applicability that can be used across disciplines. For instance, this innovation has demonstrated significant positive outcomes for student learning and development. Evaluation data across multiple cohorts show that: (a) students report significantly improved confidence in public speaking and leadership skills, (b) there are significantly higher levels of emotional intelligence and self-awareness based on reflective journals conducted throughout the semester, and (c) students exhibit enhanced critical thinking, conflict resolution, and interpersonal coordination skills during group-led activities. These results are supported by qualitative data from post-event debriefs, peer evaluations, and instructor observations. Students often describe the course as "transformational", "empowering", and "the first time I saw myself as a real leader". These outcomes align with NALI's goal of producing graduates with entrepreneurial mindsets, ethical values, and professional agility. Furthermore, the project encourages sustained engagement beyond the classroom, as students often maintain contact with industry speakers, reflecting the programme's role in building professional networks and lifelong learning orientation.

Research Methodology

This innovation was implemented in Seminar in Leadership Development (MHMR1133) course, offered to postgraduate students of Master of Human Resource Development at Universiti Teknologi Malaysia during Semester 1 and 2, 2024/2025. A mixed-methods approach was adopted to evaluate its effectiveness, integrating both quantitative and qualitative data sources to capture measurable skill development and personal transformation. The study involved 36 postgraduate students from diverse professional and academic backgrounds of full-time and working adults. All students engaged in the full cycle of multi-modal active learning activities, including scenario-based learning, peer-led mini workshops, reflective journaling, and the Industry Leadership Talk. The learning model was structured around three core components:

Leadership Development Packet: A personalized reflection and growth toolkit completed progressively over the semester. It contains the student's personal leadership philosophy, life reflection and self-awareness exercises, leadership development action plan, reflective journals based on weekly class topics, results of the action plan, and closing thoughts. This involves multiple reflective journaling activities throughout the semester.

Leadership Poster Exhibition: Students design and create individual leadership-related posters, all of which compete in the IHRDEX 2024 convention and exhibition.

Industry Leadership Talk: Student-organized events with invited industry leaders, involving full planning, moderation, and debriefing responsibilities. The participants include both postgraduate and undergraduate students from SHARPS, FSSH, UTM.

Mini Workshop Facilitation: Peer-to-peer sessions where students design and deliver leadership development content through mini workshops, complete with relevant leadership enhancement activities and evaluations to assess their peers' understanding. This also includes scenario-based learning.

A few methods of data collection were used, which are: (a) Pre- and post-course self-assessment surveys measuring leadership confidence, communication skills, emotional intelligence, and conflict resolution ability, (b) Structured reflection journals analyzed thematically for evidence of mindset shifts, skill acquisition, and self-awareness, (c) Peer and instructor evaluation rubrics for leadership roles, public speaking, and event coordination, and (d) Observation field notes from course facilitators documenting behavioral and engagement changes. As for the Data Analysis, Quantitative data (pre-post survey scores) were analyzed using descriptive statistics to determine percentage changes in targeted competencies. Meanwhile, Qualitative data (reflection journals, debrief transcripts) were coded and thematically analyzed to identify recurring patterns of leadership growth, application of theory, and changes in professional identity. This methodology ensured a comprehensive evaluation of the innovation's effectiveness, linking the NALI framework's intended learning transformations to observable and measurable outcomes.

Findings and Discussion

The evaluation of the MHMR1133 innovation indicates a significant positive impact on postgraduate students' leadership development, consistent with the objectives of the NALI framework. The Quantitative findings showed:

Public Speaking and Communication: 89% of students reported improved confidence in speaking to diverse audiences, as measured by pre- and post-course surveys.

Emotional Intelligence: 86% demonstrated higher self-awareness, empathy, and conflict resolution skills, as evidenced in reflective journals and peer evaluations.

Leadership Readiness: 83% showed greater capability in planning, decision-making, and coordinating multi-stakeholder events, based on instructor observations and assessment rubrics.

While the Qualitative findings of the thematic analysis of reflective journals and post-event debrief revealed three recurring growth themes:

Transformation from Learner to Leader: Students gained ownership of their learning process, taking initiative in planning and executing leadership events.

Bridging Theory and Practice: Direct interaction with industry leaders allowed students to relate and validate classroom concepts in real-world contexts.

Enhanced Leadership Skills and Professional Confidence: Participation in high-stakes activities such as moderating industry talks significantly reduced performance anxiety and improved self-assurance. Many reported their improved leadership skills, such as the ability to lead others and enhanced interpersonal skills.

These are examples of student's reflections:

"Organizing the Industry Leadership Talk pushed me beyond my comfort zone, teaching me to lead a team and speak with confidence. The Leadership Packet deepened my self-awareness, clarified my career direction, and showed me how to collaborate effectively across cultures."- Student A

"Interacting with an industry leader face-to-face gave me insights that no textbook could provide. From all the assignments, I learn that leadership is about empathy, listening, and making decisions that benefit the whole team. Before this course, I avoided public speaking, now, I see it as an opportunity to share my vision." - Student Y

"All the assignment and tasks extend my views and provide me with various useful ideas that I may employ in my daily life. It improves my leadership skills and how important it is for a leader to possess great qualities. In leadership packet, I learn self-awareness and notice areas to be improved and how to improve it which is great!" - Student Z

Outcomes

The innovation has achieved significant recognition and tangible results in postgraduate leadership development. It was implemented successfully in MHMR1133: Seminar in Leadership Development, engaging postgraduate students from diverse backgrounds. Notably, one of the innovation, that is the Leadership Packet has previously become a finalist for the NALI Award 2022 and won a silver medal for the exhibition, showcasing its alignment with the New Academia Learning Innovation framework. The innovation has also led to high student satisfaction, measurable improvements in leadership competencies, and positive industry engagement through the Industry Leadership Talk series. The learning materials and leadership development packet have been adopted in subsequent course offerings to maintain impact and sustainability.

This innovation has strong commercialization potential due to its modular, adaptable design and proven effectiveness in enhancing leadership competencies. The Leadership Development Packet, reflective tools, and structured multi-modal active learning framework can be packaged as a professional development program for organizations, universities, and training providers. Additionally, the Industry Leadership Talk model can be offered as a facilitated leadership workshop service to industries seeking to cultivate emerging leaders. The combination of evidence-based methodology, adaptability to different sectors, and alignment with global leadership frameworks positions this innovation as a scalable, market-ready solution for both academic and corporate leadership training markets.

Conclusion

The integration of scenario-based learning, peer-led workshops, reflective journaling, and industry engagement created a synergistic environment that fostered both skill development and mindset change. The Leadership Development Packet served as an effective tool for continuous self-assessment and targeted skill enhancement, while the Industry Leadership Talk provided authentic, high-impact experiences that deepened understanding of leadership in practice. The findings support previous research that experiential, student-led learning fosters more profound engagement, sustained motivation, and transferable leadership skills. Furthermore, the model's adaptability suggests strong potential for replication in other postgraduate and professional development contexts.

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ID 61: Integrasi Inovasi: Pendekatan Berpusatkan Pelajar Dalam Kursus Bimbingan & Kaunseling

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Sorotan: Pendekatan inovatif berasaskan pembelajaran aktif berpusatkan pelajar ini dibangunkan untuk meningkatkan penglibatan serta kemahiran praktikal pelajar dalam kursus Bimbingan dan Kaunseling (SHPP4502). Melalui pelaksanaan kaedah simulasi, main peranan, aktiviti berkumpulan dan refleksi kualitatif yang direka secara kolaboratif antara pensyarah dan pelajar berasaskan proses *double-loop design thinking*, pengalaman pengajaran dan pembelajaran (PdP) menjadi lebih praktikal, interaktif dan bermakna. Selain itu, integrasi aplikasi teknologi digital seperti Padlet, Kahoot, Mentimeter, Slido, platform persidangan video dan lain-lain medium teknologi telah dimanfaatkan bagi menyokong kolaborasi, penilaian interaktif, simulasi maya dan penghasilan bahan pembelajaran yang kreatif. Integrasi pendekatan ini bukan sahaja memperkukuhkan pembelajaran berasaskan pengalaman dan menambah dimensi baharu dalam proses PdP, malah meningkatkan motivasi dan mempersiapkan pelajar sebagai bakal guru yang boleh mengaplikasikan kemahiran kaunseling dalam amalan profesional.

Kata Kunci: Pembelajaran aktif, berpusatkan pelajar, strategi pengajaran, pembelajaran

Pengenalan

Subjek Bimbingan dan Kaunseling menuntut keseimbangan antara penguasaan teori dan penguasaan kemahiran praktikal, sesuatu yang sering mencabar jika hanya bergantung kepada kaedah pengajaran tradisional. Justeru, pendekatan pedagogi inovatif berteraskan pembelajaran aktif dibangunkan dengan menggabungkan prinsip pembelajaran berpusatkan pelajar dan *double-loop design thinking* bagi memastikan pelajar terlibat secara aktif dalam mereka bentuk aktiviti pembelajaran. Melalui simulasi interaktif, main peranan, tugasan penyelesaian masalah serta pembelajaran berasaskan pengalaman, pelajar bukan sahaja dapat menghubungkan teori dengan konteks kerja sebenar malah mengembangkan kemahiran refleksi, pemikiran kritis, dan kolaborasi. Bagi memperkukuh pelaksanaan, integrasi teknologi digital seperti Padlet, Mentimeter, Slido, Kahoot, Quizizz, serta rakaman video untuk refleksi turut digunakan bagi mewujudkan suasana pembelajaran yang interaktif, menyeronokkan, dan bermakna. Strategi ini akhirnya menjadikan proses pembelajaran lebih praktikal, relevan, dan kreatif, di samping meningkatkan motivasi, tumpuan, dan penglibatan pelajar, serta mempersiapkan mereka sebagai bakal guru pembimbing yang celik teknologi dan kompeten dalam amalan profesional.

Objektif

i. Mengoptimumkan penglibatan dan motivasi pelajar melalui pendekatan pedagogi inovatif berasaskan pembelajaran aktif berpusatkan pelajar dan *double-loop design thinking*, dengan sokongan aplikasi digital yang menggalakkan pembelajaran aktif.
ii. Menggalakkan pengaplikasian kemahiran secara kreatif dan kritis dengan memberi ruang kepada pelajar mereka bentuk serta menilai aktiviti pembelajaran aktif secara kolaboratif menggunakan aplikasi digital.
iii. Mengukuhkan kemahiran praktikal kaunseling melalui simulasi interaktif, main peranan dan aktiviti kumpulan berasaskan kajian kes, disokong oleh platform maya serta rakaman video untuk refleksi dengan penekanan kepada pembelajaran aktif berasaskan pengalaman.

Pendekatan NALI

1. KEASLIAN	• Gabungan pembelajaran aktif dan design thinking double-loop berasaskan teknologi digital untuk menjadikan pelajar aktif dalam pembelajaran
2. KREATIVITI	• Penekanan elemen kreativiti melalui pembelajaran aktif dengan simulasi, *role play*, dan aplikasi digital untuk menghasilkan bahan visual serta audio yang interaktif
3. INOVASI	• Gabungan pembelajaran aktif berasaskan teknologi digital melalui pelaksanaan aktiviti interaktif, diikuti maklum balas awal, refleksi dan mereka bentuk semula strategi pembelajaran yang inovatif sehingga membuktikan penguasaan kemahiran kaunseling pelajar secara praktikal
4. KEBOLEHGUNAAN	• Kebolehgunaan tinggi dan fleksibiliti dalam kursus Bimbingan dan Kaunseling melalui prinsip pembelajaran aktif, berpusatkan pelajar serta integrasi teknologi digital.
5. IMPAK	• Meningkatkan minat, motivasi, kesedaran kendiri (aspek emosi, kognitif & tingkah laku), kemahiran kaunseling, komunikasi dan pemikiran kritis pelajar agar mampu mempersiapkan diri dengan keperluan sebenar dunia professional.

Metodologi Kajian

Reka bentuk dan pembangunan aktiviti pembelajaran dalam kursus Bimbingan dan Kaunseling dilaksanakan melalui perancangan topik berasaskan situasi kajian kes sebenar, seterusnya diaplikasikan dengan prinsip *double-loop design thinking* yang menekankan kolaborasi pensyarah dan pelajar dalam menilai, menambah baik, serta meningkatkan keberkesanan aktiviti. Proses ini diperkukuh dengan penggunaan aplikasi digital seperti *Google Docs*, *Mentimeter* dan *Slido* bagi kolaborasi idea, menghasilkan aktiviti autentik seperti simulasi kaunseling, main peranan, dan penyelesaian masalah secara berkumpulan.

Pelaksanaan aktiviti interaktif di bilik kuliah dan Makmal Kaunseling turut disusun secara berstruktur melalui lakonan semula kes, simulasi kemahiran, dan sketsa, manakala teknologi digital seperti *Webex, Google Meet, Kahoot, Name of Wheel* serta *Quizizz* dimanfaatkan untuk penglibatan maya, penilaian formatif, dan refleksi berasaskan rakaman video. Pelajar berperanan aktif sebagai kaunselor, klien, atau pemerhati untuk mengasah kemahiran asas kaunseling seperti mendengar, menyoal, merumus, empati, refleksi, dan soal jawab beretika, sementara penilaian dan refleksi berterusan dilakukan melalui Padlet, forum UTM *e-Learning*, serta pemerhatian pensyarah yang disokong rakaman video. Maklum balas daripada proses ini digunakan untuk penambahbaikan aktiviti seterusnya mengikut prinsip *double-loop learning*, sekali gus mewujudkan pengalaman pembelajaran yang lebih bermakna, relevan, dan praktikal dalam mempersiapkan pelajar sebagai guru pembimbing yang berkemahiran.





Integrasi Inovasi Pembelajaran Aktif Berpusatkan Pelajar



Pendekatan yang menggunakan konsep pembelajaran aktif

Pembelajaran berasaskan pengalaman



Pembelajaran secara koloboratif



Pembelajaran berasaskan masalah





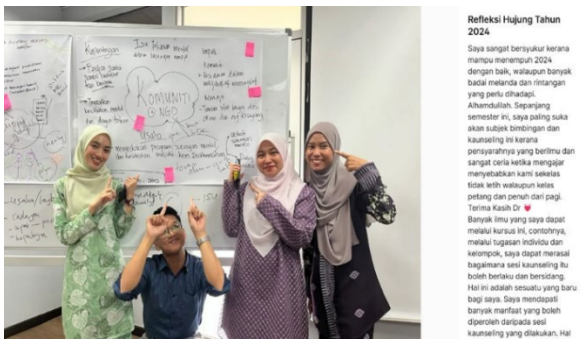


Pembelajaran Aktif: Aktiviti kinestetik dan pembentangan menggunakan aplikasi digital Padlet.com agar para pelajar dapat meningkatkan penguasaan dan pemahaman mereka terhadap topik yang diajar

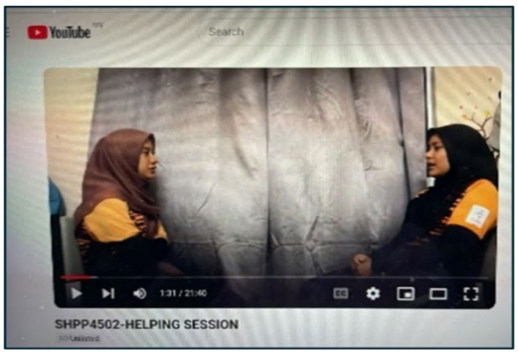
Dapatan Kajian dan Perbincangan

Pelaksanaan strategi pengajaran berpusatkan pelajar dalam kursus Bimbingan dan Kaunseling telah berjaya meningkatkan tahap penglibatan, motivasi, serta penguasaan kemahiran praktikal pelajar. Aktiviti pembelajaran aktif yang digabungkan dengan prinsip *double-loop design thinking* menjadikan sesi lebih interaktif, relevan, dan menyeronokkan, khususnya melalui integrasi teknologi digital seperti *Google* bagi pengurusan tugasan, Padlet dan *Mentimeter*/*Slido* untuk kolaborasi idea, serta *Kahoot* dan Quizizz bagi penilaian formatif. Proses penilaian pembelajaran turut diperkaya dengan penggunaan *Google Forms, e-flipbook, dan e-book* yang memudahkan pensyarah menilai kefahaman secara segera, manakala rakaman video aktiviti simulasi menjadi bahan refleksi untuk penambahbaikan berterusan. Kesemua elemen ini bukan sahaja menyokong keperluan teori dan amalan, malah memupuk suasana pembelajaran yang lebih bermakna.

Berdasarkan sudut kemahiran insaniah, pelajar menunjukkan perkembangan dalam aspek komunikasi, kolaborasi, pemikiran kritis, dan keupayaan membuat keputusan secara beretika. Aktiviti seperti lakonan semula kes, simulasi kemahiran kaunseling, serta penghasilan produk kreatif menggunakan Canva atau Powtoon memberi ruang kepada pelajar membina rasa pemilikan terhadap proses pembelajaran mereka sendiri. Pendekatan ini membuktikan keberkesanan inovasi berasaskan teknologi digital dalam merapatkan jurang antara teori dan amalan, sekali gus memperkukuh kompetensi pelajar sebagai bakal kaunselor. Secara keseluruhan, integrasi pembelajaran aktif, kreatif, dan kolaboratif ini bukan sahaja memperkayakan pengalaman dalam bidang bimbingan dan kaunseling, malah berpotensi diaplikasikan ke dalam bidang pengajaran lain yang menuntut penguasaan kemahiran praktikal melalui pendekatan yang lebih relevan dengan keperluan abad ke-21.



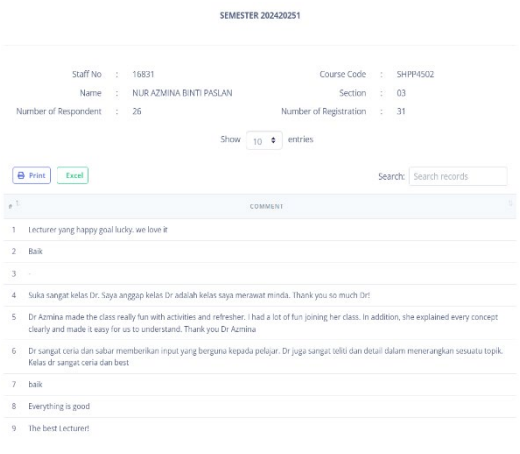
Pembelajaran berasaskan projek dan refleksi pelajar di platform Padlet



Aplikasi pembelajaran koperatif (penolong dan 'klien') melalui tugasan "Sesi Menolong Praktikal



Penghasilan e-flipbook untuk kaedah penilaian pelajar



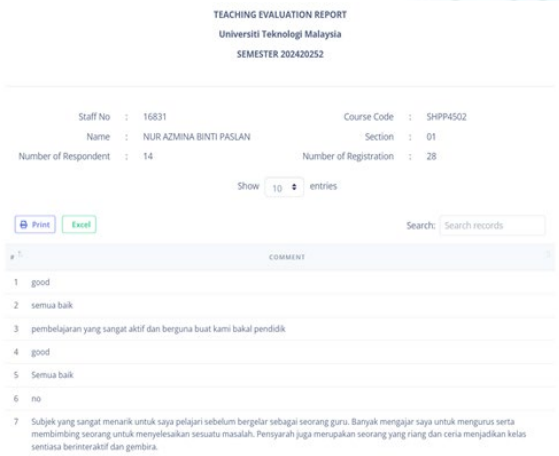
SEMESTER 202420251

Staff No : 16831 | Course Code : SHPP4502
Name : NUR AZMINA BINTI PASLAN | Section : 03
Number of Respondent : 26 | Number of Registration : 31

Show 10 entries

Print Excel Search: Search records

#	COMMENT
1	Lecturer yang happy goal lucky. we love it
2	Baik
3	-
4	Suka sangat kelas Dr. Saya anggap kelas Dr adalah kelas saya merawat minda. Thank you so much Dr!
5	Dr Azmina made the class really fun with activities and refresher. I had a lot of fun joining her class. In addition, she explained every concept clearly and made it easy for us to understand. Thank you Dr Azmina
6	Dr sangat ceria dan sabar memberikan input yang berguna kepada pelajar. Dr juga sangat teliti dan detail dalam menerangkan sesuatu topik. Kelas dr sangat ceria dan best
7	baik
8	Everything is good
9	The best Lecturer!



TEACHING EVALUATION REPORT
Universiti Teknologi Malaysia
SEMESTER 202420252

Staff No : 16831 | Course Code : SHPP4502
Name : NUR AZMINA BINTI PASLAN | Section : 01
Number of Respondent : 14 | Number of Registration : 28

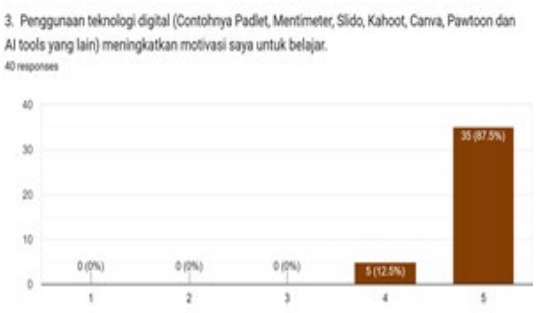
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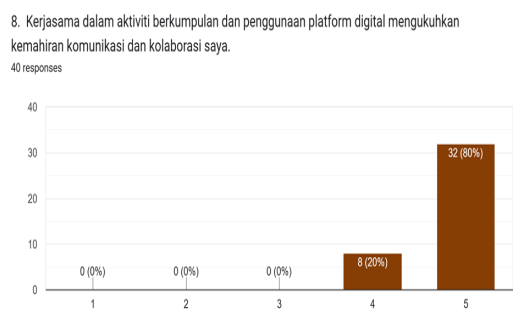
Print Excel Search: Search records

#	COMMENT
1	good
2	semua baik
3	pembelajaran yang sangat aktif dan berguna buat kami bakal pendidik
4	good
5	Semua baik
6	no
7	Subjek yang sangat menarik untuk saya pelajari sebelum bergelar sebagai seorang guru. Banyak mengajar saya untuk mengurus serta membimbing seorang untuk menyelesaikan sesuatu masalah. Pensyarah juga merupakan seorang yang riang dan ceria menjadikan kelas sentiasa berinteraktif dan gembira.

Penilaian pelajar terhadap pensyarah dilakukan di platform e-PPK

Malah diakhir pembelajaran pada minggu terakhir, pelajar diberikan peluang untuk memberikan maklumbalas melalui *google form* yang disediakan oleh pensyarah untuk bagi menilai keberkesanan pengajaran dan pembelajaran kursus Bimbingan dan Kaunseling supaya dapat melakukan penambahbaikan pada semester hadapan demi meningkatkan kualiti pengajaran dan pembelajaran kursus Bimbingan dan Kaunseling.





Penilaian pelajar terhadap keberkesanan pengajaran dan pembelajaran kursus Bimbingan dan Kaunseling melalui *Google Form*

Potensi Pengkomersialan

Inovasi ini berpotensi dikomersialkan sebagai modul PdP yang interaktif berasaskan integrasi pembelajaran aktif dan aplikasi digital melalui platform MOOC & Micocredential. Malah modul ini boleh diperkembangkan penggunaannya kepada institusi latihan untuk pembangunan kemahiran insaniah dan profesional.



Modul pengajaran yang dibangunkan dalam kursus Bimbingan dan Kaunseling

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ID 62: Leveraging the Usage of Social Media Platforms in Quantity Surveying Subject

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Highlights: Technological advancements have revolutionized the society into a global forum and give impact to the educational processes and learning environment. The trend of using the social media platform as teaching and learning medium is increasing and prompt the educators to deploy the usage of various digital tools in the classroom. This trend is particularly relevant for Generation Z where they use the Internet and social media time after time. This project emphasized on the application of TikTok as the digital tool in the Quantity Surveying subject. The implementation of TikTok as a learning tool contribute significantly to student's understanding on the subject matter.

Keywords: Social Media; TikTok; Quantity Surveying; Teaching and Learning; Generation Z

Introduction

The Generation Z learners are the current generation entering the university. This generation is the true digital natives where they are more captivated and influenced by technology and social media (Sartor, 2020). Gen Z students are constantly using technology and have expectations for their educators to offer learning experiences using social media platform where they can have access on their phones. As traditional educational approaches evolve, educators are increasingly leveraging the use of social media platforms to engage and educate the Gen Z in more interactive and relatable ways.

Social media is defined as internet-based applications or inter-active platforms that allows the creation and exchanges of the content generated by the users (Latif et al., 2019). Today, the social media has become one of the most influential tools that emanate versatile information. Greenhow and Chapman (2020) in their research stated that the social media usage in formal education as well as higher education has been quite marketable. The popular social media platforms such as Facebook, Twitter, Instagram and Pinterest are widely adopted in learning environment. The Gen Z use these platforms not focusing on socialization only but also as a vital tool for learning and information exchange.

NALI Approach

Creativity in the classroom has become a subject of intense interest to educators in many universities around the world. Educators are aggressively looking for a creative learning environment where students are more likely to express their ideas, think creatively and effectively challenge problems with innovative solutions. Therefore, the main reason of adopting the use of social media platform among the Quantity Surveying students are to create new opportunities for connection, collaboration and content sharing. All the students are the Gen Z who prefers digital media over traditional and have different learning styles from previous generation.

Quantity Surveyor Roles at Pre and Post Contract Stage: Application of TikTok as Medium. This paper starts with the objectives of the project followed by the novelty of the project. The creativity consists of the idea of the students in presenting their video assignments and the applicability of creativity factor in students' understanding in learning process. The innovativeness and applicability of the project further delve into the enhancement of teaching and learning from the project-based learning assessment.

Objectives

The main objectives of this assignment project are to promote resilience among students which consist of the following:

i. To offer a holistic learning experience that integrates creative thinking and presentation abilities.
ii. To nurture resilience, creativity and adaptability among students.
iii. To enhance creativity by allowing the students to use the TikTok platform in delivering the content of assignment.
iv. To enhance student's adaptability by involving them in the phases of creating and presenting.
v. To improve the students' understanding on the roles of quantity surveyors at Pre-Contract and Post-Contract stage.

Research Methodology

This study employs a quantitative research design, specifically a quasi-experimental approach, to evaluate the impact of social media platforms on students' achievement in the Quantity Surveying subject. The design includes a pre-test

and post-test for two cohorts which is one that has not used social media as a learning tool (Cohort A) and one that has integrated social media platforms into their learning process (Cohort B). The sample sizes for both groups are matched, ensuring comparability between the two cohorts.

A standardized achievement test covering key concepts in Quantity Surveying at the Pre-Contract and Post-Contract stages was administered to both Cohort A and Cohort B at the beginning of the academic term, prior to the use of social media in the learning process.

During the course, Cohort B was exposed to learning through social media platforms, with a particular focus on TikTok. Students were required to create and present course-related content using this platform. The activities were designed to enhance creativity, adaptability, and understanding of key course concepts. Cohort A, on the other hand, followed the traditional lecture-based and project-oriented learning model without social media integration. At the end of the academic term, both cohorts underwent the same standardized achievement test. The test results from Cohort A (before social media use) and Cohort B (after social media use) were collected for comparison.

The standardized tests used for both pre-test and post-test were developed in alignment with the course curriculum and reviewed by subject matter experts to ensure content validity. The question will be divided into Pre-contract (Q2F) and post-contract (Q4F) To ensure reliability, the same test format and conditions were maintained for both cohorts. The tests were piloted with a small group of students prior to the study to ensure consistency and clarity in assessment.

Findings and Discussion

Table 1: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Q2F	Equal variances assumed	1.806	.182	-1.478	97	.143	-1.27545	.86276
	Equal variances not assumed			-1.470	92.711	.145	-1.27545	.86778
Q4F	Equal variances assumed	.562	.455	2.377	97	.019	1.90532	.80140
	Equal variances not assumed			2.365	93.096	.020	1.90532	.80563

Based on the results, it shows that the t-value is -1.478 with a degree of freedom (df) of 98, and a p-value of (Sig. 2-tailed) of 0.143, the p-value is greater than 0,05, indicating there is no statistically significant difference between the two groups for Q2F, However, for the case of Q4F which shows the t-value of 2.377 with a df of 87, and a p-value of 0.019, this shows that there is statistically significant differences between the two groups.

The independent samples t-test results provide insights into the effectiveness of integrating social media (in particular, TikTok) in the learning process of Quantity Surveying students. The results for pre-contract (Q2F) shows that that the difference in the achievements between the two groups at the Pre-Contract stage (Q2F) is not statistically significant, This suggests that using social media platforms like TikTok did not have a significant impact on students' understanding or performance related to Pre-Contract activities compared to the traditional teaching method. Both cohorts performed similarly at this stage. This could be due to the nature of Pre-Contract topics, which may require more structured, formal learning that does not lend itself as well to the informal, creative aspects of social media platforms.

However, for Post-contract (Q4F), he p-value of 0.019 indicates that there is a statistically significant difference in achievement between the two cohorts at the Post-Contract stage (Q4F). The positive mean difference (1.90532) shows that the group that used social media (Cohort B) performed significantly better than the group that did not. This implies that social media platforms, especially TikTok, enhanced students' understanding or engagement in the Post-Contract topics of Quantity Surveying. Since post-contract activities may involve more real-world applications, creativity, and problem-solving (which social media can enhance), the students who utilized social media platforms likely benefited from the interactive and engaging learning style.

The significant improvement in post-contract learning suggests that integrating social media platforms into teaching methods can be particularly effective for stages that require creativity, collaboration, and practical application. The lack of effect in the Pre-Contract stage indicates that traditional methods may still hold value for teaching foundational knowledge. Therefore, Educators could focus on blending traditional teaching methods with social media engagement for later stages of the course that benefit from interactivity and creativity. Social media tools might be especially useful for practical topics, where visual, interactive content could deepen understanding and enhance student performance.

Conclusion

The results of this study indicate that social media platforms, particularly TikTok, can be powerful tools for improving student performance in Quantity Surveying, especially in practical, application-oriented topics like those covered in the post-contract stage. However, for more theoretical and technical content, such as the Pre-Contract stage, traditional teaching method may still be more effective. Educators should therefore adopt a balanced approach,

integrating social media where it complements the learning objectives while maintaining traditional methods for content that requires structured learning.

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ID 63: Nadi Sirah

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Sorotan: Sirah bukan sekadar sejarah, ia adalah sebuah perjalanan hidup yang mampu mengubah jiwa apabila dihayati dengan berbantukan teknologi digital. Ilham kepada projek ini telah bermula sejak penulisan tesis PhD pada tahun 2021 dan telah berjaya menyiapkan tapak "garis masa" Rasulullah SAW yang interaktif pada NALI 2024, namun dalam bentuk kurang penggunaan digital. Manakala, Projek Nadi Sirah bertujuan membangunkan sebuah platform interaktif berasaskan teknologi digital sepenuhnya yang berfungsi sebagai pusat rujukan sirah Rasulullah SAW dalam bentuk laman sesawang responsive. Melalui pendekatan teknologi digital, projek Nadi Sirah akan menghimpunkan kandungan sirah Rasulullah SAW yang sahih dan terpilih berdasarkan 20 buah kitab sirah mu'tabar yang disusun dalam bahasa Melayu, khusus sumbangan kepada bakal pengguna di rantau Nusantara. Kandungan laman sesawang juga merangkumi pelbagai bahan berformat multimodal seperti artikel ilmiah, interactive timeline hayat Rasulullah SAW, infografik, senarai buku sirah, kuliah video tokoh ilmuwan, audio lagu Sirah dan permainan interaktif dan inovasi dalam sirah. Keunikan utama projek ini adalah timeline sirah dihujung jari berdasarkan rujukan kitab sirah yang telah disahkan kesahihannya oleh panel pakar serta disediakan Chatbot Ai yang berfungsi menjawab pertanyaan yang diajukan berdasarkan usmber yang sahih. Hal ini sekaligus menjamin etika dan integriti maklumat. Justeru, Nadi Sirah menawarkan solusi sebagai one-stop center ilmu sirah yang sahih, tersusun dan mudah dicapai. Projek ini menyokong pendekatan heutagogi, iaitu pembelajaran kendiri yang fleksibel. Kolaborasi antara penyelidik dalam bidang Sains Sosial dan Fakulti Komputeran bagi memastikan pembangunan produk ini selaras dengan aspirasi UTM dalam menginovasi penyelesaian lestari demi manfaat masyarakat. Akhirnya, Nadi Sirah diharap dapat mencetus transformasi dalam dakwah dan pendidikan sirah dengan mendekatkan masyarakat kepada Rasulullah SAW melalui wahana teknologi.

Kata Kunci: Sirah; Garis Masa; Interaktif

Pengenalan

Pendidikan Islam hari ini menjadi perhatian yang penting dalam memberikan penghayatan kepada pelajar dan Masyarakat. Justeru, bidang sirah menjadi medium yang mustahak bagi melihat al-Quran dan as-Sunnah itu diterapkan secara praktikal. Namun, yang menjadi cabaran bukan input sirah, namun kepada kaedah pengajaran sirah tersebut disampaikan. Pengajaran sirah Rasulullah SAW merupakan komponen penting dalam pendidikan Islam. Namun, kaedah pengajaran tradisional sering kali dianggap kurang menarik dan kurang mengesani dalam kalangan pelajar dan Masyarakat hari ini (Talhah Ajmain & Kamaru Salam, 2025). Sebagai tambahbaik terhadap cabaran ini, pengkaji telah melaksanakan inovasi pada NALI 2024 dengan membangunkan "garis masa" sirah yang interaktif namun masih berbentuk *hardcopy*, kali ini pengkaji telah digitalkan sepenuhnya hanya dihujung jadi dan boleh dimanfaatkan secara percuma.

Inovasi pembelajaran ini memperkenalkan pendekatan baharu dalam pengajaran Sirah dengan membangunkan "*garis masa Rasulullah SAW*", iaitu bahan bantu mengajar (BBM) yang menggabungkan kandungan sirah yang padat dan sahih, bantuan teknologi digital interaktif, penerangan yang ringkas namun jelas, serta integrasi Chatbot AI yang mampu menjawab soalan secara pantas dan berlandaskan rujukan *mu'tabar*. Pendekatan ini dibina untuk memperkukuh pemahaman pelajar terhadap peristiwa penting dalam Sirah melalui penjelasan kontekstual dan visual yang menyeluruh. *Nadi Sirah* (nadisirah.com) membolehkan pelajar menelusuri perjalanan peristiwa Sirah secara lebih nyata, mendalam dan interaktif, sekaligus memberikan pengalaman pembelajaran yang bersifat ilmiah, menarik, serta memberi kesan mendalam yang boleh diakses pada bila-bila masa dan di mana sahaja.

Tujuan utama inovasi ini adalah untuk meningkatkan kefahaman pelajar terhadap kehidupan Rasulullah SAW, mendorong penggunaan teknologi dan bahan visual dalam pengajaran Sirah, serta memupuk minat dan penghayatan mendalam terhadap sejarah Islam. Dengan inovasi ini, diharapkan pembelajaran Sirah tidak lagi bersifat pasif dan tekstual, sebaliknya menjadi pengalaman yang menghidupkan kembali sejarah Islam secara bermakna.

Objektif

Inovasi ini bertujuan untuk meningkatkan pemahaman pelajar mengenai peristiwa sirah Rasulullah SAW dengan membangunkan satu bahan bantu mengajar (BBM). Pendekatan ini mempersembahkan fakta sejarah secara visual dan konkrit, membolehkan pelajar menelusuri perjalanan Sirah Rasulullah SAW dari awal, penjelasan lokasi penting

dan peristiwa-peristiwa utama pada setiap tahun hayat Rasulullah SAW. Objektif utama inovasi ini adalah untuk memperkukuh kefahaman pelajar terhadap konteks dan makna peristiwa dalam Sirah, menggalakkan pendekatan visual dalam pembelajaran Sirah, serta memupuk minat dan penghayatan mendalam terhadap sejarah Islam. Melalui pengalaman pembelajaran yang bersifat fizikal, interaktif dan naratif, Nadi sirah ini diharapkan dapat membantu pelajar mengaitkan fakta sejarah dengan realiti secara lebih berkesan.

Pendekatan NALI

Pendekatan NALI (New Academia Learning Innovation) yang diaplikasikan dalam projek ini berteraskan kepada heutagogi, iaitu pembelajaran kendiri yang fleksibel dan berpusatkan pelajar. Nadi Sirah membolehkan pengguna meneroka kandungan secara autonomi mengikut minat dan tahap penguasaan mereka, selari dengan prinsip pembelajaran sepanjang hayat. Keupayaan ini diperkukuh dengan integrasi Chatbot AI Sirah yang membolehkan pengguna mendapatkan jawapan segera, penjelasan kontekstual, dan rujukan muktabar secara interaktif, sekali gus memperluas peluang pembelajaran di luar bilik darjah. Selain itu, pendekatan blended learning turut diterapkan melalui integrasi bahan dalam talian seperti video ilmiah, permainan interaktif, dan artikel sirah yang disokong oleh teknologi web responsif. Gabungan elemen-elemen ini menyokong aspirasi NALI dalam menggalakkan kemahiran abad ke-21, termasuk pemikiran kritis, kreativiti, literasi digital, serta kemahiran interaksi dengan teknologi kecerdasan buatan dalam konteks pendidikan Islam.

Metodologi Kajian

Metodologi inovasi ini melibatkan membangunkan laman sesawang Interaktif serta Chatbot Ai berdasarkan kajian kualitatif pada pengkajian kitab tentang perjalanan kehidupan Rasulullah SAW. "Garis masa Inetraktif" yang telah dibangunkan lebih awal pada NALI 2024 telah dikembangkan lagi dalam kajian NALI 2025 kali ini dengan sepenuhnya digital dengan merujuk kitab Sirah ke atas 20 buah sumber yang diiktiraf seperti *Ar-Raheequl Makhtum* (1996); *Biografi Muhammad bin Abdullah: Perjalanan hidup seorang nabi* (2010); *Sirah Nabi Muhammad SAW: Pengajaran & pedoman* (2001); *Nurul Yakin: Kitab sirah Rasulullah SAW* (1999); *Ini sejarah kita* (2015); *Muhammad: His life based on the earliest sources* (2006); Fiqh Sirah (2008); *Al-sirah al-nabawiyyah* (2010); *As-Syamail Muhammadiah* (2014); *Kelahiran teragung Junjungan mulia Muhammad* (2019); *Kisah ringkas kehidupan Rasulullah SAW* dan karya-karya ilmiah lain. Kod QR yang disertakan membolehkan akses kepada sumber digital tambahan.

Dapatan Kajian dan Perbincangan

Penemuan awal daripada ujian pengguna menunjukkan bahawa 90% pengguna menyatakan Nadi Sirah membantu mereka memahami kronologi kehidupan Rasulullah SAW dengan lebih jelas, berbanding pendekatan konvensional. Responden juga melaporkan bahawa elemen visual seperti garis masa dan info tambahan yang interaktif memberi impak besar terhadap pemahaman peristiwa sirah dalam konteks sejarah dan geografi. Selain itu, penggunaan naratif yang bersifat cerita turut meningkatkan aspek penghayatan dan emosi terhadap perjuangan Rasulullah SAW. Perbincangan juga menunjukkan bahawa pendekatan ini berpotensi untuk meningkatkan motivasi intrinsik pelajar, serta memperkasa guru dalam menyampaikan sirah secara lebih berkesan dan kontemporari. Projek ini menjadi bukti bahawa pengajaran sirah boleh ditransformasikan melalui teknologi tanpa menjejaskan ketulenan sumber.

Maklumat Lain

Bahan pengajaran ini mempunyai potensi tinggi untuk dikomersialkan dan dikembangkan ke pelbagai peringkat pengguna, termasuk sekolah, institusi pendidikan tinggi, pusat komuniti, masjid dan organisasi bukan kerajaan (NGO) di dalam dan luar negara. Inovasi terdahulu dalam bentuk garis masa interaktif (NALI 2024) telah menerima pengiktirafan termasuk Pingat Emas atas pelaksanaan kemahiran berfikir aras tinggi (KBAT) dalam pengajaran sirah. NADI SIRAH sebagai kesinambungan kepada inovasi tersebut kini disempurnakan dalam bentuk digital sepenuhnya dan mesra pengguna. Projek ini turut membuka peluang kolaborasi antara bidang pendidikan, teknologi dan industri kandungan kreatif Islam. Dalam jangka panjang, platform ini boleh dijadikan asas bagi pembangunan aplikasi mudah alih, kurikulum digital sirah, dan integrasi kecerdasan buatan untuk carian kandungan secara lebih mendalam.

Anugerah Diterima

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Silver Medal Award. Sirah Navigator. Virtual Innovation Competition Exhibition (VICE), 2024

Gold Medal Award. Implementation of Sirah Teaching Composition on Higher Order Thingking Skills (HOTs). Bulan Penyelidikan FSSH. 2023

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ID 64: AI- and AR-Enhanced Business Model Canvas: Bridging University and Communities to Ignite School-Based Entrepreneurship

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Highlights: Entrepreneurial mindset and skills remain underdeveloped among today's youth, leaving them unprepared for real-world challenges. To address this gap, a knowledge transfer project was designed for secondary school students in Kulai, Johor, with the aim of nurturing entrepreneurial competencies at an early age. The initiative introduced the Business Model Canvas (BMC) enhanced with Artificial Intelligence (AI) and Augmented Reality (AR) applications to help students solve authentic problems in their school cooperatives, particularly improving sales and operations. A key innovation was the Augmented Reality–Business Model Canvas (AR-BMC) eBook, an interactive resource that enabled students to access animated diagrams, tutorials, and case studies by scanning AR markers or QR codes. Guided by Kolb's Experiential Learning Theory and Problem-Based Learning (PBL), students engaged in real-world problem-solving, market research, and strategy design. As a practical outcome, several school cooperatives recorded noticeable sales growth after students applied their redesigned business models. Findings show that AI- and AR-enabled frameworks enrich entrepreneurial learning, fostering critical thinking, teamwork, and innovation while making education more practical and immersive.

Keywords: Business Model Canvas; Artificial Intelligence; Augmented Reality; Knowledge Transfer; School-Based Entrepreneurship

Introduction

In today's rapidly evolving entrepreneurial landscape, young people often lack the skills and mindset needed to navigate the complexities of business creation and management. Traditional school-based education often emphasizes rote learning and theoretical concepts, leaving students underprepared to apply entrepreneurial knowledge in practical settings (Miço & Cungu, 2023). This gap is particularly evident among secondary school students, who rarely have opportunities to experience entrepreneurship as a real-world, problem-solving activity. Without early exposure, students may struggle to develop innovative thinking, resilience, and the capacity to manage business challenges effectively in future.

To address this issue, the Young Innovators BMC Challenge was introduced as a knowledge transfer project targeting secondary school students in the Kulai district. The initiative leveraged the Business Model Canvas (BMC) integrated with Artificial Intelligence (AI) and Augmented Reality (AR) applications, reflecting the growing importance of digital transformation in entrepreneurship education (Al-Mamary, 2025). This innovative project enabled students to analyze and design solutions for their school cooperatives (also known as 'koperasi sekolah' in Malaysia), which faced practical challenges such as unsold stock, limited product variety, and weak customer engagement, real issues that became the foundation of learning. A key innovation was the AR-BMC eBook, which allowed students to access animated diagrams, tutorials, and case studies through AR markers and QR codes, thereby extending the learning beyond the classroom in an interactive and immersive way.

Grounded in Kolb's Experiential Learning Theory (ELT) and Problem-Based Learning (PBL), the project provided students with authentic, hands-on experiences. They engaged in market research, critical discussions, and solution design, moving through the stages of concrete experience, reflective observation, abstract conceptualization, and active experimentation. This approach allowed them to bridge theory and practice, while cultivating entrepreneurial skills such as creativity, teamwork, and problem-solving (Santoso et al., 2023; Rodrigues, 2023). By situating learning within real-world cooperative challenges, the project not only enhanced students' entrepreneurial knowledge but also sparked confidence and motivation to think like young entrepreneurs. In doing so, it highlights the potential of integrating AI- and AR-enabled tools with experiential learning to cultivate an entrepreneurial mindset at an early age.

Objectives

The objectives of the teaching innovation are:

i. Introduce students to the BMC and teach AI-assisted enhancement methods: To equip students with both conceptual and technological skills. The BMC is a globally recognized framework that helps visualize, design, and innovate business models in a structured way. The integration of AI ensures students not only understand the fundamentals of business model but also adapt to the demands of digital transformation in the real world.
ii. Apply the BMC in school cooperatives to improve planning and boost sales: To emphasize the practical application of the BMC. School cooperatives serve as a real-life laboratory where students can implement

the theoretical knowledge they have learned. The end goals are to improve the strategic planning capacity of the cooperative and to boost its sales performance, while simultaneously providing students with hands-on experience in entrepreneurship and problem-solving.

iii. Create an AR-BMC eBook as a practical guide for future projects: To allow students to interact with content in an immersive way. By scanning AR markers or QR codes, students can access digital resources such as animated BMC diagrams, interactive case studies, step-by-step tutorials, and demonstrations of AI tools applied to business contexts. The AR-BMC eBook will serve as a practical toolkit for future student projects, entrepreneurial ventures, and even community-based business initiatives.
iv. Enhanced Entrepreneurial Skills: Students learned to apply business concepts using the BMC, strengthening creativity,critical thinking, and opportunity recognition.
v. Practical Skills, AI, AR, & Digital Literacy: Exposure to AI- and AR-enhanced BMC tools improved students' digital literacy, analytical skills, and adaptability in technology-supported decision-making.
vi. Collaborative Problem-Solving: Team-based projects fostered communication, teamwork, and collective problem-solving by tackling real cooperative challenges.

NALI Approach

Impacts

The impacts of the teaching innovation:

i. Enhanced Entrepreneurial Skills: Students learned to apply business concepts using the BMC, strengthening creativity,critical thinking, and opportunity recognition.
ii. Practical Skills, AI, AR, & Digital Literacy: Exposure to AI- and AR-enhanced BMC tools improved students' digital literacy, analytical skills, and adaptability in technology-supported decision-making.
iii. Collaborative Problem-Solving: Team-based projects fostered communication, teamwork, and collective problem-solving by tackling real cooperative challenges.

Novelty and Innovativeness

The novelty of the designed Entrepreneurial experiential learning through 'AI- and AR-enhanced BMC' are:

i. Guided BMC development for real cooperative projects where students can engage in a step-by-step, mentor-guided process that allows them to explore each of the nine building blocks of the BMC in a practical context with the guidance of AI tools.
ii. Live strategy testing with real-time data feedback by allowing students to test and refine their cooperative strategies in a live environment, using real-time data as the basis for continuous improvement.
iii. AR-BMC eBook documenting the process for replication by transforming temporary teaching activities into a long-term, accessible, and engaging educational guide.

Applicability

Kolb Experiential Learning and Problem-Based Learning in Business Model Canvas (BMC):

Entrepreneurship education requires more than theoretical knowledge; it demands active engagement, reflection, and problem-solving. Two pedagogical approaches that effectively support this are Kolb's Experiential Learning Theory (ELT) and Problem-Based Learning (PBL), both of which can be integrated into the teaching of the BMC to enhance students' entrepreneurial competencies, particularly when supported by AI- and AR-enabled tools.

Kolb's ELT emphasizes a cyclical process of learning that consists of four stages: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation (Kolb, 1984). In the context of the AI- and AR-enhanced BMC, students begin with a Concrete Experience by engaging with real challenges faced by their school cooperatives, such as unsold inventory, limited product variety, or weak marketing strategies. They then move into Reflective Observation as they analyze these challenges, drawing insights from peers, teachers, and cooperative managers. The Abstract Conceptualization stage is reinforced by the BMC framework, where students map out key elements such as value propositions, customer segments, and revenue streams, aided by AI analytics or AR-visualized models. Finally, through Active Experimentation, students propose and test innovative strategies, such as diversifying product offerings or improving customer engagement—while using AI tools for forecasting and AR simulations for design, thereby applying their conceptual understanding in a practical and interactive setting. This cycle ensures that students not only gain knowledge but also internalize it through repeated application and reflection.

Complementing this, PBL positions students at the center of the learning process by confronting them with authentic problems that require collaborative solutions. Instead of passively receiving information, students work in teams to identify the root causes of cooperative challenges, conduct market research, and design feasible interventions using the AI- and AR-supported BMC. PBL encourages them to take ownership of their learning, develop inquiry skills, and practice critical thinking. Importantly, it mirrors the uncertainty and complexity of entrepreneurial practice, where problems are often ill-structured and require adaptive solutions (Yu & Zin, 2023).

Impact:

When ELT and PBL are combined in teaching the BMC, students experience a powerful learning process. ELT provides a structured framework for cycling through experience, reflection, and action, while PBL ensures that learning remains problem-driven and collaborative. Together, and with the integration of AI- and AR-driven applications, they transform the BMC from a static business planning tool into a dynamic learning platform where students not only understand entrepreneurial concepts but also apply them meaningfully. This integration fosters entrepreneurial mindset, practical skill development, and confidence in decision-making. By situating learning in authentic cooperative challenges and

leveraging an AI- and AR-enhanced BMC, students are empowered to think critically, act creatively, and embrace entrepreneurship as a lived experience rather than abstract theory.

Research Methodology

The integration of Kolb's Experiential Learning Theory (ELT) and Problem-Based Learning (PBL) provides a strong pedagogical foundation for teaching entrepreneurship through the AI- and AR-enhanced BMC. In the AI- and AR-enhanced BMC project, this integration was applied systematically to guide students through authentic business challenges in their school cooperatives, ensuring that learning was experiential, reflective, and problem-driven. The phases were designed in six steps, each aligning with Kolb's experiential cycle and PBL's problem-driven approach, ensuring that learning was both reflective and practical, as presented in Table 1.

Table 1: The integration of Kolb Experiential Learning Theory and Problem-Based Learning in AI- and AR-enhanced Business Model Canvas

Phase	Kolb's ELT Stage	PBL Element	Project Activity
Phase 1: Design & Prepare: Defining learning outcomes related to real-world problems in school cooperatives	Concrete Experience	PBL Trigger - Define project scope and context	UTM lecturers plan project flow, define learning outcomes, prepare AI-BMC resources; students were introduced to cooperative project scope.
Phase 2: Challenge Discovery: Identifying the pain points of the school cooperative	Concrete Experience	PBL Trigger- Define the real-world problem.	Students identify real cooperative challenges (e.g., low sales, limited products, poor marketing). UTM lecturers introduce BMC & AI tools via online class.
Phase 3: Investigate & Analyse: Conducting market research and mapping with AI-BMC	Reflective Observation	Problem analysis - Gather evidence to understand the issue.	Students conduct market research (interview cooperative managers, collect sales data, conduct surveys, and use AI) to assist in designing research tools.
Phase 4: Implement & Test: Bringing the BMC to life	Abstract Conceptualisation → Active Experimentation	Generate & test solutions – Plan strategies and apply them in real settings.	Students create an initial BMC based on findings, using AI for strategy ideas, marketing plans, and product innovations; implement strategies in cooperative for two weeks.
Phase 5: Pitch & Share: Presenting and refining BMC solutions for the school cooperative	Reflective Observation → Active Experimentation	Evaluate, refine & present solutions – Share findings, receive feedback, and propose improvements.	Analyse results, compare with initial goals, and pivot the BMC using AI insights to improve further; prepare AI-enhanced pitch decks and present to judges.
Phase 6: Evaluate, Improve & Design AR-BMC eBook: Consolidating lessons into the AR-BMC resource	Reflective Observation → Abstract Conceptualisation	Knowledge transfer & documentation – Consolidate learning into a reusable resource.	Collect sales and learning data, reflect on outcomes, and design an Augmented Reality BMC eBook featuring project insights for future learning.

Through this integrated model, the BMC became more than a planning tool; it evolved into an experiential learning platform. By cycling through Kolb's stages and tackling ill-structured problems via PBL, students not only learned entrepreneurship but lived it, developing practical skills, teamwork, and innovation capacity grounded in real-world application. The following pictures represent the phases of the project:

Phase 1 – Design & Prepare Program Learning Outcomes	Phase 2 – Challenge Discovery	Phase 3 – Investigate & Analyse
 	 	 



Figure 1 depicts the integration of Kolb's Experiential Learning Theory and Problem-Based Learning within the six phases of the AI- and AR-enhanced BMC. It illustrates a cyclical process where students move from identifying real-world cooperative challenges to testing solutions, pitching ideas, and refining outcomes through continuous reflection and knowledge transfer.

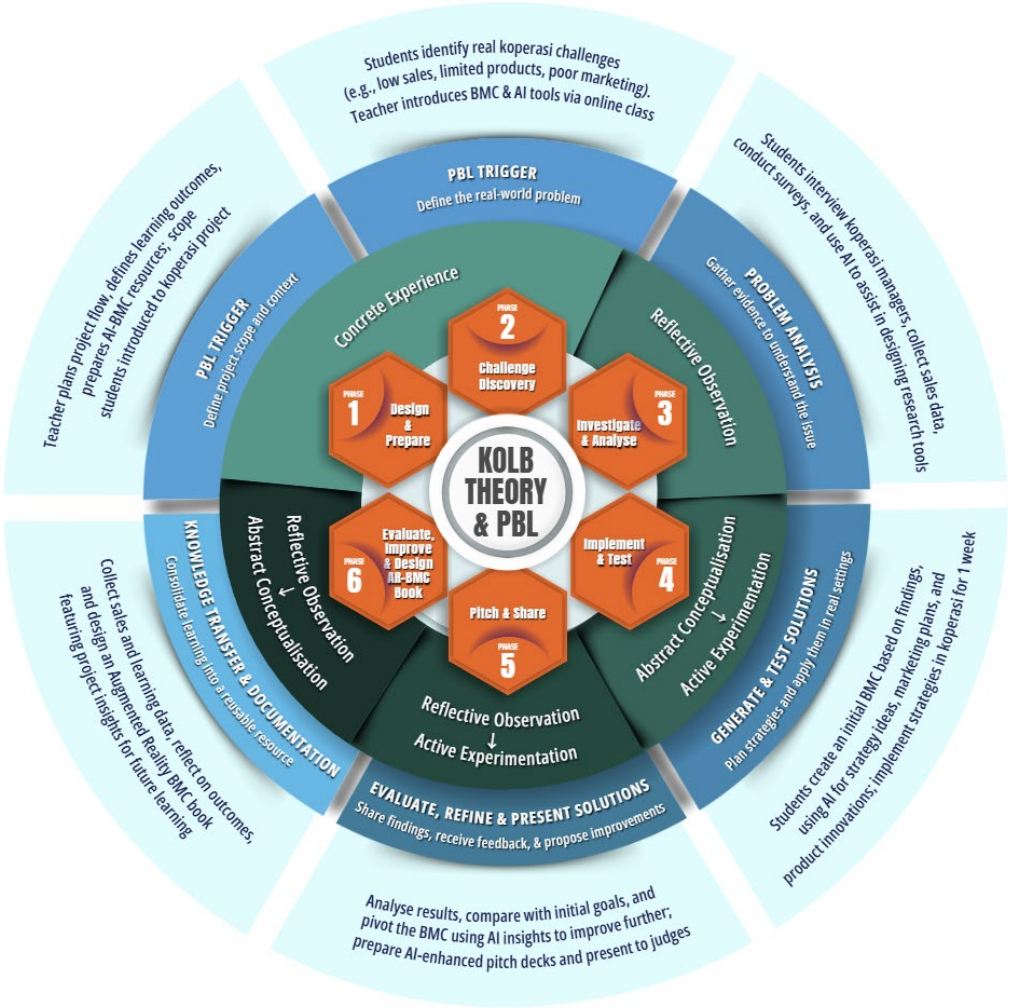


Figure 1: Kolb Experiential Learning Theory and Problem-Based Learning in AI- and AR-enhanced Business Model Canvas

Findings and Discussion

The knowledge transfer assessment shows clear improvements in students' entrepreneurial competencies after the AI-BMC Challenge. Post-test scores were consistently higher, with the largest gains in explaining all nine BMC components (80.35%), organizing business presentations using AI tools (80%), and presenting customer problems and solutions (80%). Identifying target customers and describing revenue strategies also rose by nearly 80%. Moderate gains appeared in explaining key activities and resources (59.62%), pitching for business model understanding (69.62%), and competition

readiness (60.66%). Communication-related skills such as public speaking (50.96%) and answering questions (26.78%) showed smaller but meaningful growth. Overall, integrating AI and AR tools into BMC learning significantly strengthened students' entrepreneurial knowledge, confidence, and ability to apply structured frameworks to real cooperative challenges.

Table 2: Pre and Post test of Knowledge transfer through AI- and AR-enhanced Business Model Canvas

Questions	Pre-test (mean)	Post-test (mean)	Changes (%)
I can organize a business presentation using BMC with AI tools.	1.85	3.33	80.00
I can explain all 9 BMC components confidently.	2.29	4.13	80.35
I can clearly present customer problems and solutions.	2.05	3.69	80.00
I can identify target customers and explain their importance.	1.79	3.22	79.89
I can describe revenue strategies for our business.	2.03	3.65	79.80
I can explain key activities and resources in operations.	2.08	3.32	59.62
I am confident speaking in front of an audience.	2.08	3.14	50.96
I can answer questions about our BMC.	2.39	3.03	26.78
Pitching helps me understand our business model better.	1.87	3.17	69.62
I feel prepared to present in competitions or real-life situations.	1.83	2.94	60.66

Commercialisation Potential

The AI- and AR-enhanced BMC offers a few commercialisation values:

Educational Kits & Modules

The structured six-phase model can be packaged as a training kit (printed + digital) for schools, colleges, and entrepreneurship bootcamps. Schools can subscribe annually, receiving updated cases, AR-enhanced BMC guides, and facilitator toolkits.

Digital Platforms & AR-BMC eBook

The planned AR-BMC eBook can be transformed into a mobile/web app, allowing students and teachers to interact with AI-supported templates, survey tools, and pitching simulations. Licensing the AR-BMC resource provides a recurring revenue model.

Training & Consultancy Services

Teachers and cooperative managers can be trained through professional certification workshops on AI-BMC, making UTM a hub for entrepreneurship education. Corporates and development agencies could sponsor or adopt the program for CSR initiatives, extending impact while generating income.

Conclusion

This study demonstrates that integrating the BMC with AI and AR tools offers an effective approach to nurturing entrepreneurial competencies among secondary school students. By addressing authentic challenges within school cooperatives, students not only gained practical entrepreneurial knowledge but also developed critical thinking, problem-solving, and collaborative skills. The project underscores the value of experiential and problem-driven learning in making entrepreneurial education more relevant and impactful. Furthermore, the findings suggest that AI- and AR-enabled frameworks can significantly enrich students' preparedness to face real-world opportunities.

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ID 65: Pengajaran dan Pembelajaran (PdP) melalui pendekatan P-TED: Mengajar dengan Gaya, Mendidik dengan Jiwa dalam Memperkasa Kemahiran Etika dan Digital Pelajar

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Sorotan: Dalam era teknologi masa kini, graduan perlu memiliki gabungan kemahiran etika dan literasi digital yang seimbang. Pendekatan Pembelajaran Teradun dan Kolaboratif (P-TED) digabungkan dengan konsep mengajar dengan gaya, mendidik dengan jiwa untuk membentuk pelajar yang cemerlang akademik, berkeperibadian mulia, dan mahir teknologi. P-TED mengintegrasikan pembelajaran bersemuka dan dalam talian bagi meningkatkan keterlibatan pelajar, manakala mengajar dengan gaya, mendidik dengan jiwa menekankan penerapan nilai murni melalui komunikasi berhemah, bimbingan berstruktur, dan penyampaian yang menyentuh hati. Aktiviti seperti penghasilan video tamadun, pembentangan, dan penulisan artikel digunakan untuk mengasah kemahiran kolaborasi, komunikasi beretika, serta penguasaan teknologi digital. Analisis borang penilaian kursus menunjukkan teknik penyampaian ini berkesan dalam meningkatkan penglibatan pelajar dan memupuk kemahiran etika serta literasi digital secara serentak. Dapatan membuktikan bahawa P-TED dengan sentuhan mengajar dengan gaya, mendidik dengan jiwa mampu menjadi strategi pengajaran yang holistik, menghubungkan pencapaian akademik dengan pembentukan keperibadian pelajar, selaras dengan keperluan pendidikan abad ke-21.

Kata Kunci: Pengajaran dan Pembeljaran; P-TED, mengajar; mendidik; Kemahiran; etika; digital

Pengenalan

Dalam era teknologi masa kini, graduan bukan sahaja perlu menguasai ilmu akademik, malah perlu memiliki keseimbangan antara kemahiran etika dan literasi digital. Kajian-kajian terkini menunjukkan bahawa pembelajaran teradun (*blended learning*) mampu meningkatkan penglibatan pelajar secara kognitif, afektif dan sosial, khususnya apabila digabungkan dengan pembelajaran kolaboratif dan berasaskan aktiviti (McCarthy, 2023; De Bruijn-Smolders, 2024). Blended learning juga merupakan integrasi pengajaran secara bersemuka dan pengajaran dalam yang talian telah diterima pakai secara meluas di seluruh pengajian tinggi (Graham, 2013). Tambahan pula, pembelajaran teradun berasal daripada latihan korporat yang dilakukan dalam dunia perniagaan (Sharma & Barret 2007. Pendekatan ini bukan sahaja relevan dalam bidang pendidikan umum, malah penting dalam pendidikan teknikal seperti kejuruteraan elektronik, di mana penguasaan teknologi perlu disokong oleh adab dan keperibadian yang baik (Vuu, 2024; Stelios, 2025).

Pada masa yang sama, agenda transformasi digital pendidikan menekankan keperluan pendekatan berpusatkan insan, di mana teknologi berperanan sebagai alat sokongan kepada hubungan pensyarah–pelajar yang harmoni, bukannya pengganti (UNESCO, 2023). Dalam konteks ini, konsep Mengajar dengan Gaya, Mendidik dengan Jiwa memberi penekanan kepada penyampaian ilmu yang berkesan, bersulam nilai murni, komunikasi berhemah, dan bimbingan secara berstruktur (Löper, 2024). Pendekatan Pembelajaran Teradun dan Kolaboratif (P-TED) digabungkan dengan falsafah ini dilihat berpotensi membentuk pelajar yang seimbang dari segi pengetahuan, kemahiran digital, dan etika.

Objektif

Berikut adalah objektif Pengajaran dan Pembelajaran (PdP) melalui pendekatan P-TED iaitu Mengajar dengan Gaya, Mendidik dengan Jiwa dalam Memperkasa Kemahiran Etika dan Digital Pelajar:

i. Menilai keberkesanan gabungan pendekatan P-TED dengan falsafah Mengajar dengan Gaya, Mendidik dengan Jiwa dalam memperkukuh kemahiran etika dan literasi digital pelajar.
ii. Mengenal pasti teknik penyampaian pengajaran yang menyumbang kepada peningkatan penglibatan, komunikasi berhemah, dan kerjasama pelajar.

Pendekatan NALI

Novelty

i. Menggabungkan pendekatan P-TED dengan falsafah Mengajar dengan Gaya, Mendidik dengan Jiwa untuk memupuk kemahiran etika dan literasi digital secara serentak.
ii. Menggunakan data borang penilaian kursus sebagai bukti keberkesanan teknik pengajaran, menggantikan ukuran berasaskan OBE.
iii. Memanfaatkan aktiviti autentik seperti penghasilan video bertemakan tamadun, pembentangan

berkumpulan, dan penulisan artikel akhbar untuk menghubungkan nilai etika dengan produk digital.

Kesan terhadap Pembelajaran Pelajar

Pelaksanaan pendekatan P-TED: Mengajar dengan Gaya, Mendidik dengan Jiwa telah memberikan impak positif yang signifikan terhadap proses pembelajaran pelajar. Hasil maklum balas melalui borang penilaian kursus menunjukkan beberapa perkembangan utama:

i. Peningkatan Penguasaan Kemahiran Digital
Pelajar lebih cekap mengaplikasikan teknologi digital untuk tugasan akademik, komunikasi, dan kolaborasi dalam talian, selaras dengan keperluan pembelajaran abad ke-21 (Rahman et al., 2023).

ii. Pengukuhan Nilai Etika dan Sikap Profesional
Penerapan unsur nilai murni dan akhlak melalui interaksi berfokus hati ke hati telah membantu membentuk sahsiah pelajar yang lebih berdisiplin, menghormati norma akademik, dan mengamalkan etika penggunaan teknologi yang betul (Yusof & Hamid, 2022).

iii. Peningkatan Motivasi dan Penglibatan Aktif
Pelajar menunjukkan tahap penglibatan yang lebih tinggi dalam aktiviti PdP, sama ada secara bersemuka atau dalam talian, disebabkan pendekatan yang mesra, inklusif, dan interaktif.

iv. Pemantapan Kemahiran Insaniah (Soft Skills)
Pendekatan ini turut menyumbang kepada peningkatan kemahiran komunikasi, kepimpinan, dan kerja berpasukan, sekali gus menyokong penghasilan graduan yang holistik seperti digariskan dalam Pelan Pembangunan Pendidikan Malaysia 2015–2025 (Pendidikan Tinggi).

v. Pencapaian Akademik yang Lebih Konsisten
Kejelasan penyampaian dan keseimbangan antara bimbingan akademik dengan pembinaan nilai telah membantu pelajar mencapai hasil pembelajaran kursus (CLO) secara lebih konsisten.

Pendekatan P-TED: Mengajar dengan Gaya, Mendidik dengan Jiwa dibangunkan dengan gabungan strategi pedagogi moden dan elemen pembinaan nilai, menjadikan PdP bukan sekadar proses penyampaian ilmu tetapi pengalaman pembelajaran yang bermakna dan menyentuh emosi pelajar. Elemen kreatif yang diperkenalkan meliputi:

i. Integrasi Pembelajaran Teradun (*Blended Learning*) dengan Sentuhan Nilai
Tidak sekadar menggabungkan sesi bersemuka dan dalam talian, tetapi menyuntik unsur nilai murni secara terancang dalam setiap aktiviti, termasuk tugasan berkumpulan, lakonan video, dan penulisan kreatif.

ii. Penggunaan Aktiviti Autentik dan Kontekstual
Aktiviti seperti lakonan video tamadun dan penulisan artikel akhbar memberikan konteks dunia sebenar, membolehkan pelajar mengaplikasikan kemahiran digital dan etika secara praktikal.

iii. Pendekatan "Hati ke Hati" dalam Penyampaian
Walaupun berteraskan teknologi, hubungan manusiawi tetap menjadi fokus. Kaedah ini membina kepercayaan, rasa hormat, dan kesediaan pelajar untuk terlibat secara aktif.

iv. Pemupukan Nilai Melalui Role Modeling
Pensyarah menggunakan pendekatan role modelling tanpa perlu menonjolkan diri, sebaliknya membina suasana pembelajaran yang kondusif dan penuh teladan.

v. Penggabungan Media Pelbagai
Menggunakan video, platform pembelajaran digital, forum interaktif, dan pembentangan kreatif untuk memastikan pelajar dapat mengekspresikan idea dengan pelbagai medium.

Methodologi Kajian

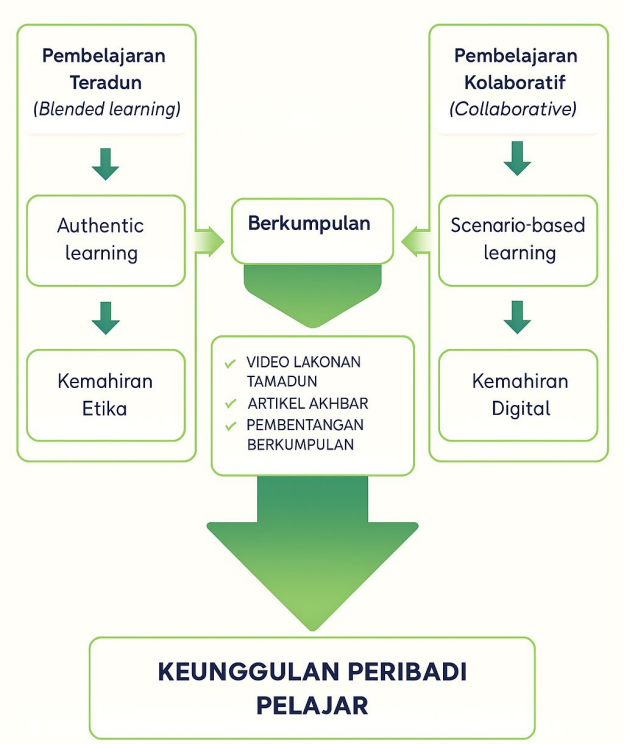
Sampel kajian ini melibatkan pelajar daripada dua seksyen berbeza yang mengikuti kursus Penghayatan Etika dan Peradaban (ULRS1182), di bawah Fakulti Sains Komputeran, dan Fakulti Kejuruteraan Mekanikal bagi Sesi 2024/2025 Semester 2, dengan jumlah pelajar seramai 176 orang iaitu seksyen 1 sejumlah 92 orang pelajar, manakal seksyen 2 berjumlah 84 orang pelajar. Rajah 1 menggambarkan Pengajaran dan Pembeljaran (PdP) melalui pendekatan P-TED iaitu mengajar dengan gaya, mendidik dengan jiwa dalam memperkasa kemahiran etika dan digital Pelajar terhadap gabungan proses penggunaan pembelajaran teradun dan pembelajaran kolaboratif. Tujuannya adalah bagi melahirkan pelajar yang memiliki akhlak yang baik dan serta berkemahiran dari aspek etika dan digital.

Pendekatan P-TED dilaksanakan sepanjang satu semester, menggabungkan sesi pengajaran bersemuka, pembelajaran dalam talian melalui platform e-pembelajaran universiti, dan aktiviti kolaboratif. Antara aktiviti utama yang dijalankan termasuk:

i. Lakonan video tamadun (aktiviti berkumpulan berasaskan 5 tamadun utama)
ii. Pembentangan berkumpulan dengan elemen nilai bekerjasama
iii. Penulisan artikel akhbar bertema isu etika dan teknologi
iv. Perbincangan reflektif berasaskan pendekatan *role modelling* oleh pensyarah

Data kajian diperoleh melalui borang penilaian kursus yang diisi oleh pelajar pada akhir semester. Analisis data menggunakan kaedah analisis deskriptif untuk mengenal pasti persepsi pelajar terhadap keberkesanan kaedah P-

TED dari aspek peningkatan kemahiran etika, kemahiran digital, dan pengalaman pembelajaran secara keseluruhan. Pada awal semester, pelajar telah diberi taklimat oleh pensyarah tentang proses pembelajaran yang melibatkan konteks pembelajaran secara teradun dan kolaboratif iaitu melibatkan pembelajaran secara bersemuka dan secara atas talian. Para pelajar dibahagikan kepada 10 kumpulan bagi melaksanakan aktiviti pembelajaran secara *authentic* dan *scenario-based*. Pembelajaran *authentic* dilaksanakan bagi memastikan pelajar memahami situasi yang nyata dan sebenar disamping dapat menyelesaikan pelbagai masalah yang berkait dengan kemahiran etika



Rajah 1: Pengajaran dan Pembeljaran (PdP) melalui pendekatan P-TED

Disamping itu, pembelajaran *scenario-based* pula digunakan bagi mempamerkan kemahiran dan pengetahuan yang dikuasai oleh pelajar. Situasi sebenar diterangkan kepada pelajar kerana situasi tersebut mungkin akan ditemui dalam kehidupan sebenar. Pelajar akan lebih bermotivasi untuk menyelesaikan masalah secara intrinsik apabila scenario yang diberikan adalah lebih menarik (Hmelo-Silver, 2004). Justeru, pembelajaran secara *scenario-based* ini mampu meningkatkan tahap kemahiran digital para pelajar melalui rakaman dan suntingan video lakonan yang berkait dengan penghayatan etika.

Terdapat beberapa aktiviti yang dilaksanakan secara berkumpulan oleh para pelajar bagi memastikan pelajar dapat berinteraksi dan bekerja secara dalam kumpulan. Berikut merupakan aktiviti yang dilaksanakan:

i. Berbincang dan menghuraikan definisi etika daripada pelbagai perspektif.
ii. Membuat penulisan artikel berkenaan tamadun yang terpilih.
iii. Membuat video lakonan mengenai kehidupan masyarakat dalam pelbagai tamadun.
iv. Membuat peta minda berdasarkan subtopik yang diberikan dengan menggunakan canva.
v. Membuat penulisan artikel akhbar mengikut kreativiti ahli kumpulan masing-masing berdasarkan tajuk yang dipilih.

Kesimpulannya, aktiviti yang dibuat adalah melahirkan keunggulan peribadi pelajar yang lebih beradab dan berakhlak mulia selaras dengan keperluan pendidikan abad ke-21.
Kebolehgunaan: Pendekatan P-TED: *Mengajar dengan Gaya, Mendidik dengan Jiwa* mempunyai pelbagai potensi aplikasi yang melangkaui konteks bilik kuliah asal. Model ini boleh dimanfaatkan dalam:

i. *Pengajaran dan Pembelajaran di Institusi Pendidikan Tinggi*
Sebagai rangka kerja bersepadu yang menggabungkan pembelajaran teradun dan kolaboratif dengan pemupukan nilai etika serta kemahiran digital, ia boleh dijadikan modul latihan pensyarah bagi meningkatkan keberkesanan penyampaian PdP.

ii. *Latihan Profesional dan Industri*
Digunakan dalam program pembangunan profesional berterusan (CPD) untuk meningkatkan kemahiran komunikasi digital dan etika kerja dalam persekitaran industri yang berasaskan teknologi.

iii. *Pembangunan Modul dan Polisi Institusi*
Menjadi rujukan bagi pembangunan modul etika digital di universiti dan kolej, sekali gus menyokong pencapaian domain nilai, sikap dan profesionalisme dalam Kerangka Kelayakan Malaysia (MQF).

iv. *Penyelidikan Pendidikan*

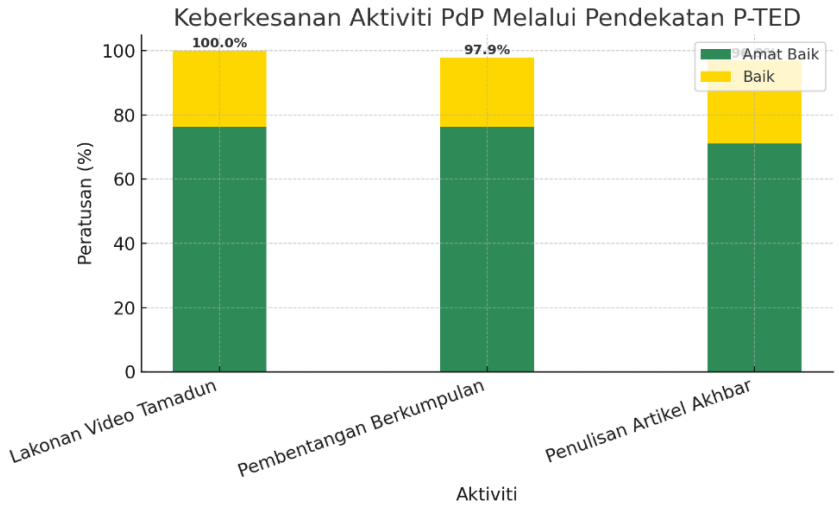
Menyediakan asas instrumen dan indikator untuk kajian lanjut berkaitan integrasi nilai murni dalam pembelajaran digital, literasi digital, dan pembentukan sahsiah pelajar.

v. *Pendidikan Komuniti dan Sekolah*

Diadaptasi untuk program pendidikan komuniti dan sekolah menengah bagi membimbing pelajar serta masyarakat menjadi pengguna teknologi yang beretika dan bertanggungjawab.

Dapatan Kajian dan Perbincangan

Dapatan kajian menunjukkan pendekatan P-TED yang dilaksanakan pensyarah memberi impak positif yang tinggi terhadap penguasaan kemahiran etika dan digital pelajar. Aktiviti lakonan video tamadun secara berkumpulan mencatatkan 76.3% respon amat baik dan selebihnya baik. Begitu juga pembentangan berkumpulan menerima 76.3% amat baik dan 21.6% baik, manakala tugasan artikel akhbar memperoleh 71.1% amat baik dan 25.8% baik. Aktiviti yang paling memberi kesan kepada pelajar adalah lakonan (51 respon), diikuti pembentangan berkumpulan (33), artikel (9) dan lain-lain tugasan. Pelajar melaporkan peningkatan nilai seperti etika, tanggungjawab, integriti, kerjasama, keadilan, saling menghormati, kasih sayang, serta penghargaan terhadap kepelbagaian budaya, agama, dan cara hidup. Dari sudut penyampaian, 91.8% menilai pensyarah amat baik, manakala selebihnya baik. Sebanyak 99% pelajar mengesahkan pensyarah menunjukkan contoh adab dan nilai murni sepanjang PdP, antaranya bertanggungjawab, menepati masa, jujur, baik hati, sabar, hormat pandangan pelajar, adil, ikhlas, sopan santun, disiplin, dan empati tinggi terhadap pelajar. Pelajar turut menekankan bahawa sikap-sikap ini wajar dicontohi dalam kehidupan seharian kerana memberi inspirasi kepada mereka untuk membentuk peribadi yang beretika dan berintegriti. Maklum balas keseluruhan menunjukkan pendekatan P-TED bukan sahaja memperkukuh penguasaan kandungan akademik, malah membina nilai-nilai murni yang relevan dengan pembentukan modal insan seimbang. Ringkasan peratusan maklum balas pelajar boleh dilihat melalui Rajah 2.



Rajah 2

Jadual 1 menunjukkan aktiviti PdP yang dijalankan berserta Kemahiran etika dan digital yang dikembangkan beserta bukti daripada borang penilaian kursus.

Jadual 1: Kemahiran etika dan digital

Aktiviti PdP	Kemahiran Etika yang Dikembangkan	Kemahiran Digital yang Dikembangkan	Bukti daripada Borang Penilaian Kursus
Lakonan video bertemakan tamadun (berkumpulan)	-Kerjasama dan toleransi dalam kumpulan -Menghormati pendapat rakan -Mematuhi peranan dan masa	-Penggunaan kamera/perisian suntingan -Pencarian maklumat dan media digital -Penerbitan kandungan video	-Pelajar menyatakan aktiviti ini menggalakkan kerjasama erat dan mengasah kemahiran menggunakan teknologi video
Pembentangan berkumpulan	-Keyakinan diri dan komunikasi beretika -Mendengar secara aktif -Memberi penghargaan kepada sumbangan ahli kumpulan	-Penggunaan perisian pembentangan (PowerPoint, Canva, dsb.) -Integrasi media digital dalam slaid	-Penilaian menunjukkan pelajar menghargai maklum balas membina pensyarah dan contoh tutur kata sopan ketika sesi pembentangan
Penulisan artikel akhbar (berkumpulan)	-Menyampaikan mesej dengan bahasa yang sopan dan berfakta	-Pemprosesan teks dan format penerbitan	-Data menunjukkan pelajar menilai positif pensyarah yang membimbing proses

Aktiviti PdP	Kemahiran Etika yang Dikembangkan	Kemahiran Digital yang Dikembangkan	Bukti daripada Borang Penilaian Kursus
	-Menghormati sensitiviti pembaca	-Penyelidikan maklumat digital	penulisan secara berhemah dan memberi contoh penggunaan bahasa baik
Penyampaian pensyarah dalam kuliah bersemuka dan atas talian	-Menunjukkan adab menghormati pelajar -Kesabaran dalam menjawab soalan -Memberi maklum balas positif	-Penggunaan platform LMS, Webex, Google Meet untuk perkongsian bahan	-Borang penilaian kursus merekodkan skor tinggi bagi item "Pensyarah menunjukkan teladan nilai murni" dan "Pensyarah memberi panduan yang jelas dan beradab"

Berdasarkan Jadual 1, dapat dirumuskan bahawa pendekatan yang dilaksanakan ini berjaya mengintegrasikan penguasaan kemahiran etika dan kemahiran digital secara seimbang melalui pelbagai aktiviti PdP yang interaktif. Aktiviti seperti lakonan video, pembentangan berkumpulan, dan penulisan artikel akhbar bukan sahaja membina nilai kerjasama, komunikasi beretika, dan penghormatan terhadap pendapat serta sensitiviti pihak lain, malah turut mengasah kemahiran teknikal seperti penggunaan perisian suntingan, penghasilan kandungan digital, dan penguasaan platform pembelajaran dalam talian. Penyampaian pensyarah yang menonjolkan adab, kesabaran, dan maklum balas positif turut menjadi teladan berkesan dalam membentuk karakter pelajar. Dapatan daripada borang penilaian kursus menunjukkan pelajar memberikan maklum balas positif dan skor tinggi terhadap keberkesanan aktiviti serta sikap pensyarah, sekali gus membuktikan bahawa pendekatan ini memberi impak signifikan dalam memperkasa kemahiran etika dan digital pelajar secara serentak.

Kesimpulan

Pendekatan P-TED: Mengajar dengan Gaya, Mendidik dengan Jiwa telah membuktikan potensinya sebagai satu strategi Pengajaran dan Pembelajaran (PdP) yang bukan sahaja meningkatkan keberkesanan penyampaian ilmu, malah memperkasa kemahiran etika dan digital pelajar secara serentak. Melalui kombinasi gaya pengajaran yang kreatif dan pendekatan pendidikan yang berasaskan jiwa, pelajar bukan sekadar memperoleh pengetahuan, tetapi turut menghayati nilai murni seperti integriti, tanggungjawab, dan toleransi yang penting dalam kehidupan profesional. Walaupun pelaksanaannya berdepan pelbagai cabaran seperti kekangan masa, perbezaan tahap kemahiran, dan komitmen pelajar yang tidak seimbang, penyelesaian strategik seperti pembelajaran terbalik (*flipped classroom*), bimbingan teknikal berfasa, penilaian berasaskan sumbangan individu, dan integrasi pembelajaran hibrid telah membolehkan cabaran tersebut diatasi dengan berkesan. Justeru, P-TED wajar diperluas penggunaannya dalam pelbagai konteks pendidikan tinggi kerana ia bukan sahaja relevan dengan tuntutan Revolusi Industri 4.0, tetapi juga menyumbang kepada pembentukan graduan yang holistik, beretika, dan berdaya saing di peringkat global.

Rujukan

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ID 66: AI-Driven Mastery-Based Learning for Higher Education (StudyPal: Your AI Mentor for Smarter Study)

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Highlights: In Malaysian higher education, especially in demanding courses, many students complete courses without achieving full mastery of intended learning outcomes (LOs). Current Learning Management Systems (LMS) focus on course completion rather than competence, leading to unresolved knowledge gaps, fragmented retention, and weak application skills. Assessments are rarely aligned with Bloom's taxonomy, and large class sizes limit personalised guidance. StudyPal introduces a mastery-based, AI-driven approach to address these challenges. Using a multi-agent architecture, it maps instructor-created assessments to LOs and Bloom's taxonomy, identifies individual gaps, and delivers personalised feedback, targeted practice, adaptive sequencing, and regenerative assessments. This continuous mastery loop ensures students' progress with deep understanding, higher-order thinking skills, and sustained knowledge retention.

Keywords: Multi-agent AI architecture; adaptive tutoring; mastery-based learning; personalised learning feedback; knowledge retention; Bloom's taxonomy alignment.

Introduction

In higher education, traditional learning models and online learning platforms often measure success by course completion rather than ensuring every student masters the course. This results in students advancing with unresolved learning gaps, inconsistent retention, and limited ability to apply knowledge in real-world contexts. Existing LMS and AI tutoring tools provide limited personalisation and do not guarantee mastery of defined LOs (Saher et al., 2022). The linear learning model typically delivers one-size-fits-all content that overlooks the diverse learning styles and abilities, enforces fixed pacing for all students, and encourages surface learning where completion takes precedence over comprehension. Assessments often highlight weaknesses but fail to ensure targeted remediation.

From lecturers' perspectives, these limitations are due to generic feedback systems that lack personalisation, the mentor scalability crisis, where lecturers cannot provide individual attention to large cohorts, and the absence of systematic mechanisms to verify mastery of LOs. High enrolment rates often cause a rapid drop in student engagement. According to Ma (2025), students in massive open online courses (MOOCs) often experience cognitive overload when tackling difficult concepts, and this confusion is worsened by generic guidance such as review materials rather than providing targeted support and personalised feedback.

To better understand the underlying factors contributing to incomplete mastery in large-scale online courses, a root cause analysis was conducted. Recent literature has identified both systemic issues and technological gaps (Karim et al. (2025)). These studies, along with Liu et al. (2024) and Ma (2025), emphasise that lack of personalised guidance leads students to be fatigued and reduced engagement, suggesting that MOOC platforms should optimise content presentation and provide interactive, personalised support such as real-time question and answer sessions, tutoring, and adaptive feedback systems to reduce cognitive load and improve the student experience.

Repeated failures without targeted assistance also result in declining motivation, indirectly influencing dropout rates (Aldowah et al., 2020). The root cause analysis reveals that MOOCs show intertwined systemic and technological gaps that prevent mastery learning. These barriers explain why students often plateau at partial understanding, lose motivation and experience fragmented knowledge retention. Internal course trend analytics from the Programming Technique II cohort at UTM indicate that approximately 26% of students have progressed with unresolved prerequisite mastery gaps. This correlates with an estimated 11% lower average performance across all CLO and PLO measures related to knowledge implementation, along with a notable increase in failure rates in subsequent courses. The targeted improvement aims to close these gaps, enhance learning retention, and reduce downstream failure rates. Addressing these market gaps requires an innovation that integrates global best practices with locally relevant design. StudyPal fulfils this need through adaptive sequencing, regenerative assessment, and personalised AI tutoring, ensuring mastery-based learning is achievable and scalable within Malaysia's higher education ecosystem.

Table 1 presents the benchmarking of leading AI-driven tutoring systems, namely, Khanmigo, Squirrel AI Learning, and Carnegie Learning highlighting their focus areas and architecture insights. These platforms demonstrate proven strategies such as knowledge graph–based diagnosis, Bayesian Knowledge Tracing, adaptive sequencing, and teacher-assisted monitoring at scale. Such mechanisms address some of the systemic and technological gaps identified earlier, including the absence of mastery verification, lack of Bloom's taxonomy alignment in assessments, and limited personalisation in large cohorts. By analysing these systems, StudyPal's design draws on:

i. Khanmigo's integration of adaptive questioning aligned with cognitive levels.
ii. Squirrel AI's micro-level diagnosis of learning gaps via a knowledge graph and real-time difficulty adjustment.

iii. Carnegie Learning's mastery tracking using Bayesian Knowledge Tracing and adaptive sequencing.

Table 1: AI-Driven Tutoring Systems in Market

APPLICATIONS IN MARKET	FOCUS	ARCHITECTURE INSIGHTS	LOCAL ADAPTATION
Khanmigo Khanmigo (Khan Academy + GPT-4) is an AI tutor pilot in classrooms (US) for math, science, and programming (Shetye, 2024).	• Teacher dashboards for tracking progress. • Student chat-based AI mentor for real-time Q&A. • Integration with Bloom's taxonomy in adaptive questioning.	Built on OpenAI's GPT-4 model with Socratic-guided problem solving, integrated with Khan Academy's extensive content library, and prioritises learner discovery over simply providing answers.	Map adaptive questioning directly to Bloom's taxonomy for locally accredited LOs.
松鼠Ai 1对1 Squirrel Ai Learning Squirrel AI Learning uses AI to tailor lesson plans for each individual student. The company's AI researchers have access to the world's largest student databases (Wang et al., 2023).	• Knowledge graph-based diagnosis. • Real-time difficulty adjustment in questions. • Teacher-assisted AI monitoring for large classes.	Proprietary Intelligent Adaptive Learning System (IALS) using a micro-level knowledge graph that breaks down curricula into fine-grained learning points.	• Customise the knowledge graph to Malaysian course structures. • Implement real-time difficulty adjustment in large university lecture settings. • Deploy AI mentor dashboards for monitoring.
CARNEGIE LEARNING Carnegie Learning (Maths, Literacy and Languages), a longitudinal implementation study in US high schools and colleges; mixed-method research combining learning analytics and teacher interviews (Iqbal et al., 2025)	• Bayesian Knowledge Tracing-based skill diagnosis. • Adaptive sequencing with real-time difficulty adjustment. • Teacher-assisted AI monitoring to personalise instruction in large classes.	AI-powered intelligent tutoring system with step-by-step problem-solving support. It employs Bayesian Knowledge Tracing to model skill mastery, analyses student work-in-progress, provides just-in-time hints, and offers dashboards for teacher insights.	• Apply knowledge tracing to track mastery of programming concepts. • Use adaptive sequencing for foundation-level computer science courses. • Provide mentors with automated mastery reports aligned to accreditation standards.

These best practices form the basis of StudyPal's proposed multi-agent architecture, embedding Assessment, Learning Path, Adaptive Mentor, Progress Monitoring, and Regenerative Assessment Agents with knowledge tracing and Retrieval Augmented Generation (RAG). This ensures personalisation, continuous mastery verification, and adaptive remediation tailored for Malaysian higher education contexts, particularly in mastery-critical courses. This approach creates a transformative learning ecosystem where assessment, personalised learning feedback, and learning progression are tightly interlinked to ensure that students not only complete courses but achieve measurable and verifiable mastery with an emphasis on impact, innovation and scalability.

Objectives

The aim of this innovation is to develop an AI-driven, mastery-based learning platform that ensures students achieve verifiable competence before progressing to the next stage of their learning. This is supported by the following objectives:

i. To design and develop the StudyPal platform using a multi-agent architecture that integrates adaptive sequencing, knowledge tracing, and regenerative assessments.
ii. To implement and evaluate personalised AI tutoring and mastery verification mechanisms to ensure students attain mastery in every defined learning outcome.

NALI Approach

Novelty: StudyPal introduces a mastery-based, AI-driven learning platform that ensures every student achieves verifiable mastery of defined LOs before progressing. Unlike traditional MOOCs or LMS tools, it integrates continuous mastery verification with adaptive sequencing, preventing advancement without competency achievement.

Creativity: StudyPal innovatively integrates Bloom's taxonomy into personalised learning feedback loops. By aligning assessment questions and LOs with specific cognitive levels, the platform adapts feedback based on the student's cognitive development stage. This design ensures that learning activities not only strengthen foundational knowledge but also progressively foster higher-order thinking skills.

Innovativeness: The platform's core innovation lies in its integration of continuous mastery verification with adaptive sequencing. As students' progress, real-time performance data updates mastery models, dynamically reshaping learning paths and generating targeted assessments. This regenerative learning cycle seamlessly interweaves instruction and evaluation, reinforcing long-term knowledge retention and building student confidence.

Applicability and Impact: StudyPal's modular, agent-based architecture is scalable across different courses and adaptable to various higher education contexts. Educators/Mentors can embed domain-specific content and customise mastery thresholds, making it equally effective for both introductory and advanced courses. The system enhances student engagement, improves retention, and fosters graduate readiness by ensuring mastery of core competencies before progression. It integrates five AI agents:

- Assessment Agent
- Learning Path Agent
- Adaptive Mentor Agent
- Progress Monitoring Agent
- Regenerative Assessment Agent

Research Methodology

Phase 1: Problem Analysis & Architecture Design

Identify gaps in current higher education learning systems and design the StudyPal multi-agent architecture (as shown in Figure 1), incorporating adaptive sequencing, knowledge tracing, and RAG capabilities.

Phase 2: Multi-agent Platform Development

Build the StudyPal prototype, by integrating five core AI agents to deliver mastery-based learning pathways:

- **Assessment Agent:** Maps mentor provided questions to LOs and Bloom's taxonomy, ensuring accurate alignment between learning content and targeted cognitive levels.
- **Learning Path Agent:** Adapts content sequencing based on student performance, pre-requisite mastery, and learning style preferences.
- **Adaptive Mentor Agent:** Provides real-time explanations, personalised practice, and targeted supported.
- **Progress Monitoring Agent:** Tracks mastery across LOs.
- **Regenerative Assessment Agent:** Generates new and targeted assessment items until mastery is achieved for all outcomes.

Phase 3: Pilot Deployment

Conduct a pilot study among undergraduate students , initially focusing on programming courses due to their high complexity and defined learning outcomes. Students will be divided into intervention (StudyPal) and control (traditional LMS) groups, with performance monitored via pre- and post-tests, mastery progression logs, and mid-semester surveys.

Phase 4: Impact Evaluation & Scalability Assessment

Conduct a mixed-method evaluation to measure quantitative improvements in mastery rates, retention, and competency application, alongside qualitative insights from students and mentors. The pilot study will involve a sample of 50 students, enabling platform refinement and assessing scalability across different courses for broader adoption. This pilot targets ≥15% improvement in mastery rates across all CLOs and PLOs under Programming Technique (II), 90% of students shall achieve ≥65% increase in knowledge retention, and ≥70% student satisfaction.

As illustrated in Figure 1, StudyPal employs a mastery-based, AI-driven architecture to ensure every student achieves verifiable mastery of defined LOs before progressing. The platform operates through a continuous learn-practice-assess-feedback loop, dynamically adapting to student needs. Students and mentors interact via dedicated dashboards: mentors contribute assessments and track progress, while students receive personalised guidance. The Cognitive Model integrates five specialised AI agents with generative AI for adaptive sequencing, mastery tracking, and targeted remediation. The Assessment Agent maps mentor-provided questions to LOs and aligns them with Bloom's taxonomy cognitive levels (Remember, Understand, Apply, Analyse, Evaluate, Create) to ensure targeted skill development. Knowledge tracing continuously monitors skill acquisition, while RAG enriches learning with curated resources from local and cloud databases. StudyPal ensures mastery thresholds are met before advancement, closing the gap between completion and competence while aligning with accreditation standards.

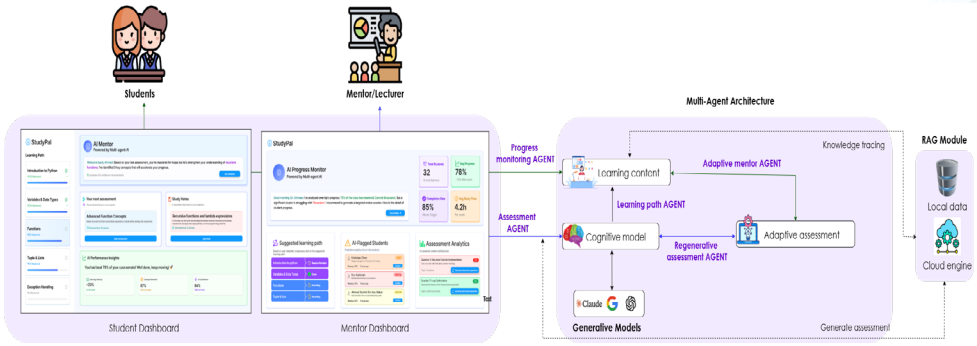


Figure 1: AI-Driven Multi-Agent Platform for Mastery-Based Learning

Commercial Value

i. **High-Impact Outcomes**: Improves student mastery, knowledge retention, and graduate readiness.
ii. **Multi-Agent AI Architecture:** Includes Assessment, Learning Path, Adaptive Mentor, Progress Monitoring, and Regenerative Assessment agents.
iii. **Beyond Traditional LMS:** Delivers mastery-based learning experiences with adaptive, personalised support.
iv. **Target Market:** Universities and colleges seeking improved learning outcomes, accreditation compliance, and strengthening competitive advantage.
v. **Phased Adoption Strategy:** Initial deployment in programming courses within the Faculty of Computing at UTM, chosen for their complexity and prerequisite mastery requirements, enabling a high-impact pilot. Once validated, expansion will progress to other courses and faculties within UTM before scaling to other Malaysian universities, minimising risks and controlling costs.
vi. **Key Advantages:** Measurable mastery tracking, automated feedback, seamless LMS integration, and scalable data-driven teaching.
vii. **Market Demand:** Aligns with global focus on graduate employability, accreditation compliance, and the adoption of AI-driven education technologies.
viii. **Revenue Model:** Institutional licensing and subscription options for cost-effective AI integration.
ix. **Competitive Differentiation:** Future-ready platform that ensures competency-based progression, strengthens curriculum delivery, and enhances institutional reputation through measurable student outcomes.

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ID 67: Penggunaan Kes Perniagaan dalam Pengajaran dan Pembelajaran bagi subjek Perakaunan Kewangan dan Pelaporan 5 (FAR 5) di Fakulti Pengurusan, Universiti Teknologi Malaysia

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Sorotan: Perakaunan Kewangan dan Pelaporan 5 atau *Financial Accounting and Reporting* 5 (FAR 5) adalah salah satu subjek teras utama dalam kursus Sarjana Muda Perakaunan dengan Kepujian di Fakulti Pengurusan, Universiti Teknologi Malaysia, Johor Bahru, Johor. Pendekatan pengajaran dan pembelajaran menggunakan kes perniagaan memberi kesan yang sangat positif kepada prestasi akademik pelajar. Penggunaan kes perniagaan daripada laporan tahunan syarikat digunakan bagi tujuan pengajaran dan pembelajaran bagi subjek FAR 5 antaranya Nestle Malaysia, CelcomDigi, IHH Healthcare Berhad, Maxis, Capital A Berhad, Maybank Berhad, IJM Corporation Berhad, Yinson Holdings Sendirian Berhad, Sime Darby Berhad, TMC Life Sciences Berhad, dan Hibiscus Petroleum Berhad. Ini dibuktikan secara empirikal dengan hasil keputusan akademik pelajar yang menunjukkan peningkatan nilai min (gred) 69.5% (B) kepada 73.4% (B+) bagi pelajar SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 Seksyen 1 Semester 2 Sesi 2024/2025. Berdasarkan tinjauan menggunakan *google form*, sebahagian besar pelajar sangat suka dengan pengajaran dan pembelajaran aktif secara dalam talian menggunakan Whatsapp, UTM E Learning dan WEBEX. Akhirnya, hasil kajian menunjukkan pembelajaran aktif masih dapat diteruskan melalui pengajran dan pembelajaran yang dilaksanakan secara dalam talian dan fizikal. Maklum balas pelajar secara majoriti lebih gemar dengan pendekatan secara bersemuka dalam pengajaran dan pembelajaran bagi subjek FAR 5.

Kata Kunci: Pengajaran dan Pembelajaran; Kajian Kes Perniagaan; Perakaunan Kewangan dan Pelaporan 5; Prestasi akademik; Fakulti Pengurusan

Pengenalan

Pengunaan kes perniagaan merupakan salah satu kaedah dalam penilaian bagi menilai prestasi kedudukan sesebuah pernigaan. Elemen penilaian menggunakan kes perniagaan berasaskan laporan tahunan syarikat berupaya melihat kedudukan sesebuah perniagaan bagi sesuatu tempoh perniagaan. Laporan tahunan syarikat seperti Nestle Malaysia, CelcomDigi, IHH Healthcare Berhad, Maxis, Capital A Berhad, Maybank Berhad, IJM Corporation Berhad, Yinson Holdings Sendirian Berhad, Sime Darby Berhad, TMC Life Sciences Berhad, dan Hibiscus Petroleum Berhad digunakan bagi melihat amalan praktis sesebuah syarikat berhubung dengan aktiviti pelaporan sosial korporat atau *Corporate Social Responsiblity* (CSR). Berdasarkan tinjauan menggunakan *google form* yang dibuat, lebih 60% pelajar menggunakan data daripada telefon untuk mengikuti pengajaran dan pembelajaran aktif secara dalam talian. Pengajar menggunakan pelbagai medium seperti Whatsapp, UTM E Learning dan WEBEX untuk menjalankan kelas secara dalam talian dan fizikal. Di samping itu, medium pengajaran dengan menggunakan Whatsapp, pengajar masih turut mengaplikasikan pembelajaran aktif seperti UTM E Learning, WEBEX waktu pengajaran dan pembelajaran secara dalam talian serta fizikal semasa mengendalikan kelas.

Objektif

Objectif memperkenalkan inovasi kaedah pengajaran dan pembelajaran termasuklah:

i. Untuk meningkatkan kefahaman para pelajar tentang asas ilmu menganalisa kes termasuk penggunaan kes perniagaan daripada laporan tahunan syarikat di Bursa Malaysia.
ii. Untuk menyediakan satu pengalaman amalan dunia perniagaan korporat kepada situasi sebenar pengajaran dan pembelajaran berdasarkan senario di kalangan para pelajar perakaunan melalui satu tugasan, sebagai contoh membuat analisa kes perniagaan berhubung pelaporan sosial korporat daripada kes perniagaan yang diambil daripada laporan tahunan syarikat.
iii. Untuk meningkatkan kefahaman ilmu analisa kes perniagaan dengan mendalami lebih lanjut ilmu perakaunan khususnya dengan menggunakan kes perniagaan seperti penggunaan beberapa laporan tahunan syarikat seperti Nestle Malaysia, CelcomDigi, IHH Healthcare Berhad, Maxis, Capital A Berhad dan Maybank Berhad.
iv. Untuk mengetahui tahap kefahaman pelajar tentang analisa yang dibuat berdasarkan kes perniagaan. Pelajar perlu menghasilkan laporan akhir analisa amalan pelaporan sosial korporat melalui penyediaan laporan berbentuk majalah *perfect bound binding*.

Pendekatan NALI

Di dalam usaha untuk menginovasi kaedah pengajaran dan pembelajaran bagi kursus Perakaunan Kewangan dan Pelaporan 5 atau *Financial Accounting and Reporting* 5, pelbagai medium inovasi pengajaran dan pembelajaran yang dilaksanakan pada subjek ini, antaranya ialah: i. Whasapp, ii. UTM E Learning iii. WEBEX, dan iv. Kajian Kes Perniagaan. Maklum balas daripada dapatan kajian ini diharapkan akan dapat membantu memberikan atau mengilhamkan idea atau kaedah baru kepada penyelidik dan pengajar untuk bagaimana menginovasi kaedah teknik pengajaran dan pembelajaran di dalam bilik kuliah bagi memastikan kaedah pengajaran dan pembelajaran yang lebih semasa, menarik, menawan dan dekat di hati para pelajar.

Metodologi Kajian

Terdapat 69 orang pelajar yang mendaftar seksyen 1 (47 orang) dan seksyen 2 (22 orang) bagi kursus SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 pada semester 2 sesi 2024/2025. Soal selidik yang digunakan untuk membuat tinjauan untuk pengajaran dan pembelajaran secara dalam talian dan fizikal dibina menggunakan *google form*. Soal selidik yang digunakan adalah diadaptasi daripada kajian Ali et al. (2020), Ali Khan (2021), Ali Khan (2022), Ali Khan (2023), dan Ali Khan dan Mohd Fuzi (2024) bagi mendapatkan pandangan balas daripada responden kajian. Tujuan tinjauan dibuat adalah untuk mengetahui tahap kesediaan pelajar terhadap perlaksanaan pembelajaran aktif dalam talian dan fizikal. Seterusnya, apabila selesai pengajaran secara dalam talian dan fizikal, sekali lagi tinjauan diedarkan kepada pelajar dalam bentuk *google form* untuk mendapatkan respon pelajar terhadap perlaksanaan pengajaran dan pembelajaran aktif secara dalam talian serta fizikal yang telah diikuti sepanjang sesi pengajian semester berlangsung. Pensyarah seterusnya membuat penambahbaikan terhadap respon yang dinyatakan oleh pelajar.

Dapatan Kajian dan Perbincangan

Berdasarkan tinjauan yang dibuat terhadap prestasi akademik, didapati min bagi subjek SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 pada semester 2 sesi 2024/2025 ialah 73.4% (B+). Manakala, didapati bahawa majoriti pelajar di dalam seksyen ini memperoleh gred B+ dengan kekerapan seramai 16 orang (34%). Jadual 1 dan Jadual 2 menunjukkan dapatan yang diperolehi daripada tinjauan keputusan akademik pelajar SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 Seksyen 1 pada semester 2 sesi 2024/2025. Keputusan nilai min menunjukkan peningkatan gred B ke B+, iaitu 69.5% ke 73.4% bagi keputusan akademik pelajar SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 Seksyen 1 pada semester 2 sesi 2022/2023 berbanding keputusan akademik pelajar SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 Seksyen 1 pada semester 2 sesi 2024/2025.

Jadual 1: Keputusan Akademik Pelajar SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 Seksyen 1 Sem 2 24/25

Gred	A	A-	B+	B	B-	C+
No (%)	10 (21.3%)	16 (34%)	17 (36.2%)	2 (4.3%)	1 (2.1%)	1 (2.1%)
Min	73.4% (B+)					

Jadual 2: Keputusan Akademik Pelajar SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 Seksyen 1 Sem 2 22/23

Gred	A	A-	B+	B	B-
No (%)	6 (15.8%)	4 (10.5%)	14 (36.8%)	7 (18.4%)	7 (18.4%)
Min	69.5% (B)				

Berdasarkan tinjauan yang dibuat sebelum memulakan pengajaran dan pembelajaran secara dalam talian serta fizikal didapati, terdapat 88.92% yang memberikan respons. Jadual 3 menunjukkan dapatan yang diperolehi daripada tinjauan sebelum pengajaran dan pembelajaran secara dalam talian serta fizikal dilaksanakan.

Jadual 3: Tinjauan sebelum pengajaran dan pembelajaran secara dalam talian serta fizikal dilaksanakan

No.	Soalan	Dapatan	
1.	Adakah anda mempunyai capaian internet di tempat yang anda tinggal sekarang?	Ya (95%)	Tidak (5%)
2.	Apakah capaian internet yang anda gunakan untuk pembelajaran secara dalam talian?	Data Telefon (hotspot) 60%	Wifi (Unifi atau provider lain melebihi 100 mbps) 40%
3.	Adakah anda boleh mengakses UTM UTM E Learning dari tempat yang anda tinggal?	Ya (100%)	Tidak
4.	Adakah anda boleh mengakses *YouTube* dari tempat yang anda tinggal sekarang?	Ya (100%)	Tidak
5.	Adakah anda mempunyai masalah untuk membeli data bagi pembelajaran secara dalam talian?	Tidak (61%)	Kadang-kadang (39%)

Berdasarkan tinjauan yang dibuat selepas pengajaran dan pembelajaran secara dalam talian serta fizikal dijalankan, terdapat 100% yang memberikan respons. Jadual 4 menunjukkan dapatan yang diperolehi daripada tinjauan setelah pengajaran dan pembelajaran secara dalam talian serta fizikal dilaksanakan.

Jadual 4: Tinjauan selepas pengajaran dan pembelajaran secara dalam talian serta fizikal dilaksanakan

No.	Soalan	Dapatan			
1.	Platform pembelajaran secara dalam talian yang digemari	Webex (100%)	GoogleMeet	WhatsApp	
2.	Adakah alatan yang anda gunakan untuk pembelajaran secara dalam talian?	Komputer (Desktop) (29%)	Komputer peribadi (70%)	Smartphone (1%)	
3.	Adakah anda berpuas hati pelaksanaan pembelajaran secara dalam talian?	Ya (100%)	Tidak (0%)		
4.	Adakah pembelajaran secara dalam talian selama hampir dua jam ini terlalu lama bagi anda?	Ya (60%)	Tidak (39%)	Bergantung kepada subjek (1%)	Kadang-kadang (0%)
5.	Pembelajaran secara dalam talian selama hampir dua jam ini membuang masa.	Ya (54%)	Tidak (46%)		
6.	Cara perlaksanaan yang mana anda rasa lebih mudah faham selepas sesi pembelajaran dalam talian dilaksanakan?	Tidak segerak (Asynchronous) seperti recored video tutorial, tugasan di UTM E Learning, Whatsapp (54%)	Segerak (Synchronous) seperti live session menggunakan BigBlueButton, Zoom @ Webex (46%)		
7.	Apakah kekangan dan masalah yang dihadapi terhadap pembelajaran dalam talian yang dilaksanakan?	Pembelajaran di rumah banyak gangguan Sering tertidur bila belajar dalam talian Masalah bekalan elektrik, teknikal dan capaian internet Menghadapi masalah hilang tumpuan pada pelajaran			

Kesimpulan

Berdasarkan pencapaian keputusan akademik, didapati bahawa hasil kajian menunjukkan bahawa terdapat peningkatan prestasi akademik nilai min bagi seksyen 1 sebanyak 3.9% daripada nilai 69.5% kepada 73.4%. Peningkatan keputusan gred prestasi akademik daripada B kepada B+. Berdasarkan tinjauan menggunakan *google form* yang dibuat, sebanyak 39% responden menjelaskan masa pembelajaran aktif secara dalam talian selama hampir dua jam ini tidak membuang masa bagi para pelajar. Pensyarah banyak menggunakan medium alternatif iaitu Whatsapp, UTM E Learning, WEBEX dan kajian kes perniagaan untuk menjalankan kelas secara dalam talian.

Maklum balas para pelajar iaitu lebih 90% responden menunjukkan pengajaran daripada WEBEX dan ePPP pengajaran menunjukkan para pelajar suka, berpuas hati dan seronok dengan aktiviti yang dijalankan secara dalam talian menggunakan Whatsapp, UTM E Learning, WEBEX dan kes perniagaan. Pandangan balas pelajar dalam pengajaran dan pembelajaran khususnya penggunaan kes perniagaan, antaranya ialah 1. Sebagai seorang pelajar, saya mendapati bahawa kes perniagaan yang digunakan dalam perbincangan CSR adalah praktikal dan berwawasan, membantu saya memahami cara syarikat menggunakan CSR dalam situasi dunia sebenar. 2. Kes perniagaan yang digunakan adalah relevan dan praktikal, membantu pelajar memahami cara syarikat menggunakan CSR dalam situasi sebenar, walaupun industri yang lebih pelbagai boleh memperkayakan lagi perbincangan. 3. Tugasan ini memberikan kes pembelajaran praktikal yang sangat berharga. Melalui perbandingan terperinci dua syarikat yang tersenarai, pelajar dapat mempelajari kekayaan dan perbezaan amalan CSR. Sinergi dan impak berkuasa yang boleh dicapai dengan menyepadukan CSR secara mendalam ke dalam strategi teras. Kepentingan melampau pelaporan yang telus, kuantitatif dan asas pematuhan yang kukuh dalam mewujudkan kredibiliti CSR. CSR merupakan faktor utama dalam membentuk imej jenama dan mempengaruhi pilihan pengguna. 4. Kes perniagaan yang digunakan adalah platform yang baik untuk meneroka CSR dalam syarikat sebenar dan memahami kaitannya dengan strategi perniagaan. Ianya membolehkan ahli kumpulan bekerjasama dan menggunakan pengetahuan teori secara praktikal.

Pelajar juga mengucapkan terima kasih atas segala bimbingan dan sokongan pengajar pada semester ini. Ianya benar-benar membantu pelajar memahami pelajaran dengan baik. Pelajar amat menghargai cara pensyarah mengajar kerana ianya membantu pelajar memahami isi pelajaran dengan jelas dan berkesan. Akhirnya, hasil kajian menunjukkan bahawa penggunaan pelbagai kaedah dalam menganalisa perniagaan memberikan kesan yang sangat positif kepada peningkatan prestasi akademik pelajar. Seterusnya, secara keseluruhan para pelajar memberikan pandangan sangat membina, gemar, memilih dan mengutamakan pendekatan secara bersemuka, iaitu pertemuan secara fizikal dalam pengajaran dan pembelajaran bagi subjek FAR 5.

Penghargaan

Penulis mengucapkan terima kasih dan penghargaan kepada Pn. Norhayati Salleh atas semakan penulisan dan semua pelajar kursus SBSC 3203 Perakaunan Kewangan dan Pelaporan 5 pada semester 2 sesi 2024/2025, ahli akademik Jabatan Perakaunan dan Kewangan, Fakulti Pengurusan (FM), Universiti Teknologi Malaysia (UTM), UTM CDex, UTM Global Connet dan Malaysian-Japan International Institute of Technology yang menganjurkan projek ini serta ahli jawatankuasa NALI 2025.

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ID 71: ChemMR-AI Lab: Transforming Chemistry Experiments — Bridging Hands-On Reactions with AI-Guided Mixed Reality

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Highlights: ChemMR-AI Lab combines Mixed Reality (MR) and Artificial Intelligence (AI) to create an immersive chemistry learning environment. By integrating virtual lab experiences with an AI guide, this innovation offers step-by-step, interactive learning opportunities. Students perform experiments using hand interaction to manipulate virtual equipment, receiving real-time feedback and guidance tailored to their needs. This approach enhances engagement, deepens understanding of chemical concepts, and fosters critical thinking, problem-solving, and scientific inquiry, equipping learners with essential 21st-century skills while transforming traditional laboratory learning into a more accessible, safe, and effective experience.

Keywords: Mixed Reality; AI-Guided; Chemistry Lab Experiment; Natural Hand Gesture

Introduction

The ChemMR-AI Lab is a pioneering initiative that redefines chemistry education by integrating cutting-edge technologies such as Mixed Reality (MR) and Artificial Intelligence (AI). This project leverages the immersive potential of MR and the intelligent guidance of AI to create interactive, hands-on learning environments where students conduct virtual chemistry experiments in virtual laboratory settings. Novelty is demonstrated through the unique combination of MR simulations and AI-driven feedback to deliver practical chemistry experiences without the limitations of physical labs. Unlike traditional methods, this approach immerses students in digital lab spaces where they can perform complex experiments safely, explore molecular structures, and observe chemical reactions dynamically, thereby deepening their conceptual understanding.

This project provides an interactive 3D environment where students manipulate virtual apparatus using natural hand movements, while AI serves as a digital lab assistant, offering tailored guidance and adaptive support based on each learner's progress. Innovativeness is reflected in the integration of AI for real-time, personalized feedback, representing a significant advancement over conventional instructional approaches. This ensures that each student receives targeted, evolving support that adapts to their learning pace and performance.

The ability of AI to analyze student actions and provide immediate, actionable insights enhances the quality of the learning experience. Applicability aligns with the New Academia Learning Innovation (NALI) model by integrating immersive, technology-driven solutions that address contemporary educational needs and make high-quality practical training accessible anytime, anywhere. The combination of MR and AI fits seamlessly within this model, preparing students for the challenges of future scientific practice with a forward-thinking approach.

The impact on students' learning is profound, as this integrated approach significantly increases engagement, motivation, and confidence in exploring complex chemistry concepts. The immersive nature of MR and the responsive support of AI create a compelling learning experience that not only improves students' mastery of chemical principles but also develops critical thinking and problem-solving skills essential for 21st-century scientific inquiry. In summary, the ChemMR-AI Lab represents a transformative advancement in educational practice. By merging novel technological innovations with creative instructional design, it offers a powerful and impactful way to modernize chemistry education, ensuring students are well-prepared for the evolving demands of science and technology.

Objectives

Traditional chemistry education often relies on physical laboratory settings that can be resource-intensive, hazardous, and inaccessible for some students, particularly those in virtual or hybrid learning environments. Conventional methods may fail to engage visual and kinesthetic learners, leading to reduced motivation and limited understanding of complex chemical concepts. The ChemMR-AI Lab project addresses these challenges by leveraging Mixed Reality (MR) and Artificial Intelligence (AI) to create an immersive, interactive, and accessible platform for chemistry experiments. The following objectives guide this innovative initiative:

i. To Develop an Interactive MR-Based Chemistry Lab Environment: Investigate and implement development of advanced MR technologies with hand-tracking capabilities to create a virtual chemistry lab where students can perform experiments through natural hand interactions. This objective focuses on designing immersive simulations of chemical reactions and laboratory processes, enabling experiential learning that bridges theoretical knowledge with practical application.
ii. To Integrate AI-Guided Systems: Implement AI-driven intelligent tutoring systems within the MR environment to provide real-time, adaptive guidance and feedback tailored to individual student needs. The AI will analyze student interactions, adapt to their learning pace, and offer personalized support to enhance

understanding and mastery of chemistry concepts.

iii. To Evaluate User Experience and Learning Outcomes: Assess the effectiveness of the ChemMR-AI Lab in improving student engagement, collaboration, and comprehension of chemistry through user experience studies. This includes evaluating the usability of hand interactions in MR and the impact of AI-driven feedback on learning outcomes, ensuring the platform aligns with modern educational needs.

NALI Approach

The impact on students' learning is profound, as the immersive MR environment, combined with AI's adaptive support, significantly boosts engagement and empowers students to explore complex chemical concepts with confidence. By bridging hands-on experimentation with cutting-edge technology, ChemMR-AI Lab not only enhances students' understanding and retention of chemistry but also equips them with critical skills for scientific inquiry in a dynamic, technology-driven world. This project represents a transformative step in chemistry education, redefining how students interact with and learn from laboratory experiences. The ChemMR-AI Lab project redefines chemistry education by seamlessly integrating Mixed Reality (MR) and Artificial Intelligence (AI) to deliver a transformative, engaging, and adaptive learning experience that aligns with the New Academia Learning Innovation (NALI) model. By addressing the limitations of traditional chemistry labs, such as resource constraints and accessibility challenges, this initiative creates a safe and scalable platform for students to explore complex chemical concepts through immersive, hands-on simulations. The project leverages advanced technologies to enhance student engagement, foster critical skills, and prepare learners for a technology-driven world, setting a new standard for experiential science education.

The **novelty** lies in its pioneering combination of MR and AI, enabling students to conduct virtual chemistry experiments in an immersive 3D environment, distinct from traditional labs or digital tools. Its **creativity** is evident in the design of interactive experiments, where students use hand-tracking technology to manipulate virtual lab equipment, fostering imaginative exploration. The **innovation** stems from AI-driven tutoring systems that provide real-time, personalized feedback, making learning interactive and accessible.

The project's **applicability** aligns with the NALI model by offering a technology-driven solution to modern educational challenges, cultivating skills like problem-solving. Its **impact on students' learning** is significant, with immersive MR simulations making abstract concepts tangible and AI feedback deepening understanding, empowering students for success in science and beyond.

In summary, the ChemMR-AI Lab transforms chemistry education by addressing the limitations of traditional methods and offering a scalable, engaging, and impactful learning solution. By integrating MR and AI, it creates an innovative platform that aligns with the NALI model, enhances student engagement, and prepares learners for future challenges in science and beyond, redefining the future of chemistry education.

Research Methodology

The ChemMR-AI Lab project follows a structured methodology to develop an innovative MR and AI platform for chemistry education, as outlined in Figure 1. The process encompasses analysis and design, development, implementation, and evaluation phases. This approach ensures the creation of an immersive, interactive virtual lab environment that enhances student engagement and learning.

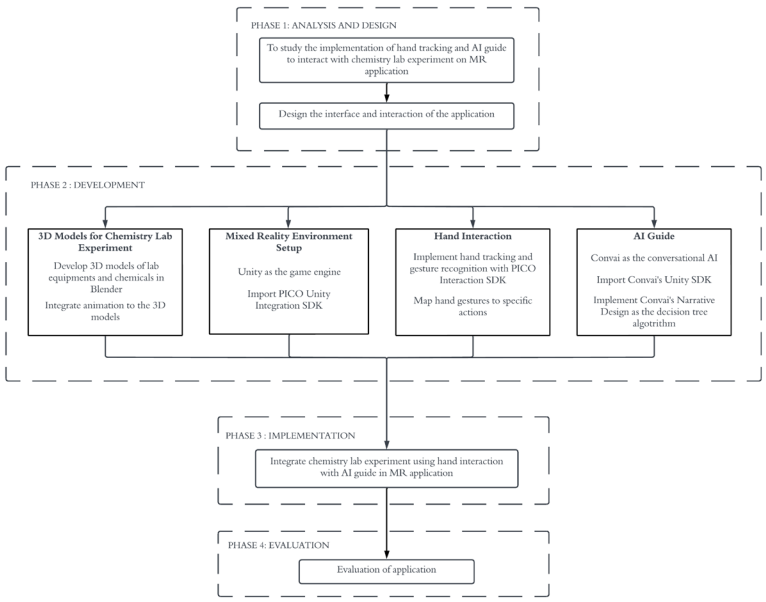


Figure 1 Methodology Flowchart

Phase 1: The project begins with an analysis and design phase, researching Mixed Reality (MR) technologies, hand interaction models, AI-guided systems, and the Form 4 Chemistry syllabus, focusing on the preparation of insoluble

salts experiment. The MR application is designed with three key elements: 3D models of lab equipment and chemicals created in Blender, an MR environment developed in Unity with the PICO SDK for immersive interaction, and a hand interaction system using PICO's Interaction SDK to support natural gestures like holding and pouring. The AI guide is designed using a rule-based decision tree on the Convai platform to provide real-time, step-by-step feedback during experiments.

Phase 2: In the development phase, the project integrates the PICO 4 headset and PICO SDK to enable real-time hand tracking, spatial anchoring, and passthrough view, aligning virtual lab elements with the user's physical space. Hand interactions are implemented using PICO's 26-joint tracking system, supporting gestures such as pinch and stir, incorporated into Unity via predefined hand prefabs. The AI guide, built on the Convai platform, uses the Narrative Design Manager to link with in-game events, delivering responsive voice feedback to ensure accurate experiment execution.

Phase 3: The implementation phase focuses on deploying the MR application and AI guide within the virtual lab environment. The PICO SDK's Interaction and Sense Packs enable seamless integration of hand tracking and spatial alignment, creating an immersive experience where virtual lab elements interact with the real world. The AI guide's decision tree, connected through Convai's Narrative Design Manager, triggers real-time voice responses based on user actions, guiding students through each experimental step with precision and clarity.

Phase 4: The evaluation phase involves at least thirteen participants aged 15–25 testing the application via a head-mounted display (HMD). Data on task time, usability issues, and interaction difficulties are collected, followed by interviews and questionnaires to assess the effectiveness of hand interactions and MR experience. This phase ensures the ChemMR-AI Lab delivers a scalable, engaging, and effective platform for chemistry education, aligned with the NALI model.

Findings and Discussion

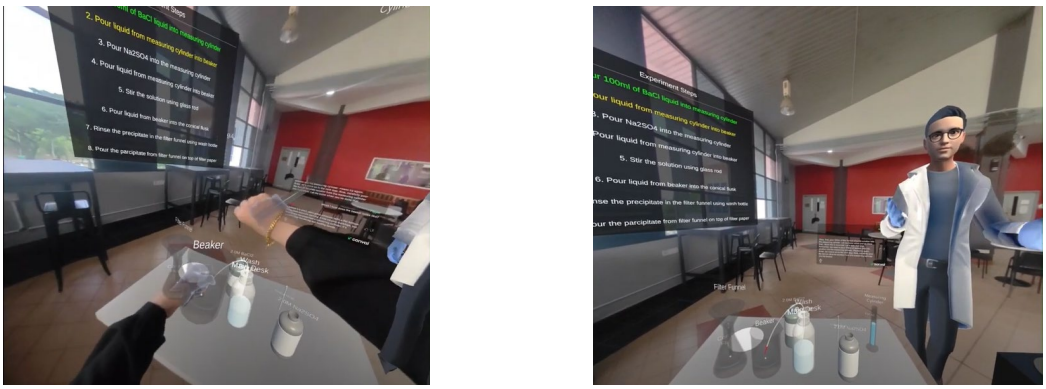


Figure 2 Finding of a user performing a chemistry experiment in the MR interface, using hand interactions to grab and manipulate lab apparatus, guided step-by-step by the AI avatar.

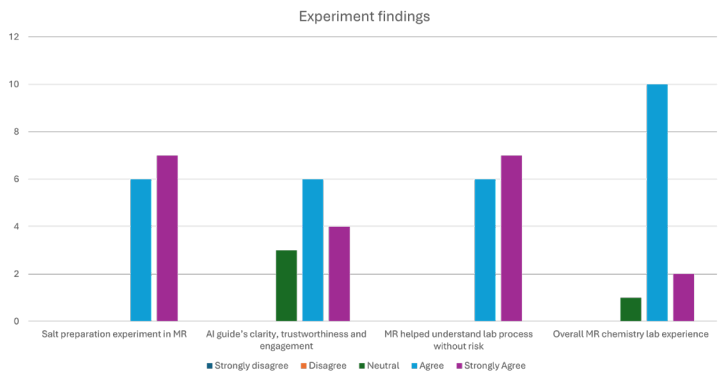


Figure 3 Survey and testing results showcasing user experience, as shown in the graph.

Findings show improved learning outcomes with the ChemMR-AI Lab. The AI guide offers clear, trustworthy, and engaging support, as evidenced by strong agreement from participants, helping students grasp chemistry concepts effectively. The immersive MR environment, with a high overall satisfaction rate, enhances understanding of lab processes without risk, fostering better retention and mastery through personalized, real-time feedback that addresses knowledge gaps quickly.

The results also highlight enhanced engagement and safety. Participants strongly agreed that the salt preparation experiment in MR was effective, with the AI guide's adaptability boosting interaction and confidence. The MR platform's risk-free setting, supported by strong agreement, allows for safe experimentation, while the data suggests improved performance and positive lab experience overall.

Other Information

The ChemMR-AI Lab holds significant commercialization potential for educational institutions. By partnering with schools, universities, and educational organizations, the project can integrate metaverse and AI technologies into their curricula, paving the way for commercial contracts and long-term collaborations that enhance chemistry education on a large scale.

Additionally, technology providers offer opportunities for growth. Collaborating with hardware and software companies specializing in VR/AR equipment, AI tools, and cloud services can lead to joint ventures and revenue-sharing agreements, further expanding the project's reach and sustainability in the education market.

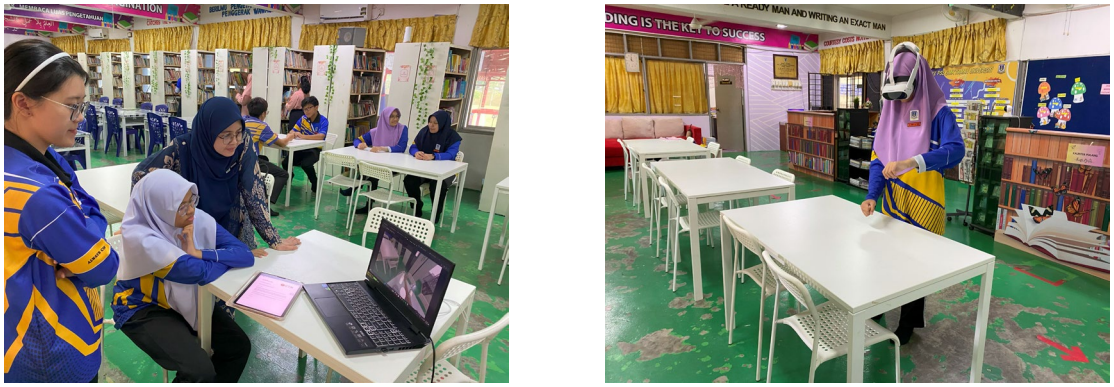


Figure 4 Potential commercialization to **educational institutions** - Ministry of Education Malaysia (KPM).

Exhibition: We showcased and demonstrated the ChemMR-AI Lab at Sekolah Menengah Kebangsaan Taman Universiti (SMKTUN), Skudai, where students tested the system and participated as experiment respondents.

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ID 72: Bridging Community Needs and Future Skills Through AI-Driven Service Learning

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Highlights: This project integrates real-world stakeholder engagement and Generative AI tools into MJIIT's Software Engineering Application Development course. Guided by the AI-Driven Service Learning Framework, combining Kolb's Experiential Learning and Service Learning Cycles, students collaborate with schools and MJIIT-unit to identify problems, co-design solutions, and deploy systems. AI tools like GitHub Copilot, ChatGPT, Figma, and CodeWhisperer enhance the project lifecycle. A comparative analysis of three group: without service-learning, current participants, and graduates shows clear gains in technical skills, innovation, and community awareness. Deployed ystems have been deployed for actual use, demonstrating strong educational impact, sustainable mentoring culture, and potential for scale-up.

Keywords: AI-assisted learning; Service learning; Software engineering education; Community engagement; Future skills.

Introduction

This project highlights an innovative teaching approach used in the SECJ3104 Application Development (AD) course for second-year Software Engineering students at the Malaysia-Japan International Institute of Technology (MJIIT). The main goal is to help students gain skills that are relevant to the industry by involving them in real-world projects with actual stakeholders, such as local schools and departments within MJIIT. In these projects, students work in teams to understand problems faced by their assigned partners and develop software solutions to address them.

To support the NALI 2025 theme: Accelerating Innovation in Teaching and Learning with AI, the course encourages students to use AI-assisted tools, including GitHub Copilot and ChatGPT, during the planning and development of their applications. These tools help students generate ideas, improve their code, and complete their projects more efficiently. The approach combines hands-on learning with real engagement and AI technology, helping students learn by doing while contributing meaningful solutions to the community.

To evaluate the impact of this approach, a survey was conducted involving three groups of students: (1) those who had not participated in the AD service learning experience (either because they had not yet taken the course or had taken a different version), (2) those who had completed the AD course with the service learning component, and (3) recent graduates. The results indicate that students who experienced the AD service learning model demonstrated stronger technical skills, better problem-solving abilities, and greater confidence in real-world settings. These students also reported feeling more prepared for internships and employment compared to their peers who did not participate in the service learning experience.

Some of the student-built systems are now being considered for real use by schools and university departments, showing that this teaching method has practical value. Overall, this project shows how combining AI tools with community-focused learning can better prepare students for future careers and can be applied in other technical programs.

Objectives

This project aims to:

i. To compare students' technical and innovation skills across three groups: those without service learning, current participants, and graduates of the service learning program.
ii. To compare students' understanding, awareness, confidence, and perceived benefits of AI-assisted coding tools before and after the AI-Driven Service Learning course.
iii. To evaluate how service learning influences students' readiness for the workforce on employability skills and career outcomes.

NALI Approach

Novelty

This project is based on the AI-Driven Service Learning Experiential Framework, which integrates Kolb's Experiential Learning Cycle and the Service Learning Cycle. This project pioneers the integration of Generative AI tools into the service learning cycle in MJIIT's Software Engineering programme, combining real stakeholder engagement with a

structured *senpai–kohai* mentoring system. Using a three-group comparative design, it delivers measurable evidence of technical skill, innovation, and community impact, with student-developed systems deployed in schools and MJIIT units. Building on a NALI 2024 Silver Award-winning model, the framework is now enhanced with AI integration, offering a scalable, transferable approach for AI-enhanced service learning across disciplines.

Creativity
The integration of AI tools fosters creative problem-solving throughout the project. Students leverage AI technologies to design, prototype, and test innovative solutions for real-world problems, enhancing their ability to think critically and creatively while developing functional systems for community stakeholders.

Innovativeness
This framework introduces a new model that integrates Generative AI with Kolb's Experiential Learning, Service Learning and Agile methodologies. This innovative combination encourages students to think beyond traditional development practices, enhancing their ability to develop impactful solutions that align with current industry trends in AI and technology.

Applicability
The solutions created by students are deployed in schools and MJIIT units, proving the applicability of the AI-Driven Service Learning approach to real-world settings. The framework is scalable and can be applied to other disciplines and institutions, demonstrating its potential for broader educational use and impact.

Impact
The project enhancing technical and innovation skills while preparing students for the workforce. The community impact is evident in the deployment of authentic functional systems that address local problems, and the mentorship model ensures long-term, sustainable knowledge transfer and skill development. The AI-enhanced framework is also poised for market scalability, allowing it to be expanded and adapted to other courses and institutions.

Research Methodology

This study employed a mixed-methods approach to examine the impact of AI-enhanced service learning on students' industry readiness and skill development. The intervention was conducted through the SECJ3104 Application Development course offered to Year 3 Software Engineering students. As part of the course, students were grouped and assigned real-world clients, either local schools or internal MJIIT units, where they identified problems and proposed system-based solutions. The intervention was guided by the AI-Driven Service Learning Experiential Framework, which integrates Kolb's Experiential Learning Cycle (Kolb, 1984) and the Service Learning Cycle, delivered using an Agile sprint approach. Previous studies at MJIIT have demonstrated the effectiveness of integrating service learning into Software Engineering courses to deliver real-world school projects (Ghazali et al., 2024) and multi-course collaborations with authentic community stakeholders (Hirol et al., 2024), underscoring the relevance of this pedagogical approach in the present work. Similar integration of Agile software development and service learning has also been successfully applied in other higher education contexts (Robinson & Hall, 2018). A total of 45 students participated, representing three distinct groups: Group A consisted of students with no service learning experience, Group B comprised graduates with prior service learning, and Group C included current participants in the AI-enhanced service learning course. Graduates also served as mentors in a structured '*senpai–kohai*' system, providing guidance in project execution, stakeholder engagement, and strategic use of AI tools, ensuring knowledge transfer and sustainable skill development.

The course was structured into four Agile sprints, with each stage aligned to the Service Learning Cycle and mapped to Kolb's stages of experiential learning. The process began with **Investigation and Preparation (Concrete Experience → Reflective Observation)**, where students attended introductory lectures on service learning, Application Development, Agile methodology, and Generative AI tools such as ChatGPT, Figma- Magician Plugin and GitHub Copilot. Brainstorming sessions were conducted to identify project ideas, followed by stakeholder engagement through site visits and interviews. At this stage, AI tools were employed to generate interview guides, summarise transcripts, and extract recurring themes.

The **Action phase (Abstract Conceptualization)** involved co-design workshops with stakeholders to finalise project specifications, followed by iterative coding and testing in Sprints 2 and 3. AI tools were used extensively to generate wireframes, propose system architectures, create initial documentation drafts, and assist with code generation, debugging, and test case development. The **Demonstration phase (Active Experimentation)** centred on a showcase event where all stakeholders were invited to evaluate live system demonstrations and final project pitches. Feedback from these sessions was incorporated to improve system functionality before deployment.

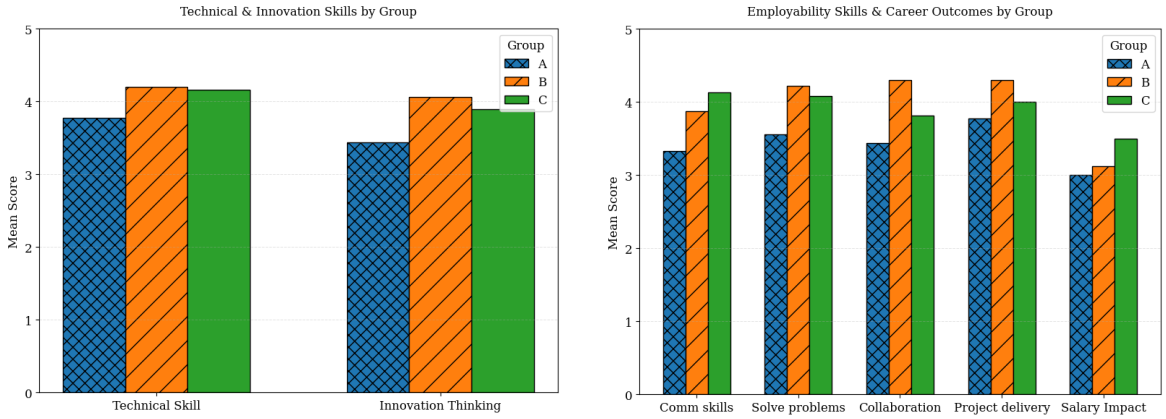
In the **Reflection phase (Active Experimentation leading to new Concrete Experience),** completed systems were deployed in partner schools and MJIIT's units, accompanied by user training sessions conducted by the students. Intellectual Property (IP) applications were prepared, and reflection sessions were conducted to consolidate learning. Surveys, stakeholder interviews, and mentor feedback were collected to evaluate project impact, with AI-assisted thematic analysis used to process qualitative data and visualise survey results.

Quantitative data from pre- and post-course surveys were analysed using the Kruskal–Wallis test for multi-group comparisons and the Mann–Whitney U test for pairwise differences. Qualitative data were analysed using thematic analysis, supported by AI-assisted text coding to enhance efficiency and reliability. This methodological approach was designed to directly address the study's research objectives: to compare skill and innovation levels across participant groups, assess the influence of service learning on community awareness and social responsibility, and evaluate students' readiness for the workforce and participation in the innovation economy.

Findings and Discussion

Analysis of post-course survey data in Figure 1 shows significant differences in technical skills and innovation across all three groups. Groups B (graduates with service learning) and C (current participants) consistently outperformed Group A (graduates without service learning) in technical skills and innovative thinking for problem solving. Results indicated that service learning, combined with the delivery of authentic real-world projects, had a sustained positive impact on technical competence and creativity. The differences between Groups B and C, indicated that the benefits of service learning improved and were sustained after graduation.

Post-course results showed that service learning participation significantly influenced employability-related competencies. Groups B and C reported significantly higher scores than Group A in communication skills, team collaboration, real-world problem solving, and project delivery. Both service learning groups reported a greater impact of the program on salary offers or industry training allowances, reflecting its contribution to job readiness and value in the job market. The combination of real-world use, stakeholder collaboration, and repeated refinement of SL project deliverables translated into tangible professional advantages for participants. Qualitative survey evidence indicated authentic use and stakeholder engagement as decisive factors: Group C alumni cited "confidence in presenting to clients" and "experience working with non-technical stakeholders" as assets in securing employment and internships. Several stated that the program "directly influenced salary negotiations" or "provided portfolio-ready projects" that attracted recruiters. Group A participants, who did not have this use experience, cited fewer examples of industry engagement and a lack of ability to "showcase applied work" in interviews.



(a) (b)

Figure 1. Comparison of (a) Technical, Innovation, (b)Employability Skills, and Career Outcomes by Group

Statistical analysis of scores revealed significant improvements in Competencies before and after the implementation of the AI-Driven Service Learning course. Groups B and C across all five AI-related competencies, with Group A showing smaller and less significant changes as shown in Table 1. Group C consistently achieved the highest scores after the course, an outcome attributed to the impact of the ongoing engagement of the framework that had been implemented for three full cycles, and their participation in the senpai–kohai mentoring model, which reinforced skills through mentoring juniors. Group A's lower gains reflect their lack of prior exposure to service learning and AI-driven frameworks.

Table 1. Student Competency Before and After the AI-Driven Service-Learning Course Implementation

Metric	Group	Before	After	Difference	Wilcoxon Z	p-value	Significant
Coding tools & task	A	2.98	3.20	-0.22	-1.14	0.253	No
	B	3.12	3.88	0.76	-2.37	0.018	Yes
	C	3.18	4.05	0.87	-2.59	0.01	Yes
Understanding use cases	A	3.05	3.28	-0.23	-1.09	0.275	No
	B	3.18	4.00	0.82	-2.46	0.014	Yes
	C	3.2	3.97	0.77	-2.52	0.012	Yes
Confidence in using AI tools	A	2.85	3.15	-0.3	-1.21	0.226	No
	B	3.00	3.82	0.82	-2.53	0.011	Yes
	C	2.92	3.9	0.98	-2.6	0.009	Yes
Responsible use of AI tools	A	2.88	3.12	0.24	-1.17	0.241	No
	B	3.05	3.88	0.83	-2.48	0.013	Yes
	C	2.95	3.92	0.97	-2.54	0.011	Yes
AI improves productivity & learning	A	3.00	3.25	0.25	-1.1	0.272	No
	B	3.1	3.95	0.85	-2.42	0.015	Yes
	C	3.08	4.00	0.92	-2.58	0.01	Yes

The integration of AI-assisted tools within a structured, community-focused service learning framework fosters not only measurable improvements in technical and professional skills but also deeper confidence, ethical awareness, and

industry readiness. Additionally, this results in an experiential project cycle, senpai–kohai mentoring model, and ongoing stakeholder engagement as additional elements for students involved in this project.

Commercialisation Potential

The AI-Driven Service Learning framework has strong commercialisation potential through customisable deployment of student-developed systems in schools, universities, and community organisations. The model supports licensing, consultancy, and integration into training programmes, with two systems already protected and 8 waiting for approval under Malaysian copyright law, signalling readiness for wider adoption.

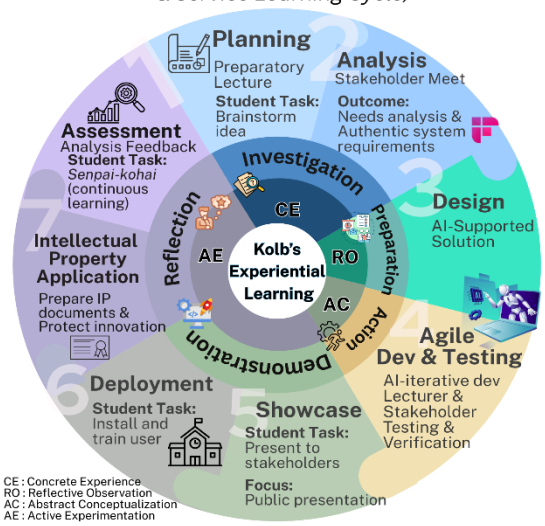
Awards Received

- Ghazali, M., Hiro, H., Shafiee, Z. A., Hamzah, A., Faiz, A., & Hamzah, A. S. S. A. (2024). *From Campus to Community: Integrating Service Learning in Software Engineering through Real-World Schools Projects*. **Silver Award**, New Academia Learning Innovation (NALI) 2024, Universiti Teknologi Malaysia.
- Hirol, H., Ghazali, M., Khairuddin, U., Azmi, K. H. M., Aid, S. R., & Ariff, M. H. M. (2024). *Integrating Software Engineering Education with Real-World Impact: A Multi-Course Service-Learning Project at MJIIT for Klang Valley Schools*. **Silver Award**, New Academia Learning Innovation (NALI) 2024, Universiti Teknologi Malaysia.

Intellectual Property

- Behaviour-Tracking and Evaluation System (Turquoise) – Copyright No. CRLY2024J06381, registered 2 October 2024.
- Sekolah Menengah Kebangsaan Sungai Pusu Attendance System (SPAS) – Copyright No. CRLY2024J09065, registered 24 December 2024.

AI-Driven Service Learning Experiential Framework
(Integrating Kolb's Experiential Learning & Service Learning Cycle)

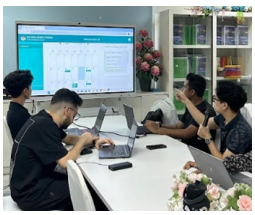


Senpai–Kohai Mentorship and Stakeholder Engagement





Agile Sprint Development, Discussion & Stakeholder Testing





Showcase sequence from 3 cycle: All stakeholders are invited







Deployment & User training



Acknowledgement

We extend our sincere gratitude to the management at MJIIT for their unwavering support, the dedicated teachers from the participating schools for their invaluable and continuous feedback, and the students whose hard work and commitment were instrumental in the success of this project. Additionally, we would like to thank the rest of the project team members for their collaboration, dedication, and valuable contributions throughout the project.

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ID 73: HoloThink-AI: Counsellor's Journey from Simulation to Escape Room Using AI

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Highlights: This innovation project presents the HoloThink-AI framework, which combines design thinking, social constructivism, and artificial intelligence (AI) to make learning in the counselling course more engaging and practical. Using this framework, instructors designed activities such as counseling simulations, AI-enhanced Explorace activities, counselling tool development, and escape room challenges. Meanwhile, the student applied the five stages of design thinking to create practical counselling tools. Assessments of the student performance through counselling simulations, Explorace, and counselling tool development showed that this interactive, AI-supported approach effectively deepens students' understanding of theory while building real-world counselling skills.

Keywords: Design thinking; Social constructivism; AI-based activity; Counseling activity; Teaching and learning innovation

Introduction

Counselling education requires a balanced integration of theoretical knowledge, problem-solving ability, and practical counselling skills. Achieving this balance can be challenging when relying solely on traditional teaching methods. To address this, HoloThink-AI was developed as an innovative pedagogical approach designed to assess students' understanding of counselling concepts, enhance learning performance, and strengthen problem-solving and practical skills through collaborative, authentic tasks supported by artificial intelligence (AI). By engaging with HoloThink-AI, students can gain deeper insights into counselling concepts, while building the confidence and competence needed for effective practice, particularly during counseling sessions. This is especially important as some students may feel unprepared, fearful, or hesitant to step into the counsellor's role, while others struggle to grasp the foundational principles of counselling theory when taught through conventional methods. Recognizing these challenges, the framework directly addresses issues of disengagement, particularly with theory-heavy content, by integrating social constructivism, design thinking principles, and AI. The approach combines instructor-led social constructivist learning with design thinking that has been implemented in designing a teaching and learning process by the instructor as well as developing the assignment by the student. Through these activities, students are encouraged to apply theoretical knowledge to authentic, real-world counselling settings. By integrating design thinking with AI, students are empowered to take ownership of their learning in conducting research to develop counselling tools, participating in Explorace challenges, and cultivating creativity, critical thinking, and collaboration. Ultimately, HoloThink-AI makes the learning process more relevant, engaging, and enjoyable, fostering both student confidence and readiness for professional practice.

Objectives

The objectives of HoloThink-AI are:

i. To enhance students' learning performance and understanding counselling concepts through the integration of design thinking, social constructivism and artificial intelligence (HoloThink-AI) within counseling courses for psychology students.
ii. To improve students' problem-solving abilities through HoloThink-AI within counselling courses for psychology students.
iii. To improve students' practical counseling skills through HoloThink-AI within counselling courses for psychology students.

NALI Approach

Novelty

The novelty of HoloThink-AI is a cutting-edge innovation tailored for counselling courses, integrating social constructivism learning with design thinking and AI to create a dynamic learning environment. The approach uses AI and real-life counselling simulation to enhance students' learning performance, problem-solving and practical counselling skills, allowing them to practice client interactions, ethical decision-making, and therapeutic strategies in a safe, controlled setting. The novelty lies in the dual application of design thinking for both instructors and students

by using the AI. Instructors use a design thinking process to iteratively design and refine these assessments and activities based on feedback from pre-assessment, ensuring they are aligned with students' evolving needs.

Creativity

The creativity embedded in HoloThink-AI stems from its theoretical grounding in Vygotsky's (1978) social constructivism and Keller's (2009) design thinking approach. Social constructivism emphasizes collaborative knowledge creation within learning communities, where students work together in groups and operate within their Zone of Proximal Development (ZPD). In this framework, scaffolding was traditionally provided by facilitators or lecturers but is now supported by AI, offering instant guidance, resources, and feedback, while human facilitators monitor and provide deeper pedagogical input when necessary. Instructors apply the design thinking framework to develop authentic, real-world counseling assessments and activities, moving through the stages of empathizing, defining, ideating, prototyping, and testing. Instructors create Explorace and escape room challenges by using AI to design tasks, activities, rubrics, and questions that directly align with course concepts. In Explorace, instructors use AI to brainstorm and design course-related station challenges. In the escape room activity, tasks are created using Google Forms, where each correct answer unlocks the next question, and incorrect answers block progress. AI supports this by generating tasks ideas, question variations, and thematic scenarios aligned with counseling concepts. AI serves as a creative partner, helping generate innovative ideas and ensuring activities remain engaging, challenging, and relevant.

In collaborative learning settings, the students use design thinking primarily in the development of their own counselling tools. By empathizing and learning from experiences in counseling sessions and Explorace activities, they define specific counselling needs, ideate solutions, and prototype tools with AI support. The AI provides instant feedback, simulates counselling-related tasks, and identifies performance patterns, enabling students to refine their designs through iterative testing. These activities ranging from AI-assisted game design to the creation of counselling tools immerse learners in rich, context-based experiences that are interactive, engaging, and fun. The synergy of social constructivism, design thinking, and AI nurtures creativity, adaptability, and critical thinking, transforming the classroom into a vibrant, imaginative space that meaningfully connects theory to practice.

Innovativeness

HoloThink-AI's innovative approach to teaching and learning process for psychology students in counselling courses involves the integration of social constructivism, design thinking framework with AI. Social constructivism helps create a realistic learning space where students can participate in counselling sessions and practice as if they were in real-life situations. Activities such as counselling simulation, the Explorace, developing counseling tools, and the escape room challenge create immersive, hands-on experiences that enable students to implement theoretical knowledge in dynamic, problem-solving situations. Furthermore, the application of design thinking provides students with the opportunity to enhance their practical skills and problem-solving abilities, particularly in developing the counselling tools. This is corroborated by the students' feedback, as illustrated below.

> *"Before this when I was learning, I had never tried this kind of learning tool. Where this is kinda new for me.*
>
> *For improvement maybe I think there aren't any. So maybe we can apply again in the future."*

Applicability

HoloThink-AI applies a student-centered approach grounded in social constructivism, design thinking, AI, and comes out with assessment and activities through the learning in counselling simulations. This HoloThink-AI can address the challenges in counselling education, particularly the gap between theory and practice. Within this HoloThink-AI, students move through stages of design thinking assisted by AI supported by authentic activities such as developing counselling tools, participating in Explorace and engaging in an escape room. At the core of HoloThink-AI is Outcome-Based Education (OBE), with each activity purposefully designed to meet Course Learning Outcomes (CLOs) aligned with PLO1 and PLO3. By the end of the course, students not only demonstrate competence in counselling theory but also apply problem-solving skills and practical techniques in authentic contexts. The engaging design processes further cultivate creativity, confidence, and readiness for professional practice. In addition, HoloThink-AI is integrated with Problem-Based Learning as it encourages students to identify the issues related to the counselling session they attend and develop ideas to solve the issue. This interactive technique helps in nurturing their critical thinking and problem-solving skills. Furthermore, HoloThink-AI aligns with CDIO practices that focus on the creation of tools for use in counselling sessions. Students begin by identifying ideas from the sessions they attend, then enlarge the ideas by refining them through design thinking approach and AI-based methods before constructing the design. The completed tools are tested during the Innovation Psychology in Exhibition (IPEX), as a platform for evaluation and improvement. By integrating student-centered learning, outcome-based education,problem-based learning and CDIO practices, HoloThink-AI offers well-rounded and practice-oriented training in shaping future-ready counselors.

Impact to Student's Learning

HoloThink-AI helps students not only learn but truly master counselling concepts by blending design thinking, social constructivism, and AI-driven activities. In counselling simulations, students step into the role of a client, gaining a deeper appreciation of the process while sharpening their problem-solving skills and professional readiness. During Explorace, they work together under time pressure, using AI to spark ideas, plan strategies, and tackle course-related challenges building practical counseling skills, critical thinking, creativity, and strong teamwork along the way. In developing counselling tools, AI becomes their creative partner, turning theory into practical resources and refining designs through instant feedback. By combining realistic simulations, collaborative challenges, and hands-on tool creation, HoloThink-AI makes learning dynamic and relevant, bridging the gap between theory and practice as well as preparing students for the realities of professional counselling.

Research Methodology

This innovation followed three stages: pre-assessment, classroom activities, and feedback. Before the semester, a pre-assessment interview using semi-structured interview was conducted with eight students who had never taken a counseling course to evaluate readiness and potential challenges. Using an AI-generated semi-structured instrument combining 5-point Likert scale and open-ended questions, data were analyzed in SPSS through descriptive and thematic analysis. Findings informed the design of the HoloThink-AI framework (Figure 1), integrating design thinking, social constructivism, and AI to improve learning performance, practical skills, and problem-solving.

The framework comprises classroom activities: Explorace, counselling tool development, and an escape room challenge and assessments of student engagement through counseling simulations, AI-integrated Explorace, and counseling tool creation, all grounded in design thinking, social constructivism, and AI. The study involved one experimental class (with HoloThink-AI) and one control class (without HoloThink-AI). Implemented in the Semester 1/2025 Counselling Psychology course, the sequence included counseling simulation, AI-integrated Explorace, counseling tool development, and escape room challenge, progressively enhancing understanding of counselling concepts and strengthening problem-solving abilities.

The instructor applied the five stages of design thinking supported by AI to prepare interactive, problem-focused learning experiences for the classroom activities.

- **Empathize**: The instructor conducts pre-assessment interviews to evaluate students' knowledge, readiness, and difficulties in understanding counselling concepts.
- **Define**: Core problems and student needs are identified from pre-assessment feedback, with AI helping to reframe challenges such as applying theory, communicating effectively, recalling ethical principles, expressing emotions, and lacking practical counseling experience. This highlights the need for more interactive and practical learning.
- **Ideate**: The instructor generates innovative classroom activities using design thinking and social constructivism, while AI explores alternative ideas for assessments and activities.
- **Prototype**: Quick drafts of activities including Explorace, escape room challenges, and counseling tool development that are created using AI, applying design thinking for both instructor and student processes.
- **Test**: The activities are implemented in the course, including Explorace, counselling tool development, and the escape room challenge.

Students also followed the design thinking process in developing counseling tools.

- **Empathize**: Students participate in counselling sessions as clients, gaining an interactive, understanding of counselling concepts and theories.
- **Define**: Students identify gaps in their knowledge and practical application through simulations and Explorace activities, which inform the creation of counselling tools applicable in real settings.
- **Ideate**: Guided by the instructor and collaborating with AI, students design solutions to address identified gaps, refining concepts to align with course theories and techniques.
- **Prototype**: Students develop fully functional counseling tools based on insights from activities, reflecting both practical challenges and theoretical understanding.
- **Test**: Completed tools are showcased at the Innovation Psychology in Exhibition (IPEX), where clients use the products in real time to evaluate functionality, practicality, and user experience.

After all activities, a second semi-structured interview employing the instrument of AI-generated questionnaire, gathered feedback on the learning experience. Responses were analysed in SPSS and were interpreted through descriptive and thematic analysis to evaluate the impact of the innovation.

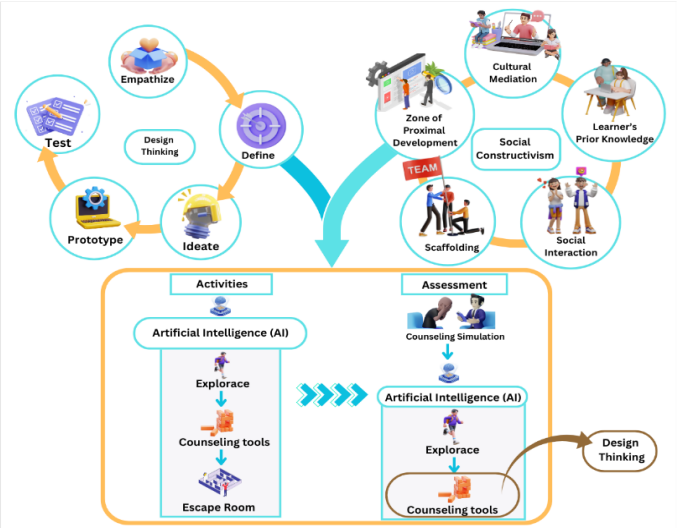


Figure 1: HoloThink-AI Framework that integrates design thinking, social constructivism and artificial intelligence (AI) for teaching and learning in Counselling courses.

Findings and Discussion

Pre-assessment interviews revealed that students reported a generally high confidence in learning the counselling course for the first time (M = 4.00, SD = 0.756), although responses varied notably. The course was perceived as highly relevant to their future careers (M = 4.38, SD = 0.518), with only slight divergence in perspective. The counsellor role-playing activity was considered moderately difficult (M = 3.88, SD = 0.641), reflecting greater variability in perceived difficulty. Comfort in working in groups for counselling activities was rated neutral (M = 3.25, SD = 0.463), with responses being relatively consistent across participants. This result highlights the need to innovate teaching in the counselling course. Similarly, the thematic analysis results show that students reported fear of theory and role-play activities but enthusiasm for self-exploration, suggesting improved teaching methods could enhance engagement and address these challenges.

Table 1 shows that Semester 1/2025 students achieved high learning performance in Counselling Psychology course (100%), with 100% attaining high problem-solving and 88% for practical counselling skills using HoloThink-AI. In contrast, students without HoloThink-AI scored lower (71%) in both overall learning performance and problem-solving and practical counselling skills, highlighting the tool's effectiveness in preparing students for real-world applications.

Table 1: Students' Learning Performance, Problem Solving and Practical Counseling Skills

	Learning Performance	**Problem-Solving Skills**	**Practical Counselling Skills**
With HoloThink-AI	100%	100%	88%
Without HoloThink-AI	71%	71%	86%

Next, the findings from the feedback interview indicate that students reported improved understanding of the counselling process through simulation (M = 4.00, SD = 0.71) and perceived the simulation as fairly realistic (M = 3.89, SD = 0.60). Creating a tool notably enhanced their understanding of counselling techniques (M = 4.11, SD = 0.60), while confidence in using the developed tool in a real session was moderate (M = 3.78, SD = 0.67). The escape room activity was rated highly engaging (M = 4.44, SD = 0.53) and moderately helpful in recalling counselling concepts (M = 3.78, SD = 0.97), though the latter showed high variability. It was also perceived as effective in challenging critical thinking (M = 4.22, SD = 0.67). Furthermore, confidence in applying counselling skills improved with HoloThink-AI integration (M = 4.11, SD = 0.78). In summary, the HoloThink-AI framework effectively enhanced students' understanding, confidence, and critical thinking through interactive activities. While responses varied moderately, the overall outcome demonstrates that using HoloThink-AI can meaningfully engage students and strengthen practical counseling skills.

Commercialization Potential

This innovation project has strong commercialization potential as a comprehensive activity kit equipped with exploration cue cards and escape room-style quizzes to enhance interactive learning experiences. The estimation of the activity kit is around RM4000 per kit for an institutional license. Train-the-trainer workshops will be offered to ensure consistent delivery and scalability across various institutions. A customization service is available to align the program with specific syllabi, learning objectives, and institutional needs for maximum relevance and impact. The adaptable framework can be licensed globally for counselling programs and extended to other disciplines such as psychology, social work, nursing, medical training, education, business communication, and engineering. This innovation provides a scalable solution to enhance skills, promote collaboration, and prepare learners for real-world professional environments.

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ID 74: The 3C Framework for Ethical Reasoning: A Case-Based Learning Module for Bioethics in Research and Development

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Highlights: The 3C Framework for Ethical Reasoning is an innovative bioethics module designed to develop students' ethical reasoning skills through a structured, case-based approach integrating ethical codes, real-world cases, and personal conscience. It uniquely incorporates AI tools like ChatGPT to enhance critical engagement and digital literacy. Delivered via active, collaborative activities such as stakeholder mapping and AI reflections, the module significantly improves ethical knowledge, practical application, and student motivation, empowering future scientists to navigate complex ethical challenges in research with integrity and confidence.

Keywords: 3C framework; Bioethics education; Ethical reasoning; AI-augmented learning; Case-based learning

Introduction

In the context of rapid advances in biotechnology, artificial intelligence (AI), and medicine, developing robust ethical reasoning skills among future scientists is imperative. Traditional teaching approaches often fail to effectively translate ethical theory into practical solutions for complex, real-world research dilemmas (Greene, 2020). Although case-based learning (CBL) is widely used in bioethics education, its effectiveness is often limited by the lack of a clear, systematic framework and specific guidelines for ethical analysis. Many students find it difficult to consistently apply ethical codes, critically evaluate complex cases, and engage in deep personal reflection during CBL exercises. Furthermore, without responsible guidance, reliance on AI tools can encourage superficial answers, which weaken critical thinking and ethical reasoning.

To address this, *The 3C Framework for Ethical Reasoning: A Case-Based Learning Module for Bioethics in Research and Development* offers a structured and reflective pedagogy centered on three pillars: **Code** (ethical codes and laws), **Cases** (real-world scenarios), and **Conscience** (personal and professional values). A notable innovation is the integration of AI tools such as ChatGPT for "AI-Augmented Reasoning," facilitating critical engagement with diverse perspectives and enhancing ethical deliberation alongside digital literacy (Schere et al., 2023). Scaffolded activities including case analysis, stakeholder mapping, and ethical framework development are delivered via collaborative platforms, aligning with established case-based and reflective learning models (Hmelo-Silver, 2004). Besides, this module addresses these gaps by integrating structured application of ethics codes, real-world case analysis, and AI-guided reflective journaling to cultivate personal conscience. By emphasizing responsible AI use as a facilitative tool rather than a shortcut, and leveraging guided reflection, collaborative activities, and technology-enhanced platforms, the 3C Framework equips students to navigate ethical complexities in research with integrity and accountability.

Objectives

The primary objective of the 3C Framework module is to equip students with a structured, case-based approach to ethical reasoning that integrates theory with real-world scenarios, fosters active and collaborative learning, and sustains motivation through diverse, engaging activities. The specific objectives are:

i. To provide a structured, case-based learning platform that supports the systematic application of the *3C Framework* to ethical reasoning in the Bioethics in Research and Development course
ii. To integrate ethical theory with real-world scenarios to enhance the relevance and applicability of bioethics concepts.
iii. To facilitate active and collaborative learning through poster presentations, AI-assisted reflections, and interactive discussions.
iv. To sustain student motivation and engagement by using diverse learning activities that replace assignment-heavy approaches with more interactive formats.

NALI Approach

NALI approach implemented in the research (e.g., novelty, creativity, innovativeness, applicability and impact)

Novelty & Creativity

The novelty of this module lies in its unique integration of AI into a structured ethical reasoning framework. This approach moves beyond traditional, static case studies by asking students to actively engage with AI tools like ChatGPT to generate diverse perspectives and simulate outcomes.

This is complemented by the creative design of the learning activities. The module employs a scaffolded learning process where students use integrated tools to build their understanding progressively. They begin with the 3C Case

Analysis Worksheet, advance to collaborative Stakeholder Mapping and culminate in formulating a personal Ethical Framework Statement. This structured yet flexible process allows students to creatively and visually map complex ethical considerations.

Innovativeness & Applicability

The module's innovativeness is most evident in its improvement over passive learning methods. It actively integrates AI as a core component of ethical deliberation rather than just a supplementary tool. The "AI Response Reflection" worksheet is a key innovation, requiring students to critically analyze, compare, and challenge AI-generated solutions against their own reasoning. This process builds essential digital literacy and critical evaluation skills, preparing students for a future where AI is a common tool in research.

From an applicability standpoint, the module is highly relevant to the NALI model as its pedagogy is grounded in Case-Based Learning, Reflective Learning, and Collaborative Learning. Furthermore, it is designed for practical implementation, with activities and assessments that can be seamlessly integrated into standard Learning Management Systems (LMS), ensuring it is easily adaptable for wide use in higher education.

Impact

The ultimate impact of the 3C Framework is its ability to empower students by transforming theoretical knowledge tangible skills. The module develops "moral wisdom (knowledge about ethics and the ability to think ethically) and moral virtue (a stronger commitment to act morally)". By working through contemporary ethical dilemmas in fields like AI in research, data privacy, and vaccine equity, students develop the ethical awareness, critical thinking, and responsible decision-making skills needed for their future careers. Upon completion, they are better equipped to navigate the complex ethical landscapes of modern science with professional integrity and confidence.

Research Methodology

Needs Analysis

The initial phase identified a key pedagogical gap in traditional bioethics education—students' difficulty in applying abstract ethical principles to complex, real-world R&D scenarios. A review of existing ethical decision-making models informed the development of the integrated 3C (Code, Cases, Conscience) Framework.

Module Design

The framework guided the creation of structured yet flexible learning materials, including the 3C Case Analysis Worksheet, Stakeholder Mapping activity, and the innovative AI-Augmented Reasoning component.

Implementation

The module was delivered over 8 weeks within the bioethics course, using blended learning strategies such as class discussions, debates, AI-supported Q&A, and peer feedback.

Evaluation

Student achievement data before and after module implementation from Semester 2 of the 2019/2020 academic year through Semester 2 of the 2023/2024 academic year were quantitatively analyzed using paired sample t-tests against course learning outcomes. Additionally, thematic analysis was conducted to compare student feedback before and after the adoption of the 3C Framework, assessing its impact on the development of ethical reasoning skills.

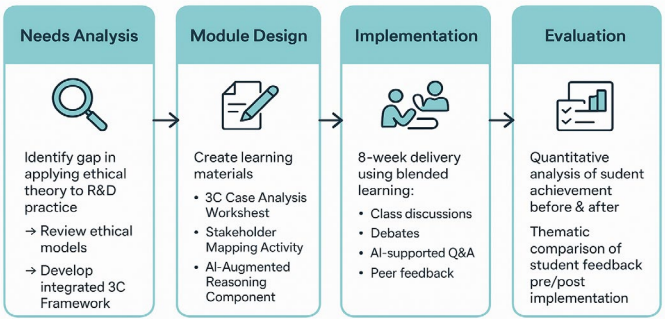


Figure 1. Phases of the 3C Framework Module Development and Implementation Process

Findings and Discussion

The study shows a significant improvement in students' average scores and attainment levels after the bioethics module (Table 1). Specifically, the ability to identify bioethics concepts improved from 72.5% to 83.0% ($p = 0.007$), with attainment levels increasing from 72.8% to 94.5% ($p = 0.003$). Similarly, analyzing ethical principles saw average marks rise from 69.3% to 77.0% ($p = 0.037$), though attainment level changes were not significant ($p = 0.319$). Recognition of ethical improvements related to the environment and professional practice increased in attainment from 80.0% to 100.0% ($p = 0.030$). Other outcomes, such as expanding ideas on ethical issues (average marks: 76.5% to 82.0%, $p = 0.304$; attainment: 87.3% to 93.0%, $p = 0.690$) and practicing sustainability principles (average marks: 82.0% to 85.0%, $p = 0.314$; attainment: 96.5% to 100.0%, $p = 0.082$), showed improvements that were not statistically significant.

These results align with bioethics education goals, confirming that structured teaching effectively enhances students' ethical knowledge and decision-making skills (Chatterjee, 2016; Beauchamp & Childress, 2020). Overall, the findings support integrating bioethics modules to strengthen ethical competencies in education.

Table 1. Student Performance and Attainment Levels Before and After Bioethics Module Application

Course Learning Outcome	Average marks (%)			Attainment level (%)		
	Before	After	p-value	Before	After	p-value
Identify basic concepts, principles, and elements of bioethics	72.5	83.0	0.007	72.8	94.5	0.003
Analyse the ethical principles relevant to the application of biotechnological tools, and related areas of concern	69.3	77.0	0.037	72.3	86.5	0.319
Expand and discuss ideas related to ethical issues in biology and biotechnology field	76.5	82.0	0.304	87.3	93.0	0.690
Recognize the potential for improvement of ethical approaches to environment, society, and professional practice	83.0	90.0	0.225	80.0	100.0	0.030
Practice principles of sustainability in making decisions related to bioethics	82.0	85.0	0.314	96.5	100.0	0.082

Attainment level refers to the percentage of students who score more than 65%

The thematic analysis also reveals a clear pedagogical shift following implementation of the 3C Framework case-based module in Bioethics in Research and Development. Prior to the intervention, students perceived instruction as merely clear but structurally limited; afterward, they described a delivery that was both well-organized and engaging, which supports the goal of creating a structured, case-based platform to apply the 3C Framework (Table 1). The module's emphasis on real-world case studies deepened students' ethical understanding. Participants commented on how connecting theory to actual research and development scenarios broadened their perspective and enhanced ethical applicability. These insights echo findings in medical education where case-based and student-centered curricula significantly increase ethical sensitivity and contextual reasoning (Damanabi et al.., 2023).

Besides, active and collaborative learning through poster presentations, AI-enabled reflection, and interactive discussions was consistently praised. This method contrasts sharply with traditional, assignment-heavy approaches and aligns with broader research showing that active learning substantially improves higher-order thinking (Karwadi et al., 2024). Students also applauded the accessibility of content due to the instructor's simplification of complex concepts. This aligns with cognitive load theory, which states that instructional clarity reduces unnecessary cognitive burden and supports deeper comprehension.

Finally, there was a noticeable increase in intrinsic motivation and ethical curiosity. Post-module feedback highlighted a renewed commitment to exploring bioethical issues beyond the classroom setting, demonstrating that diverse, interactive formats can sustain engagement and foster ethical awareness. Overall, the implementation of the 3C Framework case-based module fulfilled its core objectives: providing structure, integrating theory with real cases, facilitating active learning, and enhancing student motivation—all essential for deepening ethical reasoning in research and development.

Table 1. Thematic Comparison of Student Feedback Before and After the Implementation of the 3C Framework for Ethical Reasoning

Theme	Before Implementation (Traditional Case Study Report & Presentation)	After Implementation (3C Framework Module with Poster Presentation)	Representative Quotes	Link to Module Objectives
Clarity & Organization of Teaching	Students acknowledged clarity and organization of instructions, but focus remained on structure rather than deep understanding.	Students praised structured delivery combined with enthusiasm and concrete examples, making content both clear and relevant.	Before: "Well organized and clear instruction provided" After: "The lecturer uses a well-structured approach and delivers content with enthusiasm, which makes the lectures both informative and enjoyable"	Objective 1: Provide a structured, case-based learning platform that supports systematic application of the 3C Framework
Integration of Ethical Theory with Real-World Scenarios	Little emphasis on real-world application; focus was on completing assigned tasks.	Strong recognition of theory-to-practice connection, especially in healthcare and research ethics.	Before: "I struggled to connect ethical theories to practical situations and often found the concepts too abstract After only: "Her deep knowledge… apply them to real-life scenarios… broadened my perspective and lecturer always give example based on matter or case which had been happened before to helps students understand more"	Objective 2: Integrate ethical theory with real-world scenarios to enhance relevance and applicability
Active & Collaborative Learning	Limited active learning; assignments viewed as heavy and needing alternative formats.	Students valued interactive elements (poster presentations, class activities, AI reflections) that enhanced understanding and enjoyment.	Before: "I think I don't like the assignment part… we need different ways of thinking" After: "I love when we do class activities to enhance our understanding. He relate this course to the real-life situation"	Objective 3: Facilitate active and collaborative learning through poster presentations, AI-assisted reflections, and interactive discussions
Accessibility of Content	No mention of simplification; assumption that students handled content independently.	Students appreciated the use of simple, non-technical language and clear breakdown of complex issues.	Before: "I found some of the topics difficult to understand because the explanations were too technical and complicated." After only: "The lecturer teaches in an easy-to-understand way because they use simple, uncomplicated terms" "Had a wonderful way of simplifying explanations of more complex issues into clearly understandable"	Objective 1 & 2: Structured and accessible case-based learning integrating real-world examples
Ethical Awareness & Critical Thinking	Minimal explicit mention of ethics or critical reasoning skills.	Students reported heightened ethical awareness, sensitivity, and curiosity to explore overlooked ethical issues.	Before: "I rarely paid attention to bioethical issues or thought deeply about their impact in everyday situations." After only: "It inspires me to study more on bioethical issues… less likely to be noticed in day-to-day life"	Objective 2: Integrate ethical theory with real-world scenarios to enhance relevance and applicability
Student Motivation & Engagement	Assignments seen as burdensome; learning motivation tied to grades.	Greater intrinsic motivation, respect for lecturer's expertise, and interest in ethics beyond the classroom.	Before: "The assignment bring much marks… need different perspectives" After: "I am happy with the course material and like how it is based on real-life examples"	Objective 4: Sustain student motivation and engagement through diverse, interactive formats

Other relevant information (e.g., commercialization potential, awards received (title of project, exhibition and year))

The module has been submitted for copyright registration (Reference No: IP/CR/07794), demonstrating a commitment to protecting the intellectual property and innovation embedded in this pedagogical approach.

Acknowledgement

We are grateful for the students who provided valuable feedback during the development of the *3C Framework for Ethical Reasoning* module. We also appreciate the support from colleagues and institutions for facilitating the module's copyright registration.

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ID 75: PolyLinguAR: Reimagining Language Learning - AI and AR for the Next-Gen Educator

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Highlights: PolyLinguAR is an innovative Web Augmented Reality (WebAR)-based AI language learning application that features a multilingual AI avatar teacher. The avatar provides real-time lip-sync animation to enhance pronunciation learning and integrates speech recognition to assess learners' speaking skills. Uniquely, the system embeds sustainability-themed vocabulary and phrases, enabling students to gain environmental awareness while mastering new languages. This interactive, web-based approach makes immersive language learning more accessible, engaging, and impactful.

Keywords: WebAR; AI avatar; Multilingual education; Speech recognition; Sustainability

Introduction

PolyLinguAR represents a forward-looking approach to language education by seamlessly merging Artificial Intelligence (AI), Augmented Reality (AR), and sustainability-focused content into one accessible learning platform. By employing Web Augmented Reality (WebAR) technology, the application delivers a life-like AI avatar that can be accessed through any modern web browser, eliminating the need for costly or specialized hardware. This accessibility ensures that learners from various socioeconomic backgrounds, including those in remote or under-resourced areas, can benefit from advanced digital learning tools without technological barriers.

One of PolyLinguAR's most distinctive features is its precise lip-syncing capability. The avatar's mouth movements align accurately with the spoken language, enabling learners to visually observe the articulation of words and sounds. This visual cue provides an essential aid for pronunciation training, especially for students learning unfamiliar phonetic structures or tones. By incorporating real-time lip-sync animation, learners are not only able to listen and repeat but also actively mimic correct speech patterns with visual reinforcement.

The project also makes a significant contribution to interdisciplinary learning by embedding sustainability-related vocabulary and phrases into its lessons. This dual-purpose approach addresses both linguistic and environmental education, ensuring that while students acquire language skills, they also develop awareness of pressing global issues such as recycling, conservation, and renewable energy. This integration encourages learners to become both effective communicators and responsible global citizens.

Aligned with the NALI 2025 objectives, PolyLinguAR demonstrates novelty through its fusion of AI avatars and WebAR delivery, creativity in its immersive lip-syncing design, and applicability through its device-agnostic accessibility. By fostering interactive and personalized feedback, the application enhances motivation, deepens engagement, and improves retention rates. The result is a transformative learning experience that transcends traditional methods and equips learners with skills that are relevant for both personal growth and societal contribution.

Objectives

i. To create an accessible, immersive multilingual learning platform using WebAR and AI avatars. The goal is to ensure that learners from any geographical or socioeconomic background can access high-quality language learning without needing specialized hardware or software. By combining WebAR with AI avatars, the platform delivers an interactive and realistic language learning experience directly through standard web browsers.
ii. To enhance pronunciation learning through realistic lip-sync technology and assess learners' language proficiency using speech recognition and instant feedback. This approach allows students to observe accurate mouth movements, enabling them to mimic and refine their pronunciation in real time. The integrated speech recognition system evaluates spoken responses and provides immediate, targeted feedback to guide improvement.
iii. To integrate sustainability knowledge into language lessons for dual skill-building. Lessons are designed to include vocabulary and conversational topics related to environmental awareness, ensuring that students gain practical language skills while learning about global sustainability issues. This dual-purpose method promotes both linguistic proficiency and responsible citizenship.

NALI Approach

Novelty

The novelty of PolyLinguAR lies in its unprecedented integration of three powerful components: WebAR, multilingual AI avatars, and sustainability education. While AI-based language learning platforms are becoming more common,

few leverage WebAR to bring immersive avatars into the learner's real-world environment without requiring app downloads or dedicated AR devices. This approach reduces friction for learners, making advanced language learning tools instantly accessible.

Creativity

Creativity is exemplified in the lip-sync enabled avatar, which provides learners with a close-up, real-time model for pronunciation. Unlike static video lessons, the avatar adapts to different languages and speaking speeds, allowing learners to mimic speech more effectively. The mouth movements are synchronized with high accuracy, creating a more natural and intuitive pronunciation training process.

Innovativeness

Innovativeness is further demonstrated through the inclusion of sustainability elements in lesson design. In addition to regular everyday phrases, the curriculum incorporates vocabulary and conversational phrases about environmental protection, waste management, and energy conservation. This integration allows learners to build language skills around meaningful topics, reinforcing their awareness of global sustainability challenges.

Applicability

In terms of applicability, PolyLinguAR works on virtually any web-enabled device with a camera and microphone, from smartphones to desktop computers. The user simply scans a link or QR code and immediately begins interacting with the avatar in AR. The platform's ability to encourage active participation, enhance cultural awareness, and promote environmental responsibility positions it as a highly impactful educational innovation.

Research Methodology

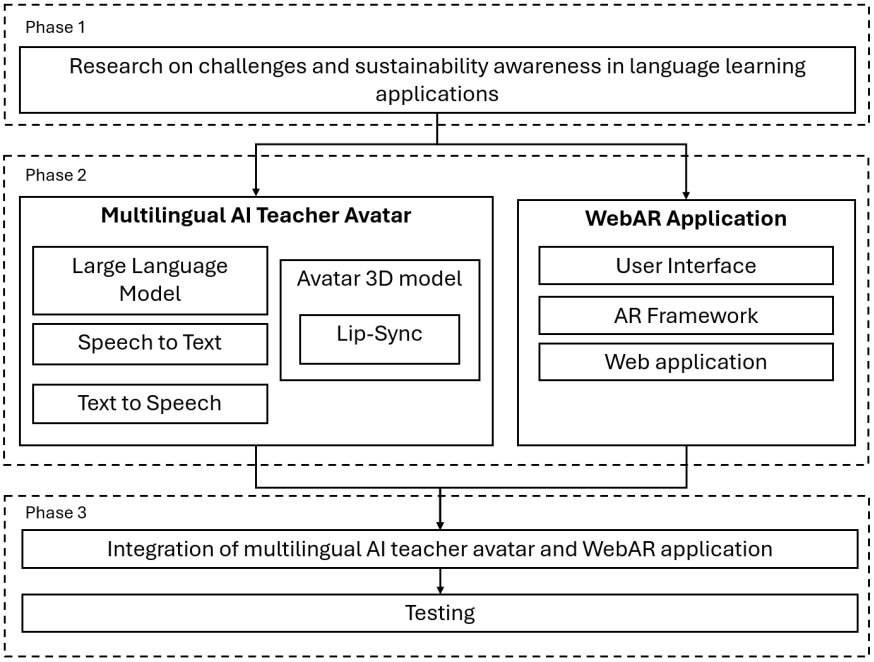


Figure 1 Methodology Flowchart

Figure 1 shows the methodology flowchart that represents the project's development phases. Phase 1 begins with foundational research that examines the current challenges in language learning applications, alongside an exploration of sustainability awareness in their design and usage. This stage ensures that the subsequent development is informed by an understanding of user needs, technical limitations, cultural considerations, and environmentally responsible practices.

Phase 2 moves into the core system development, which is divided into two main components. The first is the Multilingual AI Teacher Avatar, which incorporates advanced artificial intelligence capabilities to process and deliver interactive lessons. This includes a Large Language Model (LLM) to understand user input and generate contextually appropriate responses, Speech-to-Text (STT) functionality to convert spoken language into text for processing, and Text-to-Speech (TTS) capabilities to produce natural, spoken replies. Additionally, this avatar features a 3D model with lip-sync technology to match speech with realistic mouth movements, making the interaction more engaging and human-like. The second component is the WebAR Application, which provides the technological environment for delivering the avatar's functionality. It includes a User Interface designed for intuitive interaction, an AR Framework to render AR elements in a web browser without the need for special apps, and the web application backbone that integrates all functionalities and ensures smooth performance across devices.

Phase 3 focuses on the integration of the multilingual AI teacher avatar into the WebAR application, combining language intelligence with immersive AR to create an engaging, interactive learning experience. This phase ensures

that both systems work seamlessly together, enabling users to interact with the AI avatar in real-time within an AR environment. Once integrated, the entire solution undergoes a thorough testing process. Currently we have done internal testing on the functionalities of the application. In the future, we would like to conduct user evaluation to assess the usability of the application.

Figure 2 shows the framework PolyLinguAR's for processing and responding to a user's speech. As the user speaks, the Speech-to-Text (STT) module converts the spoken words into written text. This text is sent to a Large Language Model (LLM), which interprets the meaning and works with the Data Processing component to generate an appropriate response. Data Processing pulls from two main knowledge sources: the Language Knowledge Base, which contains multilingual rules, vocabulary, grammar, and translation abilities, and the General Knowledge Base, which holds subject matter information and facts. These two knowledge bases are interconnected, allowing the system to combine accurate content with correct language handling. Once the final response is prepared by the LLM, it is converted back into speech through the Text-to-Speech (TTS) module, enabling the user to hear the reply naturally in their preferred language. This end-to-end process ensures both accurate information delivery and effective multilingual communication.

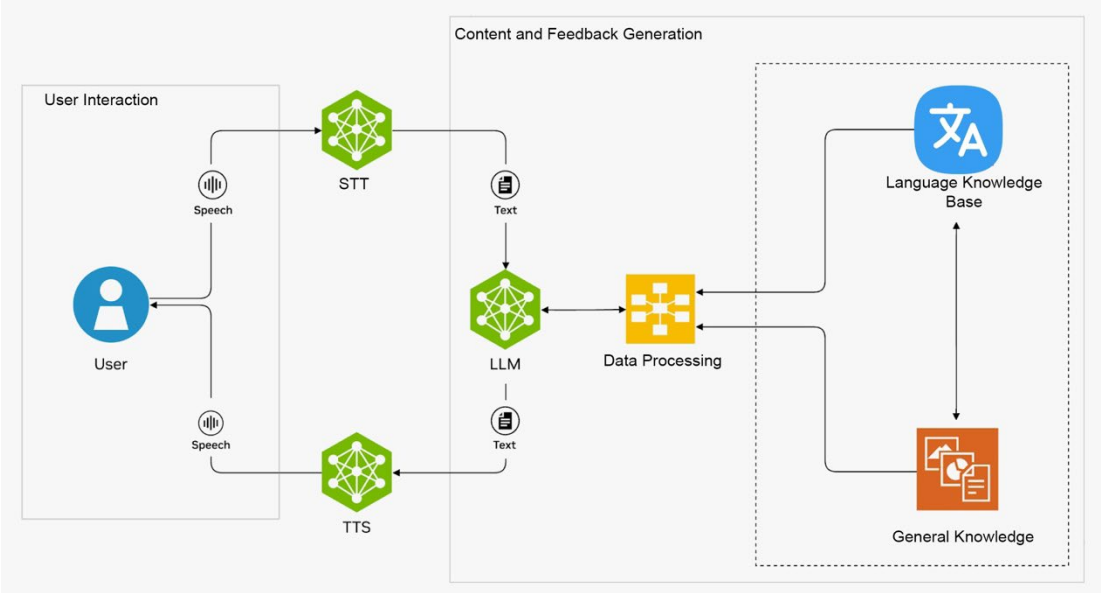


Figure 2 PolyLinguAR framework

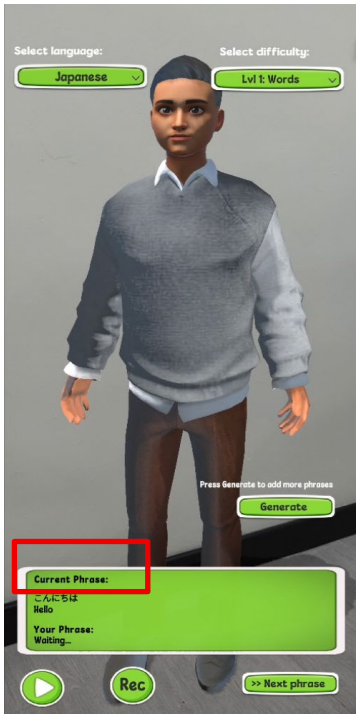
Findings and Discussion

Although the project is currently in the research and development phase, a functional prototype has been created, demonstrating promising outcomes across multiple dimensions of language acquisition. At present, the prototype supports five languages: Malay, English, Spanish, French, Japanese, and Chinese. The lip-synchronization capability has been successfully integrated into the AI avatar for all supported languages, enhancing interactivity and engagement. Furthermore, the application has been deployed to a WebAR environment, enabling the avatar to be placed within real-world contexts through a mobile browser, shown in Figure 3. This approach provides users with a personalized experience without requiring additional software downloads or installations, as all functionalities operate directly within the browser.

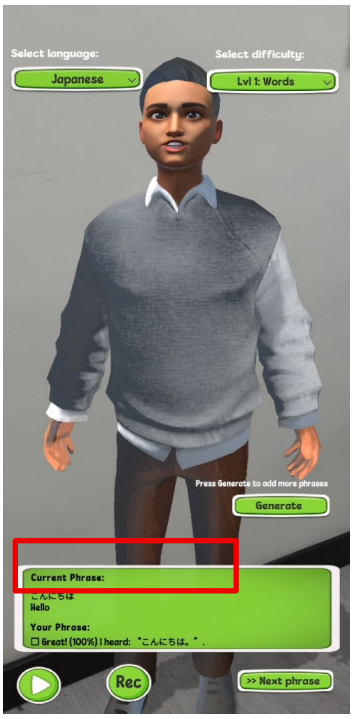


Figure 3 PolyLinguAR application prototype

The system's speech recognition component facilitates dynamic user–avatar interactions, allowing learners to receive immediate feedback. Figure 4(a) shows a screen capture of the teacher avatar is listening to the user's pronunciation, highlighted in red box. Figure 4(b) shows a screen capture of the feedback of the from AI, highlighted in red box. This interactive capability fosters a sustained learning environment by encouraging repeated engagement. Learners can communicate directly with the teacher avatar, creating a heightened sense of personal connection. The application's vocabulary has been expanded to include sustainability-themed word and phrases. Difficulty levels have also been introduced, ranging from basic words to complex sentence structures. Additionally, users may opt to have the AI autonomously generate new words or phrases to broaden their learning scope.



(a)



(b)

Figure 4 (a) Teacher avatar listening to user's pronunciation, (b) Teacher avatar gives feedback

Overall, the development of PolyLinguAR illustrates that it is not merely a language-learning tool but an integrated educational platform that simultaneously cultivates diverse skill sets. By combining advanced technical innovation

with purposeful, content-rich material, the system establishes a model for future educational technologies aimed at generating both cognitive and social impact.

Commercialization Potential

EdTech + AR Growth survey for Global EdTech market projected to hit $400+ billion by 2030, with AR/VR in education growing >30% CAGR. Language Learning Demand: Language learning app revenue is booming (Duolingo, Babbel, LingQ). AR + AI is the "next differentiator" — few incumbents offer browser-based WebAR (low friction entry). Sustainability Trend: Schools, corporations, and governments are actively looking for dual-purpose educational tools they allocate budgets and education grants to look into this area.

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Potential Commercial partnership: Premier Infinitum Sdn Bhd (Malaysia) & Kumon Education (2025)

PolyLinguAR holds strong potential for commercialization within the global language education market. Its scalability, combined with low deployment costs, makes it attractive for schools, universities, and private language learning providers. Institutions can license the platform and customize lesson content to suit specific cultural or curricular needs.

The application's architecture supports gamification, allowing for leaderboards, progress badges, and unlockable lessons to enhance learner motivation. A subscription model could provide individuals with ongoing content updates, while institutional clients could access analytics dashboards for monitoring student progress and engagement.

Beyond education, the platform could serve NGOs and cultural organizations focused on promoting environmental awareness. By providing sustainability-themed language learning experiences, these organizations can broaden their outreach while reinforcing their mission. While the product is still in the early stages, its innovative approach positions it well for recognition in competitions such as NALI 2025. Future plans include expanding the number of supported languages, refining the speech recognition AI for diverse accents, and integrating more advanced AR interaction features. User evaluation with a wider range of participants is also planned.

Acknowledgement

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ID 76: Guess the Learning Type: AI-Enhanced Gamified Learning Kit for Machine Learning Education

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Highlights: Guess the Learning Type is a micro-designed, gamified activity used in an undergraduate Artificial Intelligence course to help students differentiate supervised, unsupervised, and reinforcement learning. Working in groups, students classify real-world scenarios using "S", "U", or "R" cards within strict time limits, earning points for correct answers and losing points for incorrect ones. A visible leaderboard drives friendly competition, while immediate feedback clarifies concepts. Implemented over four semesters, this engaging approach fosters collaboration, quick thinking, and improved comprehension, making complex machine learning concepts more accessible and memorable.

Keywords: Gamification; Active learning; Learning kit; Artificial intelligence; Machine learning

Introduction

The growing demand for engaging and effective teaching methods in higher education, particularly in technical fields like Artificial Intelligence (AI), has driven educators to explore innovative strategies that improve student learning. While traditional lectures can convey information effectively, they often fall short in sustaining student engagement, especially when tackling abstract concepts such as differentiating the types of machine learning. These foundational concepts can be difficult to master through passive learning alone, limiting opportunities to develop both knowledge and critical soft skills. Gamification has emerged as a promising solution by incorporating game elements such as competition, points, and leaderboards to create dynamic learning environments that boost motivation and participation, particularly in Science, Technology, Engineering, and Mathematics (STEM) contexts where the complexity of content can reduce engagement (Deterding et al., 2011; Buckley and Doyle, 2016). According to Zainuddin et al. (2020), gamified activities also promote collaborative learning, problem-solving, and real-time feedback, supporting deeper understanding of theoretical concepts.

The Guess the Learning Type activity exemplifies this approach, using a micro-designed format to break complex material into manageable tasks, thereby reducing cognitive load and fostering intrinsic motivation (Kossen and Ooi, 2021). Implemented in an undergraduate AI course over four semesters, the activity engages students in group-based classification of real-world scenarios using "S", "U", or "R" cards which represent supervised, unsupervised and reinforcement learning respectively, under strict time constraints, with points awarded or deducted based on accuracy. This structure aligns with the research by Freeman et al. (2014) that demonstrates that micro-design and active learning significantly improve comprehension of challenging subjects. By integrating gamification elements with immediate debriefing, the activity creates a competitive yet supportive environment that sustains participation, sharpens quick decision-making, and strengthens conceptual grasp of machine learning types.

Objectives

The objectives of this innovation are as follows: (i) To develop a student-centric micro-designed gamified activity that strengthens understanding of machine learning types, (ii) To provide an unforgettable and sustainable active learning experience through AI-enhanced scenario generation, and (iii) To nurture students with collaboration, critical thinking, and problem-solving skills essential for the future workforce.

NALI Approach

Novelty

The novelty of Guess the Learning Type is that it turns a fundamental AI topic into a fun, hands-on game supported by AI-enhanced scenario generation. Unlike regular lectures, which can be less engaging for complex topics, this approach mixes physical gameplay with a digital content creation process, keeping activities fresh and adaptable over time. The novelty also lies in its flexibility, as the same concept can be applied to other technical subjects while combining the strengths of traditional teaching and modern technology.

Creativity

Guess the Learning Type combines time pressure, collaborative decision-making, points, penalties, leaderboards, and immediate feedback in a hands-on game. AI-generated scenarios add variety and personalised challenges, keeping the same mechanics fresh for every cohort. This blend of physical gameplay and dynamic digital content offers a new, engaging way to teach abstract AI concepts.

Innovativeness

When this game was first introduced, it had only 10 fixed scenarios. After a few sessions, students became familiar with the answers, which reduced excitement. Now, with AI, we have created 50 scenarios arranged from easy to hard. The game is played in three rounds, starting with easy scenarios and progressing to more challenging ones. In each round, scenarios are randomly selected from the larger pool, so even though we still play with 10 scenarios per session, the combination is always fresh. This change transforms the activity from a one-off classroom game into a reusable teaching kit adaptable for different courses and contexts.

Applicability

NALI emphasizes innovative, student-centered learning that uses diverse modes and materials to create meaningful educational experiences. Guess the Learning Type fits this philosophy by replacing the passive pen-and-paper approach with an engaging, competitive group activity. Students take the lead in discussing scenarios, making decisions under time limits, managing scores, and reflecting on their choices, while the lecturer's role is to guide rather than instruct. The activity naturally blends active learning, cooperative teamwork, critical thinking, and problem-solving.

Impact

To evaluate the impact of Guess the Learning Type on students, a 7-point Likert Scale questionnaire with seven statements was administered to a total of 187 participants across multiple cohorts. The statements measured various aspects of the activity, including enjoyment, understanding of machine learning types, perceived competence, classroom activeness, and motivation. As shown in Table 1, the result show consistently high mean scores ranging from 6.33 to 6.50, with low standard deviations (0.82–0.99), indicating strong agreement across all items. These findings suggest that the activity effectively enhanced both student engagement and comprehension while maintaining sustained interest across different groups.

Table 1: Findings for average mean and standard deviation for all semesters (N = 187)

Statement	Mean	Standard Deviation
S1. I enjoyed playing the educational game	6.50	0.82
S2. It helped me to think critically about the topic	6.37	0.90
S3. I feel competent and effective when playing the educational game	6.38	0.97
S4. I understand the topics better after playing the educational game	6.33	0.99
S5. The game made me more active in class	6.45	0.87
S6. The points-based incentives motivated me to participate	6.35	0.92
S7. I wish I have more opportunities to play such educational games	6.49	0.84

Research Methodology

Game Design

The Guess the Learning Type activity integrates key gamification elements such as competition, points, penalties, leaderboards, and immediate feedback to boost engagement and reinforce learning. Students are divided into groups, each using "S," "U," or "R" cards to represent supervised, unsupervised, and reinforcement learning. Each game consists of three rounds: the first two have three scenarios each, and the final round has four, progressing from easy to hard. When the game was first introduced, there were only 10 scenarios. This means that each time the game is played, the scenarios are the same. This causes content fatigue and discourages the students to play the game more than once. However, with AI-enhanced scenario generation, there are now 50 scenarios available, allowing random selection and varied difficulty levels to prevent content fatigue. There are 15 scenarios each for easy and medium level, while there are 20 scenarios for hard level. Points are awarded (+5) for correct answers and deducted (-1) for incorrect ones, creating accountability and discouraging random guessing. Scenarios are based on real-world applications, such as classifying email spam or segmenting customers. Each scenario is followed by an immediate explanation to address misconception. This blend of active problem-solving and immediate explanation keeps students engaged while allowing them to correct mistakes on the spot. As a result, they develop a deeper understanding of machine learning types, reinforced by relevant, practical examples.

Class Implementation

This activity is implemented in the "Types of Machine Learning" subtopic, typically taught in week nine of the semester. The conventional 2-hour lecture is shortened to about 1 hour, with the remaining time dedicated to gameplay. Because of the large class size, the game is conducted in multiple rounds, with different students taking part in each one. In every round, six groups of five students compete, while the remaining students observe the gameplay. This approach ensures broad participation, promotes teamwork, and maintains motivation through competition. Observing students also benefits from real-time examples and explanations. The combination of gamification and immediate feedback transforms the topic into an engaging, student-centered learning experience that strengthens understanding and soft skills.

Findings and Discussion

The correlation heatmap in Figure 1 shows that enjoyment played a key role in driving student engagement. There was a strong positive relationship (0.83) between "Enjoyed_Playing (S1)" and "More_Active (S5)", suggesting that students who enjoyed the game were more involved in class activities. Similarly, "Helped_Critical_Thinking (S2)" and

"Competent_Effective (S3)" had a high correlation (0.84), indicating that students who saw the game to develop critical thinking also felt more capable in the subject.

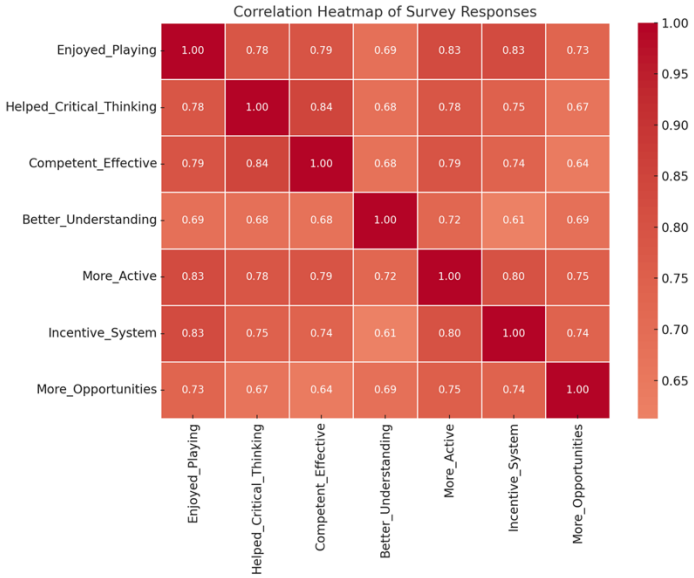


Figure 1: Correlation heatmap of survey responses.

The points-based incentive system also proved effective, with "Incentive_System (S6)" showing a strong correlation (0.80) with "More_Active (S5)". Enjoyment was linked to several other positive outcomes, including critical thinking (0.78), competence (0.79), and more learning opportunities (0.73). Overall, the results highlight that the Guess the Learning Type game improves engagement, strengthens understanding, develops critical thinking, and motivates students. These benefits offer clear advantages over traditional lectures and other active learning approaches by combining fun, competition, and immediate rewards.

Commercialization Potential

The Guess the Learning Type kit is a ready-to-use package containing printed scenario cards, answer cards, facilitator instructions, and a score card, designed to make the foundational "Types of Machine Learning" topic engaging and memorable. The Guess the Learning Type version is simply the first installment, a proven model that can expand into a full series covering more AI topics or even other subjects. With AI education in high demand across universities, polytechnics, high schools, corporate training, and community workshops, the kit offers a scalable and adaptable solution that appeals to a wide audience. It can be sold as a standalone product, delivering active learning experiences while positioning itself as an accessible entry point into the broader world of leaning AI.

Acknowledgement

We would like to thank the students whose participation and feedback were invaluable in developing and refining this innovation as well as Universiti Teknikal Malaysia Melaka for their support in making this work possible.

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ID 77: Data-Driven Discovery: A Research-Led Bioinformatics Learning Experience

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Highlights: This project transforms bioinformatics undergraduates from passive learners into active knowledge developers by embedding Research-Led Learning (RLL) principles—Research-Led, Research-Oriented, Research-Based, and Research-Tutored—into an AI-assisted, project-based curriculum for the *Special Topic on Bioinformatics* course. Integrating Project-Based and Problem-Based Learning with research flow, students apply theoretical concepts to complex genomic and healthcare challenges using Orange Data Mining and AI-assisted literature analysis. These activities develop critical thinking, problem-solving, and industry-aligned technical skills. Collaborative and scaffolded research tasks foster independence and resilience. Impact analysis shows a 70% increase in students self-rating as highly competent in research, an ePPPK score of 5.72/6.00, and 56.7% achieving top-tier grades, contributing to 91.9% attaining top grades in their final-year project. This model offers a scalable blueprint for embedding research-led practices in STEM curricula, aligning university teaching with industry needs in bioinformatics and healthcare analytics.

Keywords: Research-led learning; Bioinformatics; Data mining; Research and teaching

Introduction

Research-led learning (RLL) is an educational approach that integrates the processes of teaching and research, enabling students to actively engage in inquiry, investigation, and the creation of new knowledge. By emphasising student-led exploration, RLL fosters critical thinking, analytical skills, and problem-solving abilities that are essential in higher education and professional practice. In the context of bioinformatics education, research-led in class bridges the gap between theoretical knowledge and real-world application, equipping students to address complex problems in computational genomics and healthcare. Within this course, the principles of research-led learning are operationalized through a combination of project-based, problem-based, and research-led learning approaches. Project-based learning (PjBL) provides students with opportunities to work collaboratively on authentic projects, fostering teamwork, planning, and the translation of research into practical outputs. Meanwhile, problem-based learning (PBL) promotes active engagement through the analysis of real-world case studies, encouraging students to identify problems, evaluate potential solutions, and make informed decisions. And finally, the research-led learning (RLL) approach directly links classroom learning to current research by involving students in literature reviews, data analysis, and solution prototyping under academic supervision.

Several studies highlight the effectiveness of integrating RLL with PjBL and PBL in science and engineering education. Spronken-Smith and Walker (2010) emphasize inquiry as a means of connecting students with the nature of research across disciplines, while Healey and Jenkins (2009) propose structured frameworks for embedding research processes into undergraduate curricula. In computational science education, similar approaches have been shown to improve students' research capabilities and technical proficiency (Silva & Madeira, 2010; Regueras et al., 2010). For instance, Silva and Madeira (2010) implemented a mixed collaborative framework in programming courses to enhance inquiry and problem-solving skills, while Regueras et al. (2010) introduced a model in a networking course that blended inquiry with practical applications using technology-supported tools.

Despite these promising results, comprehensive adoption of integrated RLL approaches, particularly those combining collaborative project work, problem-based inquiry, and research-led elements remains relatively underexplored in bioinformatics education. This paper addresses the gap by presenting the design, implementation, and outcomes of a final-year bioinformatics course, Special Topic on Bioinformatics, that embeds research-led learning throughout its structure. The course serves as a case study demonstrating how undergraduate students can be immersed in authentic research processes, from problem identification to the communication of results, within a structured academic framework.

Objectives

The aim of this paper presents the implementation of a Research-Led Learning (RLL) approach in the *Special Topic on Bioinformatics* course, integrating Project-Based Learning (PjBL) and Problem-Based Learning (PBL) to enhance student engagement in bioinformatics.

1. To examine the integration of research-focused content and activities within the SECB4243 course, specifically in analysing their alignment with research-led learning approach.
2. To evaluate the course's impact on student engagement in bioinformatics research, focusing on independent inquiry, literature analysis, data exploration, and the development of computational solutions to real-world biological problems.

NALI approach

Novelty

The Special Topic on Bioinformatics course integrates Research-Led Learning (RLL), Project-Based Learning (PjBL), and Problem-Based Learning (PBL) to create a comprehensive research-driven structure. This integration addresses limitations of traditional lecture-based bioinformatics teaching, such as passive knowledge absorption, low engagement, and limited exposure to authentic research practice. PBL engages students with real-world biological problems, applying computational genomics to develop solutions and build critical thinking skills. PjBL fosters collaboration in designing and developing mock-up computational solutions using biological or healthcare datasets. RLL provides structured guidance in literature analysis, research methodology, and dissemination. Hands-on use of Orange Data Mining bridges theory and practice, enhancing conceptual understanding and applied problem-solving in computational genomics.

Creativity

The course creatively integrates computational research tasks with interactive lab activities elements. Students are challenged to process, analyse, and visualise genomic and healthcare data using Orange Data Mining's workflow-based interface, encouraging experimentation with various machine learning and data mining techniques. Creativity is further fostered through AI-assisted literature review assignments, where students identify research gaps and synthesise insights to inform their project work. Team-based projects require students to devise innovative computational strategies to address bioinformatics problems, encouraging knowledge exchange, collaborative troubleshooting, and creative solution design. Gamified lab challenges, such as problem-based workflow design, enhance motivation and deepen engagement with research concepts.

Innovativeness

By combining the four dimensions of RLL with PjBL and PBL, the course provides a multidimensional learning experience that encourages active inquiry, systematic experimentation, and iterative improvement, qualities essential for future bioinformatics professionals. The course introduces several innovative components within its RLL approach.

i. **Research-Led Learning:** Students engage directly with cutting-edge computational genomics topics, learning from current literature, datasets, and case studies.
ii. **Research-Oriented Activities:** Structured activities develop students' understanding of bioinformatics research processes, from data acquisition and cleaning to model evaluation and interpretation.
iii. **Research-Based Project Work:** Students apply their acquired skills to investigate biological or healthcare datasets, implement computational solutions, and validate outcomes against research benchmarks.
iv. **Research-Tutored Mentoring:** Students engage directly with cutting-edge computational genomics topics, learning from current literature, datasets, and case studies. Continuous supervision and feedback ensure students refine their research questions, methods, and interpretations.

Applicability

The approach is directly applicable to preparing students for both academic research and industry roles in bioinformatics, data science, and computational biology. Skills developed in this course—such as dataset curation, machine learning model building, clustering, supervised learning, and text mining—are transferable to diverse applications, from precision medicine research to agricultural genomics. Students' final outputs, including research-style articles, computational prototypes, and visualised workflows, align with professional standards, enabling graduates to transition seamlessly into postgraduate research or employment requiring advanced data analysis skills.

Impact

- Enhanced knowledge retention and research readiness: The combination of theory, applied computational practice, and project-based inquiry strengthens long-term retention of bioinformatics concepts while building confidence in handling real datasets.
- Development of critical thinking and collaboration skills: Team-based projects and peer-review exercises promote communication, problem-solving, and collaborative learning.
- Pathways to research and industry: Several students have extended their project work into final-year research projects and conference papers, demonstrating the course's ability to prepare graduates for diverse career paths.

Research Methodology

Figure 1 depicts the implementation of the Research-Led Learning (RLL) approach in *Special Topic on Bioinformatics*, structured into four structured phases: Phase 1: Course Design and RLL Integration, Phase 2: Implementation in the Learning Environment, Phase 3: Data Collection, and Phase 4: Evaluation and Analysis ensuring alignment with NALI principles and the key dimensions of RLL.

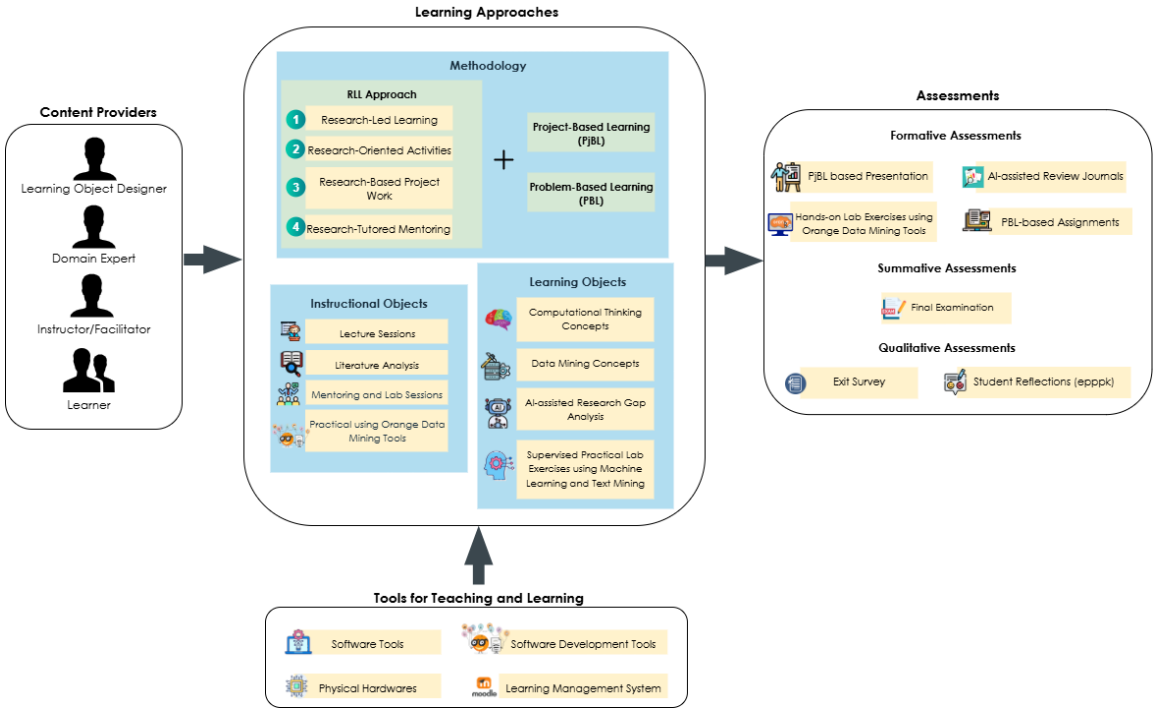


Figure 1: Research Design

Finding and Discussion

To evaluate the effectiveness of integrating Research-Led Learning (RLL) into the Special Topic on Bioinformatics course, a survey was conducted among students enrolled in the course. The participants were final-year undergraduate students from the Faculty of Computing, UTM, registered under the Bachelor of Computer Science (Bioinformatics) program. Two sets of surveys were administered: an entry survey at the start of the semester and an exit survey at the end. A total of 37 students in the cohort participated voluntarily and completed both surveys, enabling paired analysis to evaluate changes in perceptions and self-assessed competencies.

Research-Led Analysis

The survey consisted of eight questions aligned with the four RLL dimensions: Research-Led, Research-Oriented, Research-Based, and Research-Tutored. Participants rated their agreement with each statement on a 5-point Likert scale. Table 1 presents the analysis results, showing the average score for each question.

The highest average score (94.1) was recorded for the research-oriented dimension (Q5), indicating that students were highly engaged in learning how to conduct research through structured, curriculum-based activities through PjBL and PBL. This suggests the course effectively trains students in essential research processes such as literature review, data preprocessing, and workflow design.

Table 1: Analysis of Average Responses for Survey Questions (%)

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Research-Led			Research-Oriented		Research-Based		Research-Tutored	
64.7	70.6	70.6	76.5	94.1	82.4	76.5	64.7	64.7

Moderate scores in the research-led dimension (Q1–Q3) suggest that while students were exposed to current research literature in bioinformatics and healthcare case studies, there is room for improvement in fostering deeper critical engagement with primary research materials.

Similarly, research-based scores (Q6-Q7) indicate that independent investigation and the development of computational solutions are present but could be further emphasised, perhaps through additional student-driven projects. The relatively lower scores for research-tutored activities (Q8–Q9) highlight the need to strengthen one-to-one mentoring or small-group supervision to better guide students through complex research tasks.

Change in Self-Perceived Research Skills

The survey also included self-assessment questions on research competency before and after completing the course. At the beginning of the course, no participants rated themselves as highly competent in research skills, 53% moderately competent, and 47% with low or no competency. By the end of the course, the percentage of students with high competency increased to 70%, while those with low or no competency decreased to 2%. The proportion with moderate competency remained relatively stable at 28%.

This shift indicates that the course substantially improved students' confidence and capability in conducting research, particularly in areas such as computational workflow design, data interpretation, and the application of machine learning and deep learning algorithms.

Analysis of ePPPK Results and Relevance to the Course

The ePPPK results for *Special Topic on Bioinformatics* show an overall weighted mean of 5.72/6.00, indicating very high student satisfaction. Course design and organisation scored the highest (5.78), reflecting clear structure, strong alignment of CLOs/PLOs, and effective integration of research-led learning principles. Feedback, facilitation, and assessment were rated above 5.6, highlighting the value of constructive feedback, practical lab work, and real dataset projects in building research skills. While all dimensions scored highly, social presence (5.61) suggests an opportunity to further enhance peer interaction and research-tutored activities.

Grade Distribution Analysis for PSM2 and its Link to Research-Led Innovation

The grade distribution for Bioinformatics Project II (PSM2) shows 91.9% of students achieving grades in the A+, A, and A− range, with a course mean of 84.9%. This exceptionally high attainment reflects the strong preparation students gained from research-led courses, particularly the *Special Topic on Bioinformatics*, which integrated Problem-Based Learning (PBL), Project-Based Learning (PjBL), and Research-Led Learning (RLL). In PSM2, all four CLOs, covering project development, module verification, technical communication, and proposing future improvements, achieved KPI benchmarks, with attainment levels between 82% and 87%, and 100% of students meeting the minimum competency thresholds for most outcomes. These results align with the Research-Oriented and Research-Based dimensions of RLL, as well as the collaborative problem-solving focus of PBL and the practical, solution-driven nature of PjBL, as students successfully applied advanced computational, analytical, and problem-solving skills in independent projects.

Conclusion

The findings confirm that the integration of RLL in Special Topic on Bioinformatics achieved its primary aim of enhancing student research skills and engagement. High research-oriented scores reflect that structured teaching in research processes is both well-received and effective. However, moderate research-led and research-tutored scores suggest the need for additional strategies such as greater integration of primary research literature into assignments and more personalised supervision to maximise student engagement and output quality. Overall, the survey results align with the course's intended outcomes, demonstrating that a carefully designed blend of PjBL, PBL, and RLL can effectively equip undergraduates for both academic research and professional practice in bioinformatics.

Acknowledgement

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ID 78: MyInsan: Aplikasi Pembelajaran Interaktif Falsafah dan Isu Semasa

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Sorotan: Pengajaran subjek Falsafah dan Isu Semasa sering berdepan cabaran untuk memastikan pelajar memahami konsep abstrak seperti logik dan metafizik, mengaitkannya dengan kehidupan sebenar, dan menghayati nilai-nilai yang digariskan dalam konsep falsafah. Subjek ini merupakan kursus umum di Institut Pengajian Tinggi yang bermatlamat untuk membentuk keperibadian graduan sebagaimana yang dinyatakan dalam Falsafah Pendidikan Kebangsaan melalui penerapan KBAT, kemahiran komunikasi, dan kesedaran nilai. Justeru, ia memerlukan kepada pendekatan pengalaman pembelajaran yang menyeronokkan dan interaktif. Berdasarkan keperluan tersebut, MyInsan dibangunkan sebagai inovasi pembelajaran digital yang menggabungkan kuiz interaktif, penjejak amalan harian berdasarkan jasmani, emosi, rohani, dan intelek (JERI), pengaplikasian elemen permainan, serta refleksi. Pendekatan ini memanfaatkan teknologi untuk meningkatkan penglibatan pelajar, memudahkan penguasaan konsep falsafah, dan menghubungkan teori dengan aplikasi praktikal dalam kehidupan seharian.

Kata Kunci : Falsafah dan isu semasa, JERI; Pembelajaran interaktif

Pengenalan

Subjek Falsafah dan Isu Semasa diperkenalkan sebagai kursus umum di institusi pengajian tinggi bagi membentuk insan seimbang dan harmonis dari segi jasmani, emosi, rohani dan intelek, rohani (JERI) seperti yang digariskan dalam Falsafah Pendidikan Negara (FPN). Kandungannya merangkumi pengenalan kepada aliran pemikiran falsafah klasik dan moden, hubungan antara FPN, Rukun Negara, dan Wawasan Falsafah Sejahtera, serta aplikasi falsafah dalam memahami isu-isu semasa di peringkat nasional dan global.

FPN berperanan sebagai asas pembinaan modal insan abad ke-21 yang berilmu, berakhlak mulia, bertanggungjawab, dan berupaya menyumbang kepada keharmonian masyarakat serta kemakmuran negara. Prinsip-prinsip FPN diperkukuh dengan nilai Rukun Negara yang lahir daripada pengalaman sejarah, termasuk peristiwa 13 Mei 1969 yang menekankan kepentingan perpaduan kaum, keharmonian sosial, dan integriti nasional.

Dalam konteks pembelajaran, falsafah pendidikan tidak hanya mengandungi teori, tetapi juga berfungsi untuk membimbing pemikiran rasional, mengkritik andaian, menyelesaikan konflik idea, dan mencetuskan inovasi berasaskan bukti, nilai, dan tradisi masyarakat. Oleh itu, kaedah pengajaran subjek ini perlu menghubungkan konsep-konsep abstrak seperti logik dan metafizik dengan realiti kehidupan pelajar secara menyeronokkan, interaktif, dan reflektif agar penghayatan nilai dapat dilaksanakan secara berterusan.

Objektif

i. Memudahkan pemahaman subjek Falsafah dan Isu Semasa melalui modul interaktif dan berstruktur.
ii. Mengintegrasikan elemen logik untuk membentuk pemikiran kritis, analitik, dan reflektif melalui pembelajaran secara interaktif.
iii. Menggalakkan penghayatan nilai falsafah melalui penjejak amalan kehidupan berdasarkan konsep JERI.
iv. Menyediakan penilaian kendiri secara berterusan yang menghubungkan prestasi akademik dengan pembentukan sahsiah.

Pendekatan NALI

Idea Baharu
Satu platform digital pembelajaran bagi subjek Falsafah dan Isu Semasa yang menggabungkan aktiviti kuiz, elemen permainan (gamification), dan penjejak amalan harian berasaskan konsep Jasmani, Emosi, Rohani dan Intelek (JERI) dan refleksi dalam satu aplikasi yang menyeluruh.

Kreativiti
Reka bentuk yang mesra pengguna dengan akses mudah melalui kod QR atau pautan yang diberikan, serta integrasi elemen permainan (gamification), penjejakan kendiri (self-tracking), dan refleksi nilai secara interaktif.

Inovasi
Menawarkan analisis perkembangan pelajar secara automatik yang memadankan pencapaian akademik dengan perkembangan sahsiah, sekaligus membolehkan pemantauan holistik terhadap kemajuan pembelajaran.

Kebolehgunaan
Boleh digunakan oleh pensyarah dan pelajar di institusi pengajian tinggi, serta mudah diadaptasi untuk subjek lain yang memerlukan pengintegrasian elemen nilai dan kemahiran insaniah.

Kesan
Meningkatkan penglibatan aktif pelajar, membentuk keseimbangan JERI, dan memperkukuh kemahiran berfikir aras tinggi (KBAT) melalui penerapan aspek logik dan metafizik dalam pembelajaran

Metodologi Kajian

Reka Bentuk dan Pembangunan
Pembangunan aplikasi MyInsan menggunakan pendekatan Design Thinking yang merangkumi lima fasa:

Empathize
Mengumpul maklumat daripada pensyarah kursus Falsafah dan Isu Semasa berkaitan keperluan pembelajaran interaktif, serta menganalisis dapatan refleksi pelajar sebelum ini yang menekankan keinginan terhadap aktiviti pembelajaran dalam kelas yang lebih menyeronokkan dan melibatkan interaksi dua hala.

Define
Merumuskan masalah utama iaitu cabaran memahami konsep abstrak seperti logik dan metafizik, penglibatan pelajar yang rendah dalam perbincangan, dan ketiadaan platform penilaian kendiri berterusan yang menggabungkan aspek JERI.

Ideate
Menjana idea penyelesaian melalui sesi brainstorming bersama pensyarah dan pelajar bagi menghasilkan cadangan ciri-ciri aplikasi yang memenuhi keperluan PdP subjek ini.

Prototype
Membangunkan prototaip aplikasi MyInsan yang menggabungkan kuiz interaktif, penjejak amalan JERI, elemen permainan (gamification), dan modul refleksi nilai berdasarkan Falsafah Pendidikan Negara.

Test
Melaksanakan ujian rintis bersama kumpulan kecil pelajar bagi menilai kemudahan penggunaan, kesesuaian kandungan,

Kandungan Modul

- Kuiz digital interaktif: Soalan berasaskan kuliah dan isu semasa.
- Gamification: berasaskan kuliah dan isu semasa
- Penjejak amalan harian JERI : Rekod amalan jasmani, emosi, rohani, intelek.
- Refleksi : Penilaian kendiri berasaskan prinsip Falsafah Pendidikan Negara.

Ujian Rintis
Dijalankan kepada 30 pelajar bagi menilai kebolehgunaan dan keberkesanan aplikasi.

Dapatan Kajian dan Perbincangan

Hasil awal menunjukkan:

i. Peningkatan pemahaman konsep falsafah
ii. Peningkatan motivasi pembelajaran hasil refleksi pelajar
iii. Kesedaran JERI meningkat, khususnya dalam dimensi emosi dan rohani.
iv. Pelajar melaporkan aplikasi membantu mereka menghubungkan teori dengan realiti kehidupan, terutama dalam memahami isu semasa melalui perspektif falsafah.

Kesimpulan

i. Berpotensi dikomersialkan untuk kegunaan IPTA dan IPTS,
ii. Sesuai dijadikan alat pembelajaran kendiri untuk program lifelong learning.

Rujukan

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ID 79: ADAM: AI-Driven Academic Mentor to Accelerate Innovation in Programming Education

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Highlights: This innovation introduces AI-Driven Academic Mentor (ADAM), a virtual tutor developed for Bachelor of Electronic Systems Engineering students in SMJE 1013: Programming for Engineers. ADAM integrates AI-powered code review, adaptive feedback, and 24/7 access to enhance both classroom learning and independent study. Configured with course materials such as lecture slides and textbooks, ADAM personalizes learning experiences and supports timely guidance. Comparative analysis between Semester 1 2023/2024 (without ADAM) and Semester 1 2024/2025 (with ADAM) shows higher proportions of top grades, elimination of low grades, and improved Program Learning Outcomes (PLO) attainment, demonstrating its positive impact on learning outcomes.

Keywords: Artificial intelligence; Virtual tutor; Programming education

Introduction

ADAM is an AI-powered tutoring platform tailored for C/C++ programming, offering real-time feedback, natural language explanations, and adaptive learning pathways. Unlike general coding assistants, ADAM is fully aligned with course outcomes and assessment rubrics. Its design combines an Artificial Intelligence (AI) conversational interface with a code analysis engine, delivering instant guidance on syntax, logic, and optimization. The system also tracks student progress to provide targeted remedial or enrichment tasks.

By shifting from a solely instructor-led delivery to an AI-supported blended learning approach, ADAM changes the dynamics of programming education. Students can now receive instant, personalized assistance outside class hours. The approach directly supports the NALI principles of learner-centered approaches, technology-enabled learning, and data-driven education. Initial deployment shows improved academic performance, higher engagement, and increased mastery of problem-solving skills.

Objectives

The objectives of the innovation are as follows:

i. To design and implement ADAM, an AI-powered virtual tutor capable of providing personalised guidance for SMJE 1013: Programming for Engineers course.
ii. To enhance students' programming mastery by offering real-time feedback and tailored learning materials via a virtual tutor.
iii. To increase engagement and self-directed learning through conversational, interactive, and accessible tutoring with ADAM.

NALI Approach

The ADAM initiative embodies the core principles of the New Academia Learning Innovation (NALI) framework by integrating AI technology with a learner-centered, outcome-based, and data-informed approach to teaching and learning. Its design and deployment reflect five essential NALI elements: novelty, creativity, innovativeness, applicability, and impact on student learning.

Novelty

In terms of novelty, ADAM represents a paradigm shift from traditional static learning aids to a dynamic, AI-powered virtual tutor. While generative AI tools exist, ADAM is purpose-built and contextually grounded in the SMJE1013 curriculum, responding in natural language while referencing actual course slides, textbooks, assessments, and PLO-CLO mappings (Ma et al., 2024).

Creativity

The project's creativity is evident in how it personalized learning through ChatGPT (GPT-4o), allowing students to interact with the system in real-time. Unlike conventional chatbot implementations, ADAM enables deep learning engagement, including code debugging, syntax explanation, and instant feedback, all within the student's familiar course structure (Groothuijsen et al., 2024).

Innovativeness

ADAM's innovativeness lies in its dual role as both a virtual assistant for students and a reflective tool for instructors. It supports learners in mastering coding challenges while generating analytical insights into common misconceptions and performance patterns, which help aid lecturers in fine-tuning instruction delivery and assessments (Labadze, 2023).

Applicability

In terms of applicability, ADAM aligns seamlessly with the NALI model and national education policies. It serves as a scalable model for AI-enhanced instruction, especially in technical fields like engineering. It demonstrates how intelligent systems can bridge resource gaps by supplementing teacher presence with 24/7 intelligent tutoring, making it highly transferable to other courses and institutions (Yilmaz, 2023).

Impact

The impact of this innovation is demonstrated through comparative data analysis between students with and without access to ADAM. Findings reveal improved high-grade percentages, reduced low-grade occurrences, and enhanced attainment of key PLOs, particularly in design and development skills (PLO3). Students reported higher engagement, greater confidence, and more frequent independent exploration of programming tasks (Fan et al., 2025).

Research Methodology

The main objectives of this innovation are to improve C/C++ programming mastery through AI-assisted learning, to compare academic performance before and after ADAM's implementation, and to evaluate the effect of ADAM on PLO attainment. The study used a comparative analysis between two cohorts: Semester 1 2023/2024 (without ADAM) and Semester 1 2024/2025 (with ADAM). Data sources included grade distribution and PLO attainment reports. Percentage differences were calculated for each grade category and PLO to determine the overall effect.

This study employed a comparative research design involving two cohorts of students enrolled in the course SMJE1013: Programming for Engineers at MJIIT-UTM. The control group comprised students from Semester 1 of the 2023/2024 academic session, who did not use the virtual tutor ADAM. The treatment group included students from Semester 1 of the 2024/2025 session, where ADAM was fully integrated into the teaching and learning process.

ADAM was developed using ChatGPT (GPT-4o) and specifically tailored to the SMJE1013 curriculum. It was configured using multiple instructional resources, including official lecture slides, prescribed textbooks, past assessments, weekly programming exercises, and clearly defined Course Learning Outcomes (CLOs) and PLOs. These materials were embedded into the ADAM system, enabling it to respond to students' programming-related queries with accurate, context-aware explanations. ADAM was made accessible through a dedicated interface that supported 24/7 availability, allowing students to interact using natural language to receive real-time code debugging help, clarifications on programming logic, and targeted remedial support.

Quantitative data collection focused on two main performance indicators: grade distributions and PLO attainment scores for both cohorts. Grade data were analyzed by comparing the proportion of students falling into each grade category (A+ to E), while PLO attainment was evaluated based on institutional assessment metrics across five core learning outcomes: PLO1, PLO2, PLO3, PLO9, and PLO11. Descriptive statistics and bar chart visualizations were used to present the comparative outcomes and highlight the changes observed after ADAM's introduction.

Although the primary focus was quantitative, the methodology allows for future extension into a mixed-method design. Potential additions include student perception surveys, instructor reflections, and interview-based qualitative feedback to complement the performance data and provide richer insight into the effectiveness and usability of ADAM in a real educational setting.

Findings and Discussion

The analysis of grade distribution and PLO attainment demonstrates the significant impact of ADAM as an AI-driven virtual tutor. From Table 1, the grade distribution was A+ (12.00%), A (56.00%), A− (8.00%), B+ (8.00%), B (0.00%), B− (8.00%), C+ (4.00%), D+ (4.00%), with no C, C−, D, or E grades recorded in Semester 1 2023/2024 (without ADAM). In Semester 1 2024/2025 (with ADAM), the distribution improved to A+ (20.83%), A (37.50%), A− (16.67%), B+ (20.83%), and B (4.17%), with no students scoring below B. The proportion of A+, A−, and B+ grades increased by 8.83, 8.67, and 12.83 percentage points, respectively. The decline in A grade (−18.50 points) reflects a shift toward the higher A+ and A− categories. Notably, the complete removal of lower-grade categories indicates that ADAM effectively personalized support and continuous feedback, while the elimination of lower grades suggests that weaker students were able to achieve better outcomes through the use of ADAM.

Table 1: Grade distribution comparison between Semester 1 2023/2024 and Semester 1 2024/2025.

	Semester 1 2023/2024 (wihout ADAM)		**Semester 1 2024/2025 (with ADAM)**		
Grade	**No.of Students**	**Percentage (%)**	**No.of Students**	**Percentage (%)**	**Difference (%)**
A+	3	12	5	20.83	8.83
A	14	56	9	37.5	-18.5
A-	2	8	4	16.67	8.67
B+	2	8	5	20.83	12.83
B	0	0	1	4.17	4.17

	Semester 1 2023/2024 (wihout ADAM)		Semester 1 2024/2025 (with ADAM)		
Grade	No.of Students	Percentage (%)	No.of Students	Percentage (%)	Difference (%)
B-	2	8	0	0	-8
C+	1	4	0	0	-4
C	0	0	0	0	0
C-	0	0	0	0	0
D+	1	4	0	0	-4
D	0	0	0	0	0
E	0	0	0	0	0

The PLO attainment results in Figure 1 highlight targeted improvements in certain competencies. PLO1 (fundamental knowledge) rose from 91.67% to 95.00%, indicating steady enhancement of core understanding. PLO3 (design and development of solutions) saw the largest gain, from 84.00% to 100.00%, reflecting the effectiveness of ADAM in building practical skills. PLO9 and PLO11 maintained perfect scores, suggesting no negative impact on communication and lifelong learning. However, PLO2 (problem analysis) declined from 83.33% to 70.83%, indicating a need for complementary activities to reinforce analytical thinking.

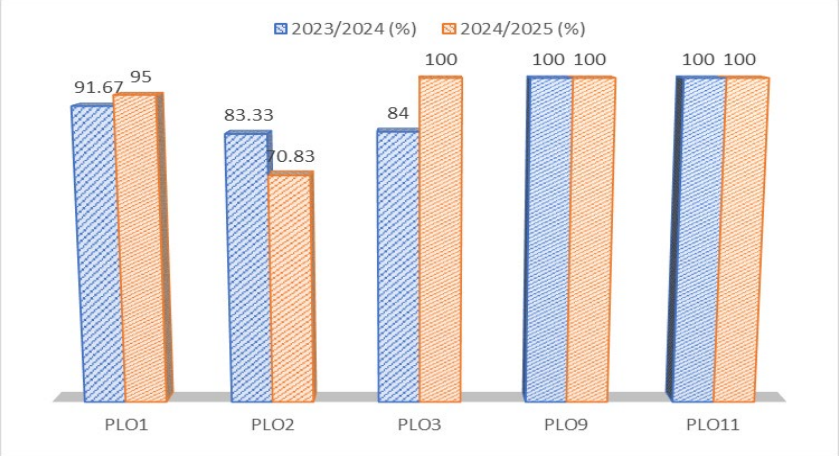


Figure 1: PLO attainment comparison between Semester 1 2023/2024 and Semester 1 2024/2025.

Impact and Significance

The introduction of ADAM has delivered clear, measurable benefits in programming education. By offering continuous, personalised support beyond classroom hours, ADAM has empowered students to develop stronger mastery of programming concepts and practical coding skills. The AI-driven feedback loop, adaptive guidance, and instant code review capabilities have reduced learning barriers, enabling students to progress at their own pace while maintaining engagement and motivation. Comparative academic results further confirm ADAM's role in elevating performance, increasing the proportion of top grades, and eliminating low grades.

From a teaching perspective, ADAM has streamlined the learning process by reducing the lecturer's time spent on repetitive troubleshooting and basic concept clarification. This efficiency has allowed educators to dedicate more effort to higher-order thinking tasks, such as fostering problem-solving skills, guiding project-based learning, and facilitating industry-relevant applications. At the institutional level, ADAM provides concrete evidence of AI's capacity to enhance learner-centred, outcome-based education, supporting Malaysia's national educational strategies and aligning with the Pelan Pembangunan Pendidikan Malaysia (Pendidikan Tinggi) 2015–2025 vision for innovation-driven teaching and learning.

Acknowledgement

We want to express our gratitude to Universiti Teknologi Malaysia (UTM) and the Malaysia-Japan International Institute of Technology (MJIIT) for their support in the development and implementation of ADAM (AI-Driven Academic Mentor). Special thanks to the Department of Electronic Systems Engineering for providing the necessary resources and to the students of SMJE 1013: Programming for Engineers for their participation and feedback. Additionally, we would like to thank the rest of the project team members for their collaboration, dedication, and valuable contributions throughout the ADAM project.

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ID 80: Illustrating Planning Theory Through Creative Narrative and AI-Driven Visual Storytelling

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Highlights: This project introduces an innovative approach to teaching planning theory by engaging fourth-year urban and regional planning students in creating illustrated children's storybooks. Grounded in experiential, constructivist and reflective learning, the method requires students to distil complex theoretical concepts and planner roles into accessible narratives. The process promotes deeper comprehension, transferable communication skills, and an appreciation of planning theory's relevance to practice, transforming abstract concepts into experiences that are engaging, memorable, and visually compelling.

Keywords: Planning theory; Experiential learning; Storytelling pedagogy; AI-assisted illustration; Creative knowledge translation

Introduction

Planning theory is often perceived by students as abstract, multi-paradigmatic and disconnected from real-world practice (Faludi, 1973; Campbell & Fainstein, 2003; Olesen, 2018). This project addresses that challenge by introducing a creative, student-centred approach in a fourth-year Planning Theory course at the Department of Urban and Regional Planning, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia. Students were tasked with translating complex planning theories and planner roles into illustrated children's storybooks, combining narrative and visual storytelling to make theoretical concepts tangible and memorable. Grounded in experiential learning (Kolb, 1984), constructivist pedagogy (Piaget, 1972; Vygotsky, 1978) and reflective practice (Schön, 1983), the project required students to distil and reframe abstract content while experimenting with AI-assisted illustration tools. This blend of creativity, technology and theoretical rigour enhanced engagement, deepened comprehension and empowered students to see planning theory as relevant to their future professional roles (Friedmann, 2008; Bruner, 1990).

Objectives

The primary objective of this project was to enhance student engagement and comprehension in the Planning Theory course by transforming abstract theoretical concepts into relatable, illustrated narratives. Specifically, the project aimed to:

i. Simplify complex planning theories and planners' roles into accessible narratives without compromising theoretical accuracy
ii. Foster creativity and visual communication skills through storytelling and illustration, including the use of AI-assisted design tools
iii. Promote reflective learning by replacing traditional quizzes with reflective writing to deepen understanding and self-awareness in connecting theory to practice

NALI Approach

This project integrates novelty, creativity, innovativeness, applicability and impact into a single teaching approach. The novelty lies in the adaptation of illustrated children's storybooks, traditionally used in early education, as a medium for teaching complex planning theories at the undergraduate level. Creativity is demonstrated through the fusion of narrative and visual elements, where students developed original characters, plots and metaphors to communicate theoretical concepts, enhanced by the use of AI-assisted illustration tools. Innovativeness is reflected in the replacement of conventional assessments such as quizzes with reflective activities. During these sessions, when a group presented its storybook, other individual students listened and reflected on key questions: *What planning theory was applied and how was it used in the presentation? Do you agree with the application of that theory? Why or why not? What did you learn from the presentation that can influence your own planning approach?* This process encouraged critical thinking, peer-to-peer learning and self-awareness in linking theory to practice. The approach is highly applicable to student-centred, active and experiential learning, empowering learners to become active interpreters and communicators of knowledge. The impact is evident in heightened student engagement, improved comprehension of abstract theories and increased confidence in applying planning theory to real-world professional contexts, thereby producing future-ready graduates with both disciplinary knowledge and transferable communication skills.

Research Methodology

The project was implemented in Semester 2, 2024/2025, in the fourth-year Planning Theory course at the Department of Urban and Regional Planning, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia. Students were divided into small groups, each assigned a planning theory or planner role based on Olesen's (2018) framework and classic readings such as Faludi (1973). The selected theories included Rational Planning Theory (a logical, data-driven approach to urban planning), Incrementalism (planning in small, gradual steps), Communicative Planning (emphasising public participation and consensus-building), Advocacy Planning (ensuring marginalised communities have a voice), Equity Planning (aiming for fair access to urban resources) and Radical Planning (focusing on grassroots movements and community-led planning).

Students were tasked with translating their assigned theory into an illustrated children's storybook that retained theoretical accuracy while making concepts accessible. The process involved four key stages. First, students engaged in deep reading of assigned theories to identify their core principles and implications for practice. Second, they developed original narratives suitable for a children's audience, incorporating metaphors, characters and scenarios to represent the theoretical ideas. Third, they produced illustrations using AI-assisted tools to complement and enhance the story. Fourth, the completed storybooks were presented in class, followed by structured reflection activities where peers analysed the theoretical application, assessed its appropriateness and considered how it might influence their own planning approach.

Assessment comprised the storybook (30%), evaluated on theoretical accuracy, creativity, clarity and visual design, and individual reflective writing (20%), focusing on the learning process and the connection between theory and practice. To measure the project's effectiveness, a post-project survey was administered to all participating students to capture their perceptions of learning, engagement, creativity and the use of AI-assisted tools. The survey included both Likert-scale and open-ended questions to enable a combination of quantitative and qualitative analysis of the project's impact.

Findings and Discussion

The storybook project generated high levels of student engagement compared to previous semesters where planning theory was taught through lectures and written assignments. Students reported that the process of translating abstract theories into narratives required them to first internalise the concepts before simplifying them, which deepened their comprehension. Many expressed that creating a storybook allowed them to "see the theory in action" by imagining how planners' roles or decision-making approaches could be represented through characters and story events. The integration of AI-assisted illustration tools enhanced visual creativity and encouraged experimentation with design elements that effectively conveyed theoretical ideas. Visual metaphors became a powerful learning aid, such as using a jungle to represent diverse community voices in Communicative Planning or depicting the gradual construction of a playground to illustrate the step-by-step nature of Incrementalism. This combination of creative narrative and AI-generated visuals helped make abstract content more memorable and accessible.



Figure 1: Samples of students' storybooks

The replacement of quizzes with structured reflective activities and written reflections strengthened critical thinking and peer-to-peer learning. Students were able to evaluate the appropriateness of different theoretical applications, agree or disagree with their peers' interpretations and identify transferable insights for their own future planning practice. A post-project survey (n = 43) further confirmed the positive impact of the approach. The majority of students strongly agreed that the project improved their understanding of planning theory, their ability to explain concepts to others and their confidence in applying theory to real-world contexts. Average scores for key survey items ranged from 4.4 to 4.7 on a 5-point scale (Figure 2). Open-ended responses highlighted three recurring benefits: deeper comprehension through simplification, enhanced creativity from combining narrative and visuals, and improved teamwork skills.

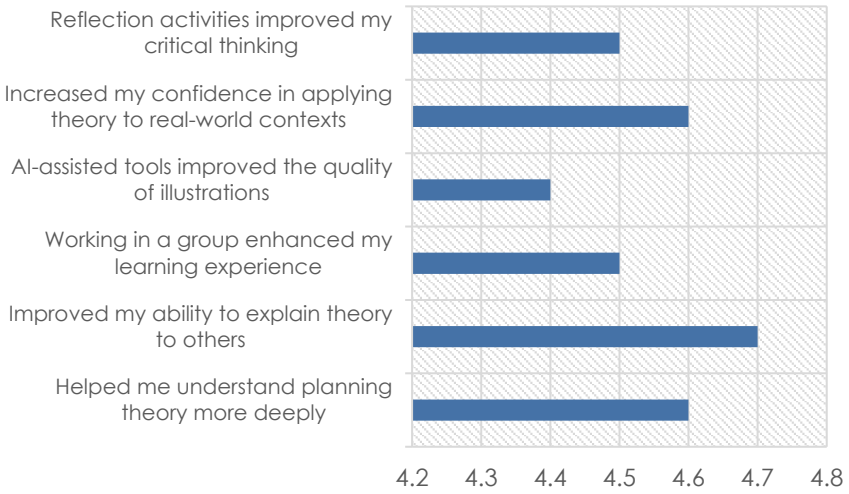


Figure 2: Student Feedback on Planning Theory Storybook Project

Conclusion

The storybook project holds strong potential for application across different areas of planning education, such as planning theories and urban history, and can be adapted for other disciplines where complex concepts need to be translated into accessible formats. Its combination of narrative, visual communication and AI-assisted design tools could be adapted for public education, professional training or community engagement initiatives. With further refinement, selected storybooks could be developed into commercially viable educational materials for schools or public awareness campaigns. Intellectual Property (IP) rights for original story content and illustrations produced by students can be registered under the university's IP policy, to enable protection, licensing and possible revenue generation. The project also offers opportunities for collaboration with creative industries, AI developers and publishing platforms to expand its reach and impact.

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ID 82: Kad Interaktif Dakwah: Find Your Target, Explore Your Method, Do Activity

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Sorotan: Kad Interaktif Dakwah ini dibangunkan sebagai inovasi pembelajaran berasaskan permainan (*gamification*) yang menggabungkan strategi, kreativiti dan aplikasi praktikal dakwah. Melalui tiga komponen utama "*Find Your Target, Explore Your Method dan Do Activity*" peserta dibimbing mengenal pasti sasaran dakwah, memilih kaedah yang sesuai, dan melaksanakan aktiviti secara interaktif. Pendekatan ini meningkatkan penglibatan aktif, kefahaman, dan kemahiran komunikasi peserta. Ia sesuai diaplikasikan di pelbagai platform pendidikan dan komuniti, seterusnya berpotensi sebagai modul latihan standard dakwah yang kreatif dan berimpak tinggi.

Kata Kunci: Dakwah, Sasaran, Pendekatan, Aktiviti

Pengenalan

Pembelajaran melalui **Kad Interaktif Dakwah** ialah satu pendekatan inovatif yang menggabungkan elemen permainan (*gamification*) dengan kaedah pengajaran interaktif bagi meningkatkan kefahaman, penguasaan kemahiran, dan minat peserta terhadap bidang dakwah. Kad ini dibangunkan dengan tiga komponen utama ***Find Your Target, Explore Your Metho, Do Activity*** yang membantu peserta mengenal pasti sasaran dakwah, memilih kaedah yang sesuai, dan melaksanakan aktiviti praktikal secara sistematik. Pendekatan ini bukan sahaja menghidupkan suasana pembelajaran yang menyeronokkan dan interaktif, malah membina kemahiran praktikal, kemahiran komunikasi, dan pemikiran strategik dalam kalangan peserta (Abdul Rahman & Mohd Salleh, 2022). Ia juga berfungsi sebagai alat bantu latihan yang fleksibel, boleh digunakan dalam pelbagai konteks seperti bilik darjah, bengkel komuniti, program mualaf, dan latihan profesional pendakwah. Dengan gabungan strategi pembelajaran berasaskan pengalaman (*experiential learning*) dan persekitaran yang memotivasikan (Kolb, 2015), inovasi ini berpotensi menjadi modul latihan dakwah yang kreatif, relevan, dan berimpak tinggi untuk pelbagai peringkat dan latar belakang masyarakat.

Objektif

i. Meningkatkan kemahiran peserta mengenal pasti sasaran dakwah secara tepat dan berstrategi.
ii. Memberikan pendedahan kepada pelbagai kaedah dakwah yang kreatif, berkesan dan sesuai dengan konteks sasaran.
iii. Menggalakkan peserta mengaplikasikan ilmu dakwah melalui aktiviti simulasi, latihan lapangan atau tugasan kreatif.
iv. Memupuk pembelajaran kolaboratif dan interaktif yang dapat meningkatkan motivasi serta penglibatan aktif peserta.

Pendekatan NALI

Idea Baharu

Inovasi Kad Interaktif Dakwah: *Find Your Target, Explore Your Method and Do Activity* memperkenalkan pendekatan pembelajaran dakwah yang berbeza daripada kaedah konvensional seperti ceramah atau kuliah berbentuk *one-way communication*. Kad interaktif ini direka bentuk khusus untuk menggabungkan elemen strategi, kreativiti, dan pembelajaran kendiri dalam satu platform pembelajaran yang menyeronokkan dan berstruktur. Keunikan utama inovasi ini terletak pada format "3 langkah" iaitu:

- *Find Your Target* (Kenal Pasti Sasaran) – Peserta dibimbing mengenal pasti kumpulan sasaran dakwah melalui situasi atau senario yang diberikan pada kad. Proses ini memupuk kemahiran menganalisis latar belakang, keperluan, dan cabaran kumpulan sasaran secara kritis.
- *Explore Your Method* (Pilih Kaedah Dakwah) – Kad menawarkan pelbagai pendekatan dakwah kreatif yang boleh disesuaikan dengan konteks sasaran, seperti dakwah melalui media sosial, pendekatan dialog, aktiviti seni, atau kaedah bimbingan bersemuka. Ini memberi ruang kepada peserta untuk menilai kesesuaian kaedah berdasarkan situasi sebenar.
- *Do Activity* (Laksanakan Aktiviti) – Peserta diberi tugasan atau simulasi aktiviti dakwah yang perlu dilaksanakan secara individu atau berkumpulan. Aktiviti ini membolehkan mereka mengaplikasikan teori yang telah dipelajari dalam bentuk pengalaman praktikal (*experiential learning*).

Format berstruktur ini memudahkan peserta memahami aliran kerja dakwah dari peringkat perancangan hingga pelaksanaan secara sistematik. Selain itu, penggunaan kad sebagai medium fizikal atau digital memberi nilai tambah

dari segi fleksibiliti, mudah diakses, dan boleh digunakan berulang kali dalam pelbagai konteks pembelajaran dan latihan.

Kreativiti

Reka bentuk Kad Interaktif Dakwah ini menggabungkan unsur visual, warna, dan grafik yang menarik untuk meningkatkan daya tumpu dan motivasi peserta. Setiap kad memaparkan:

- Ilustrasi dan ikon tematik yang memudahkan peserta mengaitkan kandungan dengan situasi sebenar dakwah.
- Arahan dan soalan cabaran yang bersifat terbuka (open-ended questions) bagi merangsang pemikiran kritis dan kreativiti dalam mencari solusi.
- Senario ringkas yang direka berdasarkan isu semasa seperti media sosial, remaja, mualaf, atau komuniti rentan, agar peserta dapat membina strategi dakwah yang relevan.
- Interaktiviti fizikal dan digital – Kad boleh digunakan secara manual dalam kelas atau diintegrasikan dengan platform digital melalui kod QR yang memaut kepada bahan rujukan tambahan, video atau kuiz interaktif.

Pendekatan ini mengubah pembelajaran dakwah daripada pasif kepada penglibatan aktif (*active engagement*) di mana peserta bukan sekadar menerima maklumat, tetapi turut berperanan sebagai perancang dan pelaksana dakwah.

Inovasi

Inovasi ini bukan sekadar memperkenalkan medium baharu, tetapi juga memperbaiki kaedah penyampaian dakwah dengan:

- Integrasi konsep gamifikasi – Peserta memperoleh mata, tahap pencapaian, atau ganjaran simbolik apabila berjaya menyelesaikan tugasan kad. Elemen ini meningkatkan motivasi dan keseronokan belajar.
- Penyusunan modul secara fleksibel – Kad boleh digunakan mengikut tema tertentu atau digabungkan untuk membentuk modul latihan yang lebih menyeluruh, sesuai untuk pelbagai peringkat umur dan latar belakang peserta.
- Simulasi berasaskan situasi sebenar – Kad menyediakan cabaran dunia nyata, membolehkan peserta berlatih membuat keputusan dalam masa terhad, seperti menghadapi soalan provokatif atau menyantuni individu berbeza agama.
- Kebolehgunaan merentas platform – Selain versi bercetak, kad boleh diadaptasi ke bentuk aplikasi mudah alih atau set interaktif untuk latihan dalam talian.

Dengan penambahbaikan ini, kad interaktif dakwah bukan sahaja menjadi alat pembelajaran kreatif, malah berpotensi sebagai alat latihan profesional untuk pendakwah, guru pendidikan Islam, dan penggerak komuniti.

Kebolehgunaan

Kad Interaktif Dakwah ini direka dengan fleksibiliti penggunaan yang tinggi, membolehkan ia diaplikasikan dalam pelbagai konteks pembelajaran dan latihan, antaranya:

- Institusi Pendidikan – Digunakan dalam kelas Pendidikan Islam atau subjek berkaitan dakwah di sekolah, universiti, dan pusat latihan untuk meningkatkan kemahiran komunikasi serta pemahaman konsep dakwah.
- Masjid dan Surau – Sebagai modul latihan bagi imam, bilal, dan penggerak masjid dalam merancang program komuniti yang efektif dan berstrategi.
- NGO dan Badan Dakwah – Menjadi alat bantu latihan untuk pendakwah lapangan yang bekerja dengan masyarakat pelbagai latar belakang seperti mualaf, remaja, atau golongan rentan.
- Latihan Profesional – Digunakan dalam kursus pembangunan profesional (*professional development*) bagi pendakwah dan guru untuk mempelajari kaedah dakwah baharu secara praktikal.
- Platform Digital – Boleh diintegrasikan ke aplikasi pembelajaran atau modul e-learning dengan sokongan multimedia bagi memudahkan akses tanpa batasan lokasi.

Keanjalan penggunaan ini menjadikan kad interaktif dakwah relevan untuk semua peringkat pengguna, dari pelajar hingga tenaga pengajar dan pengamal dakwah profesional.

Kesan kepada Pembelajaran

Penggunaan Kad Interaktif Dakwah memberi kesan positif yang ketara terhadap pembelajaran, antaranya:

- Meningkatkan Penglibatan Aktif (Active Engagement) – Peserta tidak hanya menjadi pendengar, tetapi turut terlibat dalam perbincangan, perancangan, dan simulasi aktiviti dakwah.
- Meningkatkan Kemahiran Analisis dan Strategi – Peserta belajar mengenal pasti keperluan sasaran dakwah, memilih pendekatan yang sesuai, dan merancang aktiviti yang berimpak.
- Penguasaan Ilmu yang Lebih Mendalam – Proses *experiential learning* melalui tugasan praktikal membantu mengukuhkan kefahaman berbanding pembelajaran teori semata-mata.
- Meningkatkan Keyakinan dan Kemahiran Komunikasi – Peserta lebih bersedia menghadapi situasi dakwah sebenar kerana telah berlatih melalui simulasi.
- Pembelajaran Kolaboratif – Aktiviti berkumpulan yang disertakan dalam kad memupuk kerjasama, perkongsian idea, dan pembinaan rangkaian sokongan dalam komuniti dakwah.

Dengan impak ini, kad interaktif dakwah bukan sahaja menyokong matlamat pendidikan Islam yang berkesan, tetapi juga memperkasakan gerakan dakwah dengan kaedah yang lebih strategik, kreatif, dan mesra pengguna.

Metodologi Kajian

Metodologi pelaksanaan projek **Kad Interaktif Dakwah: Find Your Target, Explore Your Method, Do Activity** melibatkan empat fasa utama seperti berikut:

Reka Bentuk & Pembangunan

- Fasa ini melibatkan proses membangunkan prototaip kad interaktif yang mengandungi kandungan dakwah yang disusun mengikut tema. Pemilihan tema dibuat berdasarkan keperluan sasaran pengguna seperti pelajar sekolah menengah, mahasiswa, pendakwah lapangan, mualaf, dan penggerak komuniti masjid. Setiap kad direka dengan:
- Reka bentuk visual yang menarik dan mesra pengguna, menggunakan warna, ikon, dan grafik untuk memudahkan kefahaman.
- Struktur tiga langkah (Find Your Target, Explore Your Method, Do Activity) yang memandu peserta daripada proses perancangan hingga pelaksanaan aktiviti dakwah.
- Kandungan kontekstual yang merangkumi senario realistik, soalan cabaran, kaedah dakwah, dan arahan aktiviti yang boleh dilaksanakan dalam kumpulan atau secara individu.

Pelaksanaan Ujian Perintis

- Ujian perintis dilaksanakan bersama kumpulan kecil peserta (10–20 orang) daripada latar belakang berbeza. Proses ini bertujuan menilai kebolehgunaan, kefahaman, dan keberkesanan kad interaktif dalam situasi sebenar. Aktiviti ujian perintis merangkumi:
- Taklimat ringkas mengenai cara penggunaan kad.
- Simulasi aktiviti berdasarkan senario kad yang dipilih.
- Perbincangan kumpulan untuk menilai strategi yang dibina dan aktiviti yang dilaksanakan.

Penilaian Keberkesanan

- Keberkesanan kad interaktif diukur melalui kaedah kualitatif
- Pemerhatian oleh fasilitator untuk menilai tahap penglibatan, kerjasama kumpulan, dan keberanian peserta menyampaikan dakwah.
- Penilaian prestasi terhadap hasil aktiviti atau simulasi yang dilaksanakan oleh peserta, berdasarkan kriteria kreativiti, kesesuaian kaedah, dan potensi impak.

Penambahbaikan

- Maklum balas yang dikumpulkan digunakan untuk memperbaiki kandungan, reka bentuk, dan format kad. Penambahbaikan melibatkan:
- Menyemak semula senario atau soalan yang terlalu kompleks atau kurang jelas.
- Menambah variasi kaedah dakwah agar sesuai untuk pelbagai kumpulan sasaran.
- Memperbaiki kualiti reka bentuk visual untuk meningkatkan keterlibatan pengguna.

Dapatan Kajian dan Perbincangan

Hasil pelaksanaan ujian perintis menunjukkan bahawa penggunaan kad interaktif dakwah memberikan kesan positif terhadap pengalaman pembelajaran peserta. Majoriti peserta melaporkan peningkatan keyakinan diri dalam menyampaikan dakwah, terutamanya ketika menghadapi situasi simulasi yang menyerupai keadaan sebenar (Mohd Zaki & Ahmad, 2020). Pendekatan ini menjadikan proses pembelajaran lebih menyeronokkan, interaktif, dan kurang membosankan berbanding kaedah kuliah tradisional (Abdul Rahman & Mohd Salleh, 2022). Aktiviti simulasi membolehkan peserta mengaplikasikan teori dakwah secara praktikal, menguji kemampuan memilih kaedah sesuai dengan sasaran, dan membina strategi komunikasi yang berkesan (Kolb, 2015). Dapatan ini mengesahkan keberkesanan kaedah pembelajaran berasaskan pengalaman melalui media interaktif dalam meningkatkan penguasaan kemahiran, keterlibatan aktif, dan motivasi peserta (Siti Hajar & Zulkifli, 2023).

Potensi Pengkomersialan dan Pengiktirafan

Kad Interaktif Dakwah ini mempunyai potensi yang besar untuk dikomersialkan sebagai bahan latihan dakwah standard bagi institusi pendidikan, masjid, pusat latihan mualaf, dan pertubuhan bukan kerajaan (NGO) yang terlibat dalam aktiviti dakwah. Reka bentuknya yang fleksibel membolehkan ia diadaptasi mengikut tahap pendidikan, keperluan sasaran, dan konteks program. Selain itu, inovasi ini berpotensi untuk digunakan dalam program latihan dakwah di peringkat antarabangsa dengan melakukan penyesuaian bahasa, kandungan, dan elemen budaya agar sesuai dengan masyarakat setempat. Dengan keupayaan menyeimbangkan aspek strategi, kreativiti, dan aplikasi praktikal, kad ini bukan sahaja relevan dalam konteks tempatan, malah mampu menjadi produk inovasi pendidikan Islam yang berdaya saing di pasaran global.

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ID 83: Graphical User Interface Development for Quantity Take-off Process in Construction Education through AI-Enhanced Project-Based Learning

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Highlights: This innovation introduces AI-Enhanced Project-Based Learning (AI-PjBL) in a coursework for IT Applications in Built Environment course, where quantity surveying students developed functional Graphical User Interfaces (GUIs) for quantity take-off process of reinforced concrete works. Students integrated AI tools such ChatGPT, Copilot, Claude, and EdrawMax Pro for flowchart creation, coding assistance, and design refinement. The approach addresses CLO3, PLO2 and Bloom's C6 by fostering coding accuracy, critical appraisal, and creative problem-solving. Outcomes show diverse and creative GUIs, improved coding confidence, and deeper understanding of the quantity take-off principles, align with the vision to accelerate innovation in teaching and learning with AI.

Keywords: Project-based learning; Artificial intelligence; Quantity surveying; Quantity take-off; Graphical user interface

Introduction

Quantity surveyors are construction professionals responsible for managing costs, contract and procurement, with the main goal is to ensure value for money throughout a building project's lifecycle (Ashworth and Higgs, 2023). One of their key job scopes is quantity take-off, a process of systematically measuring construction work items. This task is fundamental in preparing cost estimation, Bills of Quantities, and tender documentation. Traditionally, quantity take-off is performed manually or with basic spreadsheet tools such as Microsoft Excel, which can be time-consuming and prone to human errors (Karan et al., 2021; Valinejadshoubi et al., 2024). The digital transformation of the construction industry demands that quantity surveyors move beyond manual measurement skills to embrace automation. However, changing to a new solution for a quantity surveying firm could be quite challenging, especially in terms of training employees with adequate skills and investing in new software and hardware (Ismail et al., 2021). An innovative solution is necessary to ease the transition from traditional calculation to a more advanced technique without having to incur high investment cost. Aligned with this, it is imperative that future graduates are equipped with both technical and IT competencies for the construction industry (Geng et al., 2025). Thus, a coursework in the Information Technology (IT) Applications in Built Environment course (SBEQ2642) offered for Bachelor of Quantity Surveying with Honours students is designed for students to solve the issues regarding the quantity take-off process using programming skills.

To bridge gap between the traditional quantity take-off process and automation advancement, as well as equipping quantity surveying graduates with digital and AI competency, this innovation integrates AI-Enhanced Project-Based Learning (AI-PjBL) in the SBEQ2642 coursework. Students undertake a semester-long project to design and develop a fully functional Graphical User Interface (GUI) for quantity take-off of reinforced concrete works. There are two main requirements for the coursework: students are required to leverage AI tools in the development process of the GUI; and the quantity take-off process in the GUI must be aligned with the Standard Method of Measurement 2 (SMM2). This teaching and learning innovation equipped students with technical coding skills, AI literacy, and professional competencies aligned to industry needs.

Objectives

The objectives of this innovation are as the following:

- To enhance students' understanding of the quantity take-off process for reinforced concrete works through the creation of functional GUI aligned with SMM2.
- To encourage students in integrating AI tools at multiple stages for ideation, design, flowchart creation, source code generation, and pitching for solving issues in the quantity surveying context.

NALI Approach

This AI-PjBL innovation aims to address CLO 2 (Demonstrate coding for accurate calculations by considering data types, use of accumulators, and format of output) and PLO 2 (Appraise critical and complex information, concepts, and theories to resolve issues in the quantity surveying practice). Operating at Bloom's Taxonomy C6 (Creating) level, students actively create novel and functional tools with AI assistance that are relevant to industry needs. This fosters higher-order thinking as students must apply their theoretical knowledge (quantity take-off and programming language), critically evaluate the relevant data inputs, and create usable output. This innovation also aims to improve the problem-solving skills, collaboration, and AI-augmented creativity in the context of quantity surveying practices.

Research Methodology

Over the course of a semester, students worked in groups to conceptualize, design, and code a GUI application using Visual Basic Applications (VBA) in Microsoft Excel that can automate quantity take-off for reinforced concrete elements. Briefing on the project was conducted during the first week of the semester. Starting from the first week until the seventh week, students were given series of videos prepared by the course lecturer where they were required to watch and conduct hands-on activities before the weekly lecture. During the weekly lecture, students were exposed to the theoretical understanding of the hands-on activities that they conducted prior to the lecture and were given more challenging activities to practice their ability and understanding. Equipped with their knowledge and skills gained until the seventh week of lecture, the students developed a flowchart to conceptualize their project ideas. Submission of the flowchart on the seventh week was regarded as an achievement of the first milestone. Upon receiving constructive feedback from the lecturer, the students then continue with the development of the GUI and drafting the project report. In the second milestone (tenth week), students were required to submit the progress of their GUI and report to ensure that the quantity take-off process in the GUI comply with SMM2 and the GUI fulfil the coursework requirements. Students were encouraged to leverage on the AI tools at every stage of the project – from idea generation and code troubleshooting to interface design refinement. Lastly, the third milestone was the final submission of the GUI and report on the thirteenth week. Due to the time constraint, oral presentation was not conducted and replaced with submission of pitching video presentation by the students. These staged milestones encouraged continuous feedback, teamworking, and mirroring real-world workflow where students must adhere to the deadlines.

This innovation, in the form of an AI-PjBL, is aligned with the NALI approach as it combines active, student-centred pedagogy with digital learning resources to create a meaningful and interactive learning experience. Under the Learning Mode component, the innovation applies Outcome-Based Education (OBE) by aligning the project with targeted learning outcomes, namely CLO3 and PLO2, and ensuring assessment is directly linked to students' ability to demonstrate the required competencies. While the primary method is Project-Based Learning (PjBL), it integrates selected Problem-Based Learning (PBL) elements by challenging students to solve an industry-related problem where multiple solutions are possible, requiring independent research and critical thinking. The approach also reflects High-Impact Educational Practices (HIEPs) through series of milestones, collaborative learning, and pitching presentation. Under the Learning Materials component, the innovation incorporates digital tools such as e-Learning and Youtube and AI applications, fulfilling the NALI emphasis on technology-enabled education. This innovation embodies novelty by making this project as the first coursework in the Quantity Surveying Programme where students were actively encouraged to use AI as a supportive tool for enhancement in designing and coding the GUI. This innovation also incorporates creativity through unique and customized GUI designs, innovativeness via automation of traditionally manual processes, applicability by aligning directly with professional QS practice and SMM2, and impact by equipping students with future-ready skills in coding, digital measurement, and AI literacy.

Findings and Discussion

The students were evaluated based on four criteria: the persuasiveness of their pitch presentation and effectiveness of AI in idea generation (10%); their GUI in terms of efficiency of the source code and functionality of GUI according to SMM2 (10%); completeness of the report in explaining the inputs, processes, outputs, and flowcharts (10%); and the creativity of utilizing AI throughout the process (5%), with a total mark allocation of 35%. The implementation of this AI-PjBL coursework has produced a range of diverse and innovative outputs. Each group developed a unique GUI, reflecting their creativity in presenting the quantity take-off process. The unique and highlighted features included a user login menu, a project menu for recording the project details related to reinforced concrete works, embedded SMM2 references that allow users to select items directly from a menu, automated calculation, integrated unit conversion tools such as converting reinforcement bar quantity from metres to kilograms, and intuitive user interfaces designed for ease of use. Figure 1 shows an example of a GUI for the quantity take-off process of reinforcement bars where user should fill in the required information such as the element type, number of bars, main bar length, and type of bar, and subsequently click on the "Calculate" button to obtain the total length and automatically convert to kilograms.

The students demonstrated the integration of various AI tools into their workflows. ChatGPT was commonly used for generating ideas and flowcharts, as well as producing VBA source code from simple prompts or partial code. Copilot, Jasper, Perplexity AI, MyMap AI, Adobe Firefly, and Figma were also utilized for generating ideas and flowcharts. Claude, Blackbox and Tabnine were also employed for its capability to write, explain, and debug VBA code. Students noted that they were able to automate workflows, create macros, and apply complex formula as Claude translated natural language requests into functional VBA code. Some students also used EdrawMax Pro for creating professional flowcharts that mapped out their system designs.

Feedback from students indicated increased confidence in coding, stronger understanding of quantity take-off rules, and improved teamwork and management skills. Many reported that the integration of AI made the coding process more approachable and efficient as they have very limited programming skills, while also encouraging them to critically evaluate and refine AI-generated suggestions. However, a small number of groups demonstrated only minimal AI integration and limited creativity. Despite this, the CLO and PLO were successfully achieved, as the majority of students achieved high marks in which they demonstrated maximum effort, producing functional, relevant, and well-documented applications.

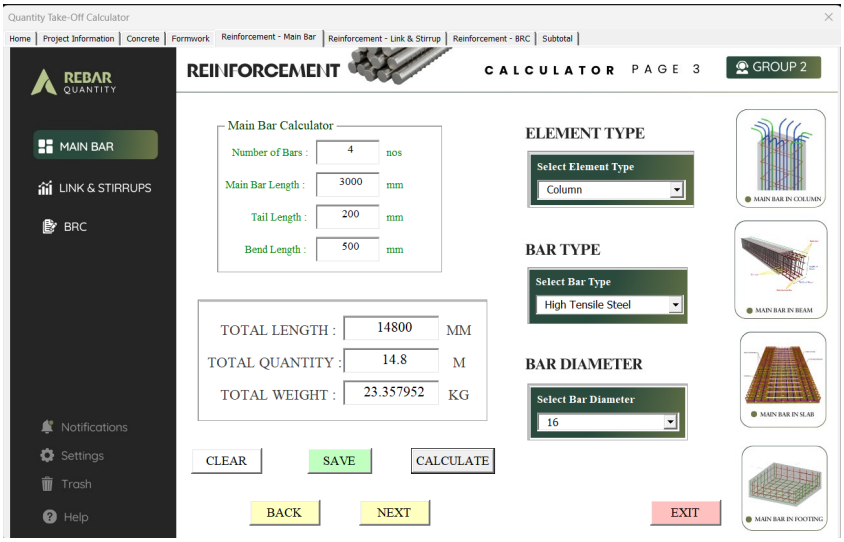


Figure 2 Example of GUI for calculating reinforcement bars

Conclusion

This innovation has shown that AI-PjBL approach can effectively bridge technical quantity surveying knowledge with emerging digital competencies. By actively encouraging students to engage with AI tools, the coursework shifted the narrative from resisting AI to leveraging it as a creative and supportive partner in professional skill development. The variety and quality of outputs proved that students are able to apply theoretical knowledge of quantity take-off and coding in novel and practical ways that are relevant to the industry needs.

Reflecting on the process, one of the key successes was the balance between guided structure and creative freedom. Students were given clear instruction on the deliverables and assessment criteria, yet they had the flexibility to choose their design and features which encouraged ownership and innovation. The students' experience also revealed that while AI can significantly accelerate learning and productivity, critical quantity surveying theoretical skills remain essential to ensure accuracy, compliance with standards and professional integrity.

Moving forward, this approach could be further enhanced by introducing collaboration with industry partners, expanding the scope of quantity take-off tasks and other quantity surveying job scopes such as preparation of BQ, tender documentation, and valuation for project payments. Ultimately, this innovation not only aligns with the NALI 2025 theme but also represents a forward-looking step in preparing QS graduates for a construction industry shaped by digital transformation and AI integration.

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ID 84: Transforming Computer Network Education through AI-Driven, Technology-Enhanced Inquiry-Based Learning

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Highlights: The work showcases an innovative transformation of the Computer Systems and Networks course (SAIA1163) under the Bachelor in Artificial Intelligence programme at Universiti Teknologi Malaysia, through the integration of New Academia Learning Innovation (NALI) principles. Two core pedagogical strategies were employed: (1) technology-enhanced learning, the use of simulation software and digital tools (Cisco Packet Tracer, Google Colab, Kahoot, Padlet), and (2) an inquiry-based, project-driven approach in which students collaboratively design, simulate, and analyse network architectures, while proposing relevant AI applications. Survey results reveal substantial gains in conceptual understanding, critical thinking, and digital fluency, alongside high engagement and satisfaction.

Keywords: Technology-enhanced learning; Inquiry-based learning; Simulation; Artificial intelligence

Introduction

In today's fast-changing digital age, cloud-native systems, edge computing, and AI-powered automation are reshaping the skills that employers expect from new networking graduates (Abbasi et al., 2023), (Xiong & Chen, 2020), (Babou et al., 2024). Traditional syllabi that simply make students memorize protocols cannot help them diagnose packet loss, improve quality of service, or embed AI solutions in real networks (Lawson & Macfarlane, 2014), (Vijayalakshmi & Raikar, 2021).

To bridge this gap, the Computer Systems and Networks course SAIA1163 at Universiti Teknologi Malaysia was redesigned within the New Academia Learning Innovation (NALI) framework, placing strong emphasis on simulation, inquiry, and AI-based teamwork. The redesign integrates two mutually reinforcing strategies. First, technology-enhanced learning gives students Cisco Packet Tracer for network building, Google Colab for Python data work, and Kahoot or Padlet for quick feedback and idea sharing. Students can test repeatedly, get instant comments, and restart setups without breaking expensive gear (Metilda & Neena, 2017). Second, an inquiry-based, project-driven approach assigns teams of four to create an IoT network model in Packet Tracer, script device logic and traffic analyses in Python, and propose AI enhancements such as anomaly detection or adaptive QoS routing (Singh & Kaur, 2021).

By applying Open Systems Interconnection (OSI)-layer theory to Packet Tracer network simulations, students turn textbook ideas into practical industry skills while practicing data-driven decision-making. All learning activities and assessments are mapped to Programme Learning Outcomes (PLOs) through outcome-based education, ensuring constructive alignment and advancing NALI's pillars of student-centered, technology-enhanced, higher-order learning (Vijayalakshmi & Raikar, 2021). Early results show the model can lead a medium-sized class toward Industrial Revolution (IR) 4.0 readiness with evidence-based practice that scales well (Oztoprak et al., 2023).

Objectives

i. Technology-enhanced learning leverages Cisco Packet Tracer, Google Colab, Kahoot and Padlet to build an interactive, low-cost digital ecosystem that sharpens students' simulation skills and real-time analytics fluency.
ii. Inquiry-based, project-driven learning engages teams in collaboratively designing, simulating and analysing network models while proposing AI enhancements, thereby cultivating authentic problem solving and higher-order thinking.

NALI Approach

Novelty

The course brings fresh ideas to networking education by placing digital tools at the centre of every lesson. Students learn concepts through Cisco Packet Tracer simulations, Google Colab notebooks, Kahoot quizzes and Padlet boards, turning abstract theories into visible artefacts that they can edit and share. These platforms enrich both teaching and learning because they allow instructors to illustrate complex behaviours instantly and give learners room to explore without fear of breaking real equipment.

Equally new is the scenario-based inquiry model. Learners work in small groups to design and simulate an IoT network for a real scenario, such as smart farming or fire detection, using Cisco Packet Tracer as their "virtual lab. Teams must run their model under several traffic or fault conditions and study behaviour across all five TCP/IP layers, then explain what they discovered. This shift from instructor explanations to learner investigations nurtures curiosity and analytical thinking that traditional protocol-memorisation courses rarely achieve.

Creativity

A carefully designed toolkit sparks imaginative thinking. Cisco Packet Tracer lets teams build and tear down topologies at will, while Google Colab provides a cloud space for Python analysis and simple machine-learning experiments. Kahoot delivers quick formative checks, and Padlet captures brainstorming sessions in visual form. Moving fluidly among these tools, students invent network layouts, test routing options and refine ideas with rapid feedback.

Creativity is most evident during the group project, where each team designs an IoT network model aligned with real-world contexts such as smart agriculture, environmental monitoring, or intelligent buildings. Students then stress test their designs under hypothetical conditions that include sensor node failures, burst traffic, and fluctuating quality of service requirements before proposing how artificial intelligence can be used for anomaly detection or adaptive routing. The open-ended brief ensures that every solution is distinct, and participants must defend their network model and algorithmic decisions before their peers, thereby cultivating both technical skills and formal communication skills.

Innovativeness

The curriculum includes emerging topics like artificial intelligence in networking, cloud computing and even quantum communication, pushing learning far beyond networking protocols. Students see how intelligent control planes, predictive analytics and secure quantum links can reshape future infrastructure. This exposure encourages them to think of networks as adaptive and data-driven systems.

Pedagogically, the course trades one-way lectures for blended practice: gamified quizzes, visual collaboration boards and scenario-based projects. Students configure devices, solve simulated faults and optimise network configuration. The structured scenario analysis and group inquiry mark a clear improvement over traditional protocol-recall classes.

Applicability

Every task maps to Course Learning Outcomes and, in turn, to PLOs, fulfilling outcome-based education. Students take charge of projects, choose suitable tools and evaluate results which is an ideal match for the student-centred, technology-enhanced vision of NALI.

Higher-order skills grow through analysis, evaluation, and synthesis. By simulating real-world problems such as flood alerts, carbon-monoxide alarms, smart classrooms, learners connect classroom theory to authentic contexts. Continuous reflection and rubric-based marking keep objectives transparent and achievable.

Impact

Interactive simulations give learners a safe space to construct, configure and troubleshoot networks, boosting confidence and problem-solving ability. Real-time collaboration through Padlet keeps engagement high and mirrors modern distributed workflows. Because students can revisit simulations and quizzes at their own pace, the design also supports differentiated learning.

Inquiry projects deepen understanding and empower students to become innovators. Teams diagnose congestion, model fault conditions and recommend artificial-intelligence add-ons, then justify each decision in reflective reports. These experiences strengthen technical competence, communication and self-directed learning, equipping graduates with digital fluency that industry values.

Research Methodology

The study began with a pre-course readiness survey that captured students' prior knowledge of networking, experience with simulation tools and preferences for collaborative, game-like activities. Likert-scale items such as "Prior experience with simulation tools (e.g., Cisco Packet Tracer)" and "I know how AI could potentially be used in networking" established a reliable baseline of readiness and expectations

During the 14-week delivery phase, two pedagogical approaches were implemented. Technology-enhanced class activities used Kahoot for live game-style quizzes, Padlet for online idea sharing and peer feedback, and Google Colab for cloud-based Python analysis. In parallel, an inquiry-based group project (four students per team, four-week duration) required each team to design and simulate an IoT network in Cisco Packet Tracer, then script Microcontroller Unit (MCU) behaviour in Python within the Cisco Packet Tracer environment, run traffic scenarios and propose AI enhancements.

Evaluation of blended system analytics with two end-of-course instruments. The post-course learning survey probed tool effectiveness and skill gains, asking students to rate statements such as "The use of Cisco Packet Tracer enhanced my understanding of networking" and "Kahoot quizzes made the class more engaging" on a five-point scale, A subsequent student reflection survey measured perceptions of innovation and future relevance, including items like "The course delivery model was innovative and engaging."

Findings and Discussion

Systematic Measurement

Thirty-one students responded to the surveys and most respondents are male (63.9%) and the remainder female (36.1%). Only 38.9% of the respondents have previously taken a networking or AI-related course. Prior exposure to simulation tools is limited (8.3% have used Cisco Packet Tracer), whereas familiarity with collaborative digital tools is very high (97.2% have used Kahoot, Padlet, or Google Colab). Overall, they are early-stage learners with strong general digital fluency but minimal simulation experience. The survey results are summarized in Table 1. Items were rated on a 1–5 Likert scale (1 = strongly disagree, 5 = strongly agree).

Table 1: Descriptive statistics for pre- and post-course survey items and student reflections (5-point Likert).

Item	Mean	Std. Deviation
Pre Course Readiness Survey – Knowledge and Skill Level		
I have a solid understanding of basic networking concepts.	3.03	1.16
I can identify the function of basic networking devices.	3.25	1.34
I am familiar with IP addressing and subnetting	2.67	1.51
I understand the OSI model and its layers	2.69	1.6
I know how AI could potentially be used in networking.	3.17	1.52
Pre Course Readiness Survey – Learning Preferences		
I prefer traditional lectures over hands-on activities	2.86	1.25
I enjoy learning through group discussions and collaboration.	3.94	1.15
I feel motivated when learning involves games or digital interaction.	4.28	1.03
I prefer exploring topics through real-world scenarios and projects.	4.39	0.93
Post-Course Survey – Skill and Knowledge Gain		
My understanding of networking concepts has significantly improved.	4.43	0.66
I am now more confident in configuring and troubleshooting networks.	3.97	0.79
I feel better prepared for industry-level work in networking.	3.71	0.93
This course has helped me develop critical thinking and problem-solving.	4.29	0.86
Post-Course Survey – Learning Experience		
The use of Cisco Packet Tracer enhanced my understanding of networking.	4.43	0.74
Google Colab was effective in helping me understand AI concepts.	4.40	0.88
Kahoot quizzes made the class more engaging.	4.74	0.74
Padlet helped me organise and share ideas with peers.	4.34	1.03
I found project-based learning more effective than lectures.	4.14	0.97
Student Reflection - Innovative Learning		
The course delivery model was innovative and engaging.	4.10	0.87
The integration of AI and simulation provided real-world relevance.	4.36	0.76
This model encouraged active, student-centred learning.	4.23	0.92
The tools used supported higher-order thinking and application.	4.29	0.82
This innovation should be implemented in other technical courses.	4.26	0.77

The pre-course section shows moderate readiness with a notable spread. Students placed themselves near the midpoint for basic networking knowledge at 3.03 and for recognising device functions at 3.25. Confidence was lowest for IP addressing at 2.67 and the OSI model at 2.69, which also carried larger standard deviations above 1.4, indicating uneven prior exposure. Views on learning preferences were clear. Traditional lectures scored only 2.86, while group discussion reached 3.94, games and digital interaction 4.28, and real-world projects 4.39, with smaller deviations around one point that suggest broad agreement.

Post-course results point to strong gains in core outcomes and more consistent experiences. Students reported a marked improvement in understanding at 4.43 and growth in critical thinking and problem solving at 4.29. Confidence in configuration and troubleshooting rose to 3.97 and perceived industry readiness to 3.71, which are positive but still below the very high understanding score. Standard deviations mostly fell below one point, and as low as 0.66 for the improvement item, showing tighter consensus after the course.

Evidence from the learning experience and reflection blocks highlights the role of specific tools and the instructional model. Packet Tracer and Google Colab were judged effective at 4.43 and 4.40, while Kahoot was the most engaging at 4.74 and Padlet supported idea sharing at 4.34. Students also rated project-based learning as more effective than lectures at 4.14. They described the overall model as innovative at 4.10, relevant through the integration of AI and simulation at 4.36, and supportive of higher-order thinking at 4.29. With a 4.26 average for the call to extend this approach to other technical courses, the reflections suggest both satisfaction and perceived transferability.

Sustainable Impact

Interactive simulations give learners a safe space to construct, configure and troubleshoot networks, boosting confidence and problem-solving ability. Real-time collaboration through Padlet keeps engagement high and mirrors modern distributed workflows. Post-course ratings show high understanding of networking at 4.43 and stronger critical thinking at 4.29, with confidence in configuration and troubleshooting at 3.97. Engagement with the learning tools was very strong: Kahoot 4.74, Packet Tracer 4.43, Google Colab 4.40, and Padlet 4.34. The ability to revisit simulations and quizzes at a personal pace supports differentiated learning, and the smaller standard deviations after the course point to more consistent positive experiences.

Inquiry projects deepened learning and prepared students for real practice. Students rated project-based learning more effective than lectures at 4.14 and described the model as innovative 4.10, relevant to real-world work 4.36, student-centred 4.23, and supportive of higher-order thinking 4.29. Teams diagnose congestion, model faults, and propose artificial intelligence enhancements, then justify their decisions in reflective reports. These experiences strengthen technical competence, communication, and digital fluency.

Conclusion

The transformation of the SAIA1163 Computer Systems and Networks course illustrates the significant impact of integrating simulation tools, inquiry-based learning, and AI applications within the NALI framework. Survey results and student reflections indicate marked improvements in conceptual understanding, critical thinking, and digital fluency, alongside heightened engagement through technology-enhanced activities. The blended model not only bridged

gaps in prior knowledge but also cultivated industry-relevant skills such as troubleshooting, data-driven decision-making, and collaborative problem-solving. These outcomes affirm the effectiveness of NALI principles in preparing learners for IR 4.0 contexts. Moving forward, further studies will examine the scalability of this approach across disciplines and its long-term influence on graduate employability and professional readiness.

Acknowledgement

We extend our heartfelt gratitude to Universiti Teknologi Malaysia for its unwavering support and commitment to fostering innovative and impactful educational experiences. We thank SAIA1163 students for their valuable feedback.

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ID 85: From Mastery to Mindset: AI-Integrated Innovation-Based Learning with Entrepreneurial and Collaborative Approaches

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Highlights: A three-year mentorship program (2023–2025), led by Universiti Teknologi Malaysia (UTM) engaged students aged 13–15 and their teachers in AI-integrated, STEM-based innovation learning through strategic collaborative guidance. Students developed two pineapple-waste products: (1) FILAMENAS, a patented 3D printing filament, and (2) biodegradable cup sleeves embedded with plant seeds. Using a triangulated dataset comprising student surveys, teacher interviews, and longitudinal performance reports, the study highlights positive impacts on student motivation, AI competence, collaboration, and academic achievement. Findings demonstrate that embedding AI and entrepreneurship into collaborative projects fosters both technical mastery and future-oriented mindsets, aligning with the New Academia Learning Innovation (NALI) framework. Embedding these dimensions transformed classroom mastery into mindset, fostering sustainable, real-world STEM innovation.

Keywords: STEM-based entrepreneurship; Innovation-based learning; AI-integrated learning; Collaborative mentorship

Introduction

The rapid evolution of AI and digital technologies has reshaped the skills required for future STEM innovators, and traditional approaches that focus solely on technical mastery may be insufficient to prepare students for complex challenges. Recognising this, Universiti Teknologi Malaysia (UTM) initiated a three-year mentorship program (2023–2025) for students aged 13–15 and their teachers, embedding AI, innovation, entrepreneurship, and strategic collaboration into STEM education.

The program was exemplified by the Ecopine Revolution, which began when a team of secondary school students from SMK Tan Sri Mohamed Rahmat, guided by UTM mentors, won 3rd place in the Johor Mini Teater STEM 2025 competition organised by the National STEM Association (NSA). Mentoring commenced at this initial stage, enabling students to transform their STEM-themed theatrical storytelling into tangible product innovations. They subsequently developed two distinct products: (1) FILAMENAS, a copyrighted 3D printing filament produced from pineapple peel and pulp, and (2) biodegradable cup sleeves embedded with plant seeds for post-use planting. AI tools were integrated throughout the process — from idea generation and market research to presentation refinement and poster/slide design — accelerating development, enhancing communication, and nurturing entrepreneurial and problem-solving skills. Students applied STEM concepts to create real-world products and showcased their innovations at Hari Nanas Malaysia and Jom Heboh 2025, further reinforcing learning through public engagement.

Objectives

This study reports on interim outcomes of the program, addressing the following research questions:

i. How has the AI-integrated, innovation-based mentorship program influenced students' motivation, competence, and collaboration?
ii. What perspectives do teachers provide regarding students' growth and engagement?
iii. What trends are observable in students' academic performance over the three years?

NALI Approach

The program exemplifies the NALI framework by transforming STEM learning through AI, innovation, and entrepreneurship:

Novelty
Expanded a STEM theatre project into a real-world innovation program, moving students from storytelling to tangible product creation.

Creativity
Fused STEM concepts, AI tools, and entrepreneurial thinking to design solutions like FILAMENAS and seed-embedded cup sleeves.

Innovativeness
Applied iterative, hands-on problem solving to turn classroom learning into experiential STEM projects.

Applicability
Created a replicable model supported by teachers and collaboration with UTM and industry partners.

Impact
Boosted STEM mastery, motivation, collaboration, entrepreneurial mindset, and AI competence, evidenced by competition wins and public exhibitions.

Figure 1 : The Program; (a) Mentorship in developing innovation projects and STEM mindset, (b) Building the first prototype in the school lab, using manual methods, (c)Mentorship and discussions: from food packaging to FILAMENAS, (d) Mentorship in pitching and STEM theatre performance, (e) Collaboration with UTM laboratories, (f) Competing in contests and winning awards, (g) Pitching innovative ideas to judges and audiences



Innovation-based and project-oriented learning models, such as the Aalborg PBL framework, have demonstrated the importance of experiential and collaborative learning in equipping students with problem-solving and innovation skills (Kolmos et al., 2004). AI-enabled technologies are further transforming education by personalizing learning, enabling immersive experiences, and enhancing access to digital resources (Nguyen & Nguyen, 2024). Mentorship has been shown to play a critical role in sustaining student motivation, building confidence, and fostering long-term engagement in STEM fields (Eby et al., 2013). At the same time, integrating entrepreneurship into STEM education nurtures creativity, opportunity recognition, and innovation capacity, preparing students for real-world challenges (Bybee, 2013). Together, these dimensions highlight the value of AI-integrated, innovation-based mentorship in supporting future-ready STEM learning ecosystems. Building on this, the present study explores a unique program that combines AI, innovation-based learning, mentorship, and entrepreneurship to examine its impacts on students' STEM competence, motivation, collaboration, and entrepreneurial mindset.

Research Methodology

The three-year program (2023–2025) engaged UTM lecturers in mentoring secondary school students, integrating AI and entrepreneurship into hands-on projects, competition preparation, and collaborative mentoring sessions rather than teaching these as standalone modules. A total of 10 students aged 13–15 participated, supported by two teachers who were interviewed to provide qualitative triangulation of student progress and program impact. Data were collected through a 2025 survey measuring student motivation toward STEM, collaboration skills, AI competence, and entrepreneurial mindset, as well as teacher interviews capturing reflections on student engagement and growth. Additionally, performance reports spanning 2023–2025 were examined to analyse longitudinal trends in academic achievement. A mixed-methods triangulation approach was applied, with survey results analysed descriptively, interview data thematically coded, and exam performance reviewed to assess the development of STEM competence and the effectiveness of the AI-integrated, innovation-based mentorship program.

Findings and Discussion

Data from student surveys, teacher interviews, and academic performance reports collectively highlight how the program influenced motivation, collaboration, STEM competence, and real-world problem-solving skills.

Survey Results

Improved STEM Understanding
A combined 93% of students agreed or strongly agreed that the program enhanced their understanding of STEM subjects. This suggests that the mentorship approach effectively complemented classroom learning and offered students applied perspectives of STEM concepts.

Increased Interest in STEM
The program had the strongest impact on students' interest in STEM fields, with 95% agreement. Students expressed that "the program made STEM more exciting and relevant to real life."

Collaboration and Peer Learning
90% of participants reported enhanced collaboration with peers, highlighting the value of group-based activities and shared mentorship experiences. Neutral or disagree responses (10%) indicate that some students may require different group dynamics for optimal engagement.

Confidence in Problem-Solving
Approximately 91% of students reported increased confidence in solving STEM-related problems, demonstrating the program's effectiveness in fostering critical thinking and practical application skills.

Mentorship Relationships
The most positively rated aspect was the relationship with mentors, with 95% positive responses. This underscores the importance of approachable, supportive role models in sustaining student engagement.

Overall Effectiveness
94% of respondents perceived the program as effective, reflecting strong overall satisfaction and impact.

Student Voices
Open-ended responses reinforced the quantitative findings:

"My mentor really inspired me to pursue engineering. I feel more confident about my future career."

"Working in groups with friends taught me teamwork and communication, not just STEM knowledge."

"I never thought science could be this fun and connected to real life."

Teacher Observations
Teachers noted significant improvements in students' confidence, creativity, and communication. One teacher remarked, "Students who were previously quiet now take the lead in pitching innovative ideas." Another added, "The integration of AI with competitions made learning more meaningful and engaging."

Academic Performance (2023–2025)
Analysis of STEM exam scores over three years indicated steady improvement. Average scores increased annually, suggesting that participation in the AI-integrated, innovation-based mentorship program positively influenced both conceptual understanding and applied learning outcomes.

Conclusion

This AI-integrated, STEM-based mentorship program demonstrates strong commercialization potential as a replicable educational model. By combining hands-on innovation, entrepreneurship, and strategic mentorship, it equips students to develop market-ready solutions, as exemplified by the Ecopine innovations, while offering schools a scalable framework for impactful STEM learning. Findings suggest that embedding AI and entrepreneurship into STEM learning supports a shift from mastery to mindset. Beyond technical skills, students developed resilience, collaborative competence, and entrepreneurial thinking, aligning with the NALI framework that emphasises future-ready, innovative learning ecosystems. Triangulation of survey, interview, and exam data strengthens the evidence of positive program impact.

Acknowledgement

The team acknowledges the National STEM Association (NSA) for the Mini STEM Theatre platform that inspired this project, and the support of SMK Tan Sri Mohamed Rahmat administrators and teachers. Appreciation is also extended to the Faculty of Science and Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM), for technical guidance, facilities, and mentorship, and to the Lembaga Perindustrian Nanas Malaysia (LPNM) for advisory support on pineapple industry insights.

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ID 86: Taste-Lab: Experiential Cooking Portfolio Development for Students' Technical Skills and Sustainability Values

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Highlights: This innovation applies experiential learning in a practical cooking environment to foster active student participation. The approach integrates Kolb's Experiential Learning Cycle into weekly themed cooking sessions, where students plan, prepare, evaluate, and propose improvements to their dishes while conducting structured food waste audits. It also investigates the effectiveness of a Cooking Portfolio as a tool to enhance culinary competence and sustainability awareness. 28 Bachelor of Technology with Education (Design and Technology) students were divided into 14 groups. After receiving the menu and recipes, the students planned ingredient preparation, job delegation, executed cooking processes, conducted sensory evaluations, audited food waste, and proposed process improvements. This approach has proven to strengthen technical skills, critical thinking, and reflective practice while cultivating sustainable values aligned with the evolving needs of the food and beverage industry and education.

Keywords: Experiential learning; Cooking portfolio; Practical cooking environment; Kolb's experiential learning; Sustainable

Introduction

Basic Food Preparation and Nutrition (SHPL1112) is one of the core subjects in the Bachelor of Technology with Education (Design and Technology) with Honours programme. The subject provides students with theoretical knowledge in basic food preparation and nutrition, while the technical component trains them to gain skills and hands-on experience through weekly cooking activities conducted according to various culinary themes. As an innovative approach to teaching and learning, students apply culinary theory through a structured experiential learning approach, using real-world kitchen scenarios to understand how ingredient preparation, job delegation, cooking techniques, and basic nutritional considerations, alongside sensory evaluation and waste management, contribute to product quality and sustainability. This practical innovation may be used as evidence of the students' ability to analyse their kitchen preparation, cooking process, and identifying improvements. This real-world relevance makes the project impactful and highly applicable to food and beverage industry and education.

This project reimagines the cooking practical as a Cooking Portfolio based experiential learning model, integrating Kolb's Experiential Learning Cycle (1984) to actively engage students in planning, executing, evaluating, and improving their culinary work. Students are not only required to produce a dish but also document the process through plating design sketches, sensory evaluation videos, basic nutrition infographics, and a structured food waste audit. Therefore, by looking at these activities, this experiential learning enhances students' technical competence, critical thinking, and sustainability awareness by positioning them as reflective practitioners, enabling them to apply theoretical knowledge in a practical context. The collaborative and reflective nature of this project ensures that students remain actively engaged and connected to their learning experience.

Objectives

The objectives of this project are:

- To engage students in experiential learning that integrates culinary theory, basic nutrition, and sustainability practices.
- To enhance students' technical cooking skills, reflective thinking, and critical analysis through the development of a Cooking Portfolio.
- To assess the student's evaluation of the effectiveness of the Cooking Portfolio based experiential learning.

NALI Approach

Novelty

Unlike conventional kitchen practical classes that focus solely on cooking execution and grading the final product, this project introduces a Cooking Portfolio based experiential learning model that integrates Kolb's Experiential Learning Cycle (1984) into every stage of the practical session. Students are not only assessed on their cooking skills, but also required to document the entire process weekly, including ingredient preparation plans, sensory evaluation of the finished product, recipe improvements, and a structured food waste audit. This combination of culinary practice, reflective analysis, and sustainability driven innovation transforms the kitchen into a dynamic learning

laboratory. The systematic inclusion of waste reduction strategies, and reflective practice in a portfolio format sets this project apart from standard classes, fostering higher order thinking, professional competence, and sustainable values in alignment with the needs of the modern food and beverage industry and education.

Creativity

This project transforms a standard cooking practical into a complete, skills based learning experience through the use of a Cooking Portfolio. Each weekly session begins with a themed recipe and menu, where students plan their tasks, prepare ingredients, and execute cooking techniques with precision. They then evaluate their dish through a structured sensory assessment and identifying areas for improvement. The process also incorporates a food waste audit, prompting students to measure and analyze any waste generated, then design practical strategies to reduce it in future sessions. Photographs, sketches, and reflection videos are compiled into a portfolio that documents progress and growth over time. By combining technical skills, basic scientific thinking, and sustainability awareness, the design encourages active participation and produces learning outcomes that go well beyond the traditional cook and serve format.

Innovativeness

The innovation in this project lies in how the cooking practical is reimagined as a multi-dimensional learning experience that integrates technical, analytical, and sustainability skills into one seamless process. While most culinary classes focus on executing recipes and achieving product quality, this approach embeds structured reflection, basic scientific analysis, and measurable sustainability outcomes into the weekly routine. Students are not only cooking, they are also acting as analysts, problem-solvers, and sustainability advocates. The integration of a weekly waste audit with targeted reduction strategies ensures that environmental responsibility becomes a tangible learning outcome rather than an abstract concept. The portfolio format captures growth over time, enabling both students and educators to track progress in technical execution, critical thinking, and environmental impact reduction. By combining these dimensions in a way that is systematic, measurable, and directly tied to industry relevant skills, this method pushes beyond the boundaries of a standard practical class, setting a new benchmark for applied culinary education field.

Applicability

This approach is highly adaptable and can be implemented across various culinary education settings, from vocational colleges to university level programmes, as well as in short professional training courses. The Cooking Portfolio framework is flexible enough to be customised for different cuisines, theme, which making it relevant for both foundational and advanced modules. Beyond the food and beverage field, the model's structure combining technical skills practice, reflective analysis, and sustainability auditing can be adapted to other skill based disciplines such as engineering workshops, science laboratories, or design studios. The weekly cycle of plan, execute and evaluate improve ensures that learners not only gain hands on competency but also develop critical thinking and problem solving skills. In industry settings, this approach could be applied for upskilling kitchen staff or training sustainability teams, as the waste audit component aligns closely with current environmental responsibility goals. Its ability to produce measurable outcomes in both skill mastery and sustainable practice makes it relevant and valuable in education, professional training, and industry-based learning environments.

Impact

This project has demonstrated significant positive impact on student learning, professional readiness, and sustainability awareness. The integration of the Cooking Portfolio has enhanced students' technical cooking skills, with measurable improvement in preparation accuracy, cooking technique consistency, and plating presentation quality observed over the semester. The structured reflection and sensory evaluation activities have strengthened critical thinking and analytical skills, enabling students to connect cooking practice with quality standards. The weekly food waste audit has transformed the way students view kitchen by products and leftovers. Instead of seeing waste as something to be discarded, students learn to identify its type, volume, and source, and explore safe, creative ways to repurpose it into value added items or edible components. This process develops both environmental responsibility and innovative problem-solving, encouraging a waste as a resource mindset that is highly relevant to modern sustainable kitchen practices. Over time, students not only reduce the volume of waste they generate but also cultivate practical skills in resource optimisation a competency increasingly demanded by the food and beverage industry. Beyond skill acquisition, students showed higher engagement, citing the portfolio process as a meaningful way to track their growth and take ownership of their learning. This combination of skill mastery, reflective practice, and sustainability consciousness ensures graduates are better equipped for the evolving demands of the food and beverage industry and educational leadership roles.

Research Methodology

The research method for Taste-Lab: Experiential Cooking Portfolio Development for Students' Technical Skills and Sustainability Values was implemented with 28 *Bachelor of Technology with Education (Design and Technology)* students enrolled in the Basic Food Preparation and Nutrition course. Students were divided into 14 groups, with each group assigned a weekly themed recipe and menu aligned to the course's learning outcomes. The innovation was delivered through a Cooking Portfolio-based experiential learning model guided by *Kolb's Experiential Learning Cycle*. Each weekly practical session followed four stages:

Stage 1: Concrete Experience

Students engage in hands-on cooking using the assigned weekly recipe and menu. Unlike typical practical sessions that focus only on producing the final dish, this stage emphasises systematic observation, documentation, and creative planning. Students record the ingredients used via the A, B & D Form, outline the preparation steps such as washing, cutting, and measuring, and describe the cooking method including techniques, temperatures, and timings. They also produce sketches to plan their plating design before the actual class to guide presentation during service.

Final finishing touches such as garnishing or seasoning are noted, and all waste generated is documented in the Food Waste Audit Sheet.

Stage 2: Reflective Observation
Students conducted sensory assessments of their final products evaluating appearance, texture, taste, aroma, and presentation and articulated their observations in recorded video presentations.

Stage 3: Abstract Conceptualisation
Students connect their cooking experience to basic nutrition concepts. Based on their observations and sensory evaluation results, they create a mini-infographic. This highlights key points such as nutrient retention or loss, the effect of temperature on food quality, and changes in texture.

Stage 4: Active Experimentation
Students proposed at least one change to the recipe, technique, or presentation to improve nutrition, food quality, or efficiency, supported by reasoning. They also suggested innovations to reduce food waste, such as new preparation methods, repurposing by-products, or adjusting portion sizes. These proposals encouraged creative problem-solving and applied scientific thinking to enhance product quality and sustainability.

At the end of the semester, an exit survey using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) was conducted to collect student feedback on the Cooking Portfolio based experiential learning approach. The survey measured students' perceptions on their learning experience. This feedback was analysed to evaluate the effectiveness of the innovation

Findings and Discussion

The final product of students' work are shown in Figure 1.



Figure 1. Student Outputs and Cooking Portfolio based on Experiential Learning Activities

After the implementation of the cooking portfolio based on experiential learning, students' feedback were collected.

Table 1: The Effectiveness of Using Cooking Portfolio based Experiential Learning in Teaching Basic Food and Nutrition

Items	Mean
I can plan ingredient preparation and task delegation more effectively than before	4.6
I am more confident in explaining the relationship between cooking methods and food quality	4.0
The food waste audit increased my awareness of food waste in the kitchen	4.7
The reflective observation process helped me identify areas for improvement	4.6
The Cooking Portfolio made the learning process more engaging and meaningful	4.7
I prefer this experiential learning approach over traditional cooking classes	4.7

Based on the feedback given by the students, the Cooking Portfolio-based experiential learning approach successfully enhanced their ability to plan ingredient preparation and task delegation, increased their awareness of food waste through the audit process, and made the learning experience more engaging and meaningful. Overall, this approach proved effective in developing technical skills, fostering reflective practice, and cultivating sustainability values, making it a valuable and impactful innovation in education.

Commercialization Potential

In the future, the Cooking Portfolio-based experiential learning model will be converted to an AI-enabled digital platform as it has a strong commercial potential for culinary education and industry training. By converting its portfolio templates, sensory evaluation tools, plating sketch modules, and waste audit framework into an interactive application, it can deliver automated plating analysis, AI-driven food waste tracking, and instant personalised feedback. Marketable as a subscription-based platform, digital teaching toolkit, or train-the-trainer certification programme, it is adaptable for vocational colleges, culinary schools, and professional kitchens. With its blend of sustainability, skills-based learning, and AI integration, the model meets the growing demand for technology-enhanced and environmentally responsible training in the food and beverage sector.

Conclusion

The Cooking Portfolio based experiential learning approach transforms a standard cooking class into a dynamic, skills-focused, and sustainability-driven experience. By combining hands-on practice, creative presentation, and waste reduction strategies, students not only sharpen their cooking competence but also develop critical thinking and environmental responsibility skills that are highly relevant to today's F&B industry and vocational education. This innovation proves that when learning is practical, reflective, and purposeful, the impact goes far beyond the kitchen

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ID 87: AI + English + STEM = Future-Ready Students (KERAKED 2025)

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Sorotan: KERAKED'25 – Berambeh Rah Gedong ialah program pembangunan komuniti yang dilaksanakan oleh mahasiswa Universiti Teknologi Malaysia (UTM) di Kampung Gedong, Sarawak. Program ini membawa misi pendidikan, inovasi, dan kelestarian dengan menekankan integrasi kecerdasan buatan (AI) dalam pembelajaran. Modul utama "AI + English + STEM = Future-Ready Students" menjadi tonggak kepada penglibatan pelajar sekolah luar bandar dengan teknologi AI, bahasa Inggeris, dan STEM sebagai persediaan menghadapi cabaran Revolusi Industri 4.0. Selain itu, lima modul inovasi STEM turut dilaksanakan, iaitu Penanaman Hidroponik, Reka Sistem Penapis Air DIY, *Water Irrigation System*, *Water Level Indicator*, dan Sabun Organik. Keseluruhan program ini berjaya meningkatkan kemahiran insaniah mahasiswa, minat pelajar terhadap STEM, serta kesedaran komuniti terhadap inovasi dan kelestarian.

Kata Kunci: AI dalam pendidikan; STEM; English; Pembangunan komuniti; Experiential learning

Pengenalan

KERAKED'25 – Berambeh Rah Gedong merupakan inisiatif yang digerakkan oleh Jawatankuasa Kolej Mahasiswa Kolej Tun Razak, UTM dengan kerjasama Jabatan Timbalan Naib Canselor Hal Ehwal Pelajar & Alumni (JTNCHEPA), UTM International, UTM Alumni, dan i-CATS University College. Program ini bertujuan memperkukuh hubungan universiti dengan komuniti luar bandar melalui pendekatan pendidikan dan kesukarelawanan yang berasaskan inovasi. Mahasiswa bukan sahaja diberi peluang untuk memimpin aktiviti berbentuk komuniti, tetapi juga mengaplikasikan ilmu pengetahuan dalam konteks sebenar, sejajar dengan keperluan pembelajaran abad ke-21.

Tema NALI 2025, iaitu "*Accelerating Innovation in Teaching and Learning with AI*", diangkat dalam program ini melalui modul AI + English + STEM = Future-Ready Students, yang bertujuan membimbing pelajar sekolah luar bandar menggunakan teknologi AI dalam meningkatkan penguasaan bahasa Inggeris dan pemahaman STEM. Modul ini menjadi simbol transformasi pendidikan luar bandar yang menghubungkan inovasi teknologi dengan kemahiran bahasa dan sains. Di samping itu, lima modul STEM lain dilaksanakan untuk memberi pendedahan praktikal kepada komuniti, iaitu hidroponik, penapis air DIY, sistem pengairan, indikator paras air, dan sabun organik.

Objektif

Objektif utama program ini adalah untuk membentuk mahasiswa berintegriti, berdaya kepimpinan, dan proaktif melalui penglibatan kesukarelawanan. Ia juga menjadi platform untuk mewujudkan kerjasama strategik antara mahasiswa, agensi kerajaan, dan sektor swasta dalam melaksanakan inovasi yang bermanfaat kepada masyarakat. Modul AI + English + STEM berperanan memupuk minat pelajar sekolah terhadap penggunaan AI dalam pembelajaran bahasa Inggeris dan STEM, manakala lima modul STEM lain memperkasakan komuniti melalui inovasi praktikal yang mudah diaplikasikan. Secara keseluruhan, program ini menyumbang kepada pencapaian Matlamat Pembangunan Lestari (SDG) khususnya SDG 4 (Pendidikan Berkualiti) dan SDG 10 (Mengurangkan Ketidaksamaan).

Pendekatan NALI

KERAKED'25 menggunakan pendekatan New Academia Learning Innovation (NALI) dengan menekankan community-based learning dan experiential learning. Modul AI + English + STEM = Future-Ready Students menjadi aplikasi sebenar inovasi PdP berteraskan AI, di mana pelajar sekolah menggunakan aplikasi berasaskan AI seperti chatbot untuk latihan komunikasi bahasa Inggeris, sistem penilaian pintar untuk kuiz STEM, serta aplikasi AI terjemahan bagi membantu mereka memahami istilah saintifik. Melalui pendekatan ini, pelajar mengalami pembelajaran yang lebih interaktif, adaptif, dan relevan dengan keperluan masa depan.

Lima modul STEM lain menambah dimensi praktikal kepada pembelajaran, iaitu Penanaman Hidroponik yang menekankan teknologi pertanian moden, Reka Sistem Penapis Air DIY yang memberi solusi kepada isu air bersih, Water Irrigation System yang memperkenalkan pengairan automatik, Water Level Indicator yang membantu pemantauan sumber air, serta Sabun Organik yang mendidik komuniti tentang kelestarian dan inovasi hijau. Kesemua modul ini menghubungkan teori dengan aplikasi sebenar, sambil memperkaya pengalaman pembelajaran komuniti luar bandar.

Metodologi Kajian

Program dilaksanakan dalam tiga fasa utama. Fasa perancangan melibatkan pemilihan lokasi, pembangunan modul, dan penglibatan rakan kerjasama strategik. Fasa pelaksanaan berlangsung di SMK Gedong dan Kampung Gedong, Sarawak, di mana pelajar sekolah, komuniti, dan mahasiswa terlibat secara langsung dalam bengkel serta demonstrasi modul. Modul AI + English + STEM memberi fokus kepada latihan komunikasi berasaskan AI dan penerapan aplikasi pintar dalam pembelajaran STEM, manakala lima modul STEM dijalankan secara amali dengan pendekatan *hands-on*. Akhir sekali, fasa penilaian dilaksanakan melalui soal selidik dan maklum balas peserta untuk menilai keberkesanan program serta potensi perluasan modul ke kawasan luar bandar lain.

Dapatan Kajian dan Perbincangan

Dapatan program menunjukkan impak yang signifikan. Modul AI + English + STEM berjaya meningkatkan keyakinan pelajar sekolah dalam menggunakan bahasa Inggeris, di samping menanam minat terhadap STEM dengan sokongan teknologi AI. Lima modul STEM pula telah memperkasa komuniti dalam aspek praktikal seperti pertanian moden, pengurusan air, dan pembuatan produk mesra alam. Bagi mahasiswa, program ini mengembangkan kemahiran insaniah termasuk kepimpinan, komunikasi, pemikiran kritis, dan empati sosial. Manakala dari perspektif institusi pendidikan, KERAKED'25 berjaya memperkukuh hubungan universiti dengan komuniti luar bandar, menjadikan universiti sebagai pemacu pembangunan pendidikan mampan.

Pembaharuan

Program ini membawa kebaharuan dengan mengintegrasikan AI, English, dan STEM dalam satu modul utama yang dilaksanakan di sekolah luar bandar. Inovasi ini jarang dilakukan dalam konteks pendidikan komuniti, menjadikannya pendekatan baharu dalam melatih pelajar bersedia menghadapi cabaran global.

Kebolehgunaan dan Kesan Terhadap Pembelajaran

Penggunaan AI dalam pembelajaran membolehkan pelajar menerima maklum balas segera, menyesuaikan tahap kesukaran soalan, dan membina keyakinan berbahasa Inggeris. Modul STEM yang lain pula memberi kesan langsung kepada kehidupan harian komuniti dengan menyediakan pengetahuan yang boleh terus diaplikasikan. Gabungan ini menjadikan program lebih komprehensif dalam membangunkan pelajar dan komuniti.

Potensi Pengkomersialan

Beberapa modul seperti penapis air DIY dan sabun organik mempunyai potensi besar untuk dikembangkan sebagai produk komuniti. Modul AI + English + STEM pula berpotensi dijadikan kurikulum tambahan yang boleh diadaptasi di sekolah-sekolah luar bandar lain dengan sokongan KPM dan university.KERAKED'25 berpotensi dijadikan model program inovasi komuniti universiti yang boleh diadaptasi ke pelbagai lokasi luar bandar. Lima modul yang dibawa bukan sahaja relevan kepada komuniti Gedong, tetapi juga berpotensi menjadi bahan latihan untuk sekolah dan pusat komuniti di seluruh negara.

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ID 88: Penggunaan Video AI Dalam Mengaplikasi Kemahiran Pemikiran Sejarah Mata Pelajaran Sejarah Sekolah Rendah

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Sorotan: Inovasi ini mengaplikasi video berasaskan Kecerdasan Buatan (AI) untuk meningkatkan Kemahiran Pemikiran Sejarah (KPS) murid sekolah rendah merangkumi memahami kronologi, meneroka bukti, membuat interpretasi dan rasionalisasi. Kajian tinjauan terhadap 113 guru menunjukkan lebih 90% bersetuju video AI menjadikan pembelajaran lebih interaktif, imersif dan berkesan. Video AI yang dihasilkan menggabungkan teori Kecerdasan Pelbagai, visual 3D, narasi realistik dan simulasi sejarah, membantu murid memahami peristiwa, menghubungkan bukti dengan konteks serta berfikir kritis. Inovasi ini berpotensi dikomersialkan sebagai bahan bantu mengajar digital relevan abad ke-21.

Kata Kunci: Kecerdasan buatan (AI); Kemahiran pemikiran sejarah; Mata pelajaran sejarah

Objektif

Melihat sama ada penggunaan video AI, dapat mengaplikasi Kemahiran Pemikiran Sejarah (KPS) dalam proses pengajaran dan pembelajaran mata pelajaran sejarah sekolah rendah.

Pendekatan NALI

Konsep video AI adalah merujuk kepada penggunaan kecerdasan buatan untuk menjana atau menyunting video secara automatik (contoh : animasi, naratif suara, visualisasi 3D). Penggunaan video menghasilkan:

i. *Kebaharuan*

Teknologi AI membolehkan penghasilan video interaktif dengan grafik realistik, narasi automatik, dan analisis kandungan yang boleh disesuaikan mengikut keperluan murid. Melalui kebaharuan ini, pengajaran berlandaskan elemen KPS dalam mata pelajaran Sejarah menjadi lebih menarik dan efektif apabila digabungkan dengan teknologi Kecerdasan Buatan (*Artificial Intelligence*). Video AI bukan sahaja menambah nilai terhadap PdP, tetapi juga membina kemahiran berfikir kritis, kolaborasi, dan literasi digital dalam kalangan murid. Menurut Norazmi et al. (2022) penggunaan AI yang digabungkan dengan pendekatan pembelajaran berasaskan projek boleh meningkatkan kemahiran berfikir kritis dalam kalangan murid.

Penggunaan video yang menggunakan aplikasi AI





ii. *Kreativiti*

Penggunaan AI dalam menghasilkan video pembelajaran telah menjadikan bahan pengajaran lebih imersif kerana mampu menghasilkan visual 3D, suara narasi realistik, simulasi interaktif, dan pengalaman persekitaran maya. Penghasilan video AI yang dihasilkan ini melibatkan penggunaan aplikasi seperti Chatgpt, Imagefx,Pxiverse, Canva, Flow dan Capcut.

Apps yang digunakan dalam penghasilan video pembelajaran Sejarah



iii. *Inovasi*

Penghasilan video AI sebagai bahan bantu mengajar dalam mata pelajaran Sejarah telah memudahkan penerapan elemen KPS. Malah pendekatan ini selari dengan Teori Kecerdasan Pelbagai Howard yang menekankan kepelbagaian potensi individu seperti kecerdasan visual-ruang melalui animasi sejarah, kecerdasan lingustik melalui narasi dan teks, kecerdasan muzik melalui latar bunyi yang relevan serta kecerdasan interpersonal melalui aktiviti kolaboratif berasaskan video. Penyepaduan teori ini menjadikan PdP Sejarah menjadi lebih inklusif dan berkesan kerana ia menghormati gaya pembelajaran murid yang berbeza.

iv. *Kebolehgunaan*

Kebolehgunaan video berasaskan Kecerdasan Buatan (AI) dalam pengajaran mata pelajaran Sejarah dapat memvisualkan peristiwa sejarah dengan simulasi realistik, animasi dan narasi yang jelas, menjadikan kandungan lebih mudah difahami. Murid bukan sahaja mengingat fakta tetapi juga memahami konteks peristiwa, hubungan sebab-akibat dan nilai moral yang terkandung dalam mata pelajaran sejarah. Manakala guru pula boleh menyesuaikan tahap kesukaran atau menambah elemen interaktif seperti kuiz pintar dan pautan maklumat tambahan mengikut keperluan murid. Malah memudahkan guru merancang PdP yang lebih inklusif dan efektif apabila video AI dapat :

- menghidupkan peristiwa sejarah.
- pembelajaran berasaskan visual dan pelbagai kecerdasan.
- alat pemudah konsep yang kompleks.
- meningkatkan penglibatan murid serta
- menyokong elemen Kemahiran Pemikiran Sejarah (KPS).

v. *Impak*

Pengunaan video AI telah memudahkan proses PdP guru dan murid serta menjadikan proses PdP menjadi mudah, berkesan dan menarik.

Metodologi Kajian

Kajian tinjauan dijalankan dengan menggunakan soalan soal selidik terhadap 110 orang guru Sejarah sekolah rendah bagi melihat penggunaan video AI dalam mengaplikasi Kemahiran Pemikiran Sejarah dalam Mata Pelajaran Sejarah Sekolah Rendah.

Dapatan Kajian dan Perbincangan

Bahagian ini membentangkan dapatan deskriptif berdasarkn penggunaan video AI dalam mengaplikasi Kemahiran Pemikiran Sejarah mata pelajaran sejarah sekolah rendah (rujuk Jadual 1).

Jadual 1 Min Penggunaan Video AI Dalam Mengaplikasi Kemahiran Pemikiran Sejarah Mata Pelajaran Sejarah Sekolah Rendah

Konstruk Elemen KPS	N	Mean	Tahap
Memahami Kronologi	110	4.6748	Tinggi
Meneroka Bukti	110	4.6126	Tinggi
Membuat Interpretasi	110	4.6287	Tinggi
Membuat Rasionalisasi	110	4.6243	Tinggi

Berdasakan Jadual 1, dapatan menunjukan min konstruk bagi elemen KPS mata pelajaran Sejarah iaitu memahami kronologi berada pada tahap min yang tinggi dengan bacaan 4.67. Lebih daripada 90% orang guru sejarah menyatakan yang penggunaan video AI dalam proses PdP mata pelajaran sejarah telah memudahkan murid memahami konsep kronologi seperti:

i. melihat urutan peristiwa secara lebih jelas.
ii. memahami kronologi sejarah dengan lebih baik.
iii. memahami sejarah dalam susunan masa yang betul.

Dapatan min bagi konstruk meneroka bukti berada pada tahap tinggi iaitu 4.61. Penggunaan video AI telah memudahkan guru mengaplikasi konstruk meneroka bukti dalam KPS semasa melakukan PdP seperti:

i. melihat bagaimana bukti digunakan dalam menceritakan sejarah.
ii. mengaitkan sesuatu bukti dengan peristiwa sejarah yang berkaitan, logik dan bersebab.
iii. lebih menghargai nilai sejarah dan fungsi sebenar sumber berdasarkan bukti yang dilihat dalam konteks visual.

Dapatan min bagi konstruk membuat intepretasi dalam KPS juga berada pada tahap tinggi iaitu 4.62. Guru berpendapat penggunaan video AI, boleh menjadikan murid membuat interpretasi apabila :

i. menilai sesuatu tindakan atau peristiwa dari segi nilai seperti keberanian, keadilan, atau kesetiaan.
ii. membuat perbandingan dan membina tafsiran mereka sendiri melalui dua versi atau naratif peristiwa.
iii. 'merasai' emosi dan latar masyarakat sejarah serta membuat tafsiran berasaskan pemahaman.

Penggunaan Video AI dalam mengaplikasi konstruk membuat rasionalisasi dalam KPS berada pada tahap min yang tinggi iaitu 4.62. Video AI sebagai bahan bantu mengajar boleh membantu murid:

i. berfikir aras tinggi (HOTS) yang menekankan sebab, justifikasi, dan implikasi sejarah.

ii. yang sukar memahami teks menggunakan rangsangan visual AI untuk membina hujah dan justifikasi sejarah.
iii. membuat rasionalisasi dalam menilai bagaimana keputusan sejarah telah memberi kesan kepada kehidupan masa kini.

Pontensi Pengkomersialan

Penghasilan video AI sebagai bahan bantu mengajar dalam PdP mata pelajaran sejarah ini telah di Daftar Hak Cipta melalui MyIPO untuk melindungi inovasi yang dihasilkan. Video AI ini boleh dikomersialkan apabila dijadikan:

i. bahan pengajaran Digital Berlesen
ii. platform e-pembelajaran & aplikasi interaktif
iii. latihan guru & Modul Profesional
iv. penerbitan & Hak Cipta
v. perkhidmatan Penyesuaian Kandungan (Custom Content)
vi. Pertandingan & Ekspo Pendidikan (pameran edutech sebagai produk inovatif

Kesimpulan

Penggunaan video AI sebagai bahan bantu mengajar telah menghasilkan pembelajaran yang berkesan apabila guru dapat mengaplikasi Kemahiran Pemikiran Sejarah dalam mata pelajaran sejarah. Dalam kalangan murid pula, penggunaan video AI ini akan melahirkan murid yang dapat berfikir secara kritis dan kreatif.

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ID 89: Sing for the Planet: AI-Crafted Advocacy

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Highlights: The 'Sing for the Planet: AI-Crafted Advocacy' activity, integrated into Universiti Teknologi Malaysia's postgraduate course UHMS6013, leverages AI to create songs addressing environmental issues, fostering interdisciplinary learning within the New Academia Learning Innovation framework. Students from diverse fields use AI tools to craft lyrics and melodies, enhancing AI proficiency, environmental literacy, and entrepreneurial skills. Through collaborative songwriting and multimodal presentations, the activity promotes creative advocacy, teamwork, and societal impact, aligning with Sustainable Development Goals. Reflections reveal heightened engagement, technical skills, and awareness, demonstrating music's potential as a transformative tool for environmental education and action.

Keywords: AI-driven advocacy; Environmental education; Music-based learning; New Academia Learning Innovation, Interdisciplinary collaboration

Introduction

Environmental crises demand innovative educational approaches to inspire action among the young generation, who will be the future leaders. Music, a universal medium, has historically catalyzed social movements (Kyomugisha, 2025). However, its integration with artificial intelligence (AI) for environmental advocacy remains underexplored in higher education. The 'Sing for the Planet: AI-Crafted Advocacy' activity was introduced and integrated in a 3-hour class session for a Universiti Teknologi Malaysia's postgraduate course entitled Seminar on Global Development, Economic, and Social Issues (UHMS6013) which empowers students in diverse fields such as social sciences, engineering, management, and natural sciences, to use AI tools for generating songs that educate and mobilize them on various environmental issues. Grounded in the New Academia Learning Innovation (NALI) framework, it emphasizes student- driven learning, blended formats, and entrepreneurial outputs, bridging scientific rigor with artistic expression to address gaps in traditional environmental pedagogy (Zulmaidi et al., 2024; Ho et al., 2019).

Objectives

The primary objectives of this innovative 'Sing for the Planet: AI-Crafted Advocacy' activity for a postgraduate course entitled Seminar on Global Development, Economic and Social Issues (UHMS6013) are to:

- Develop AI proficiency for creative outputs by allowing students to explore AI tools for creating songs and lyrics, thereby fostering critical engagement with the technical and ethical dimensions of AI.
- Advance environmental literacy through art by enabling students to research environmental issues and solutions, translating findings into compelling lyrical narratives that advocate for sustainability.
- Implement blended and multimodal learning by combining AI platforms, collaborative activity, and multimedia presentations to engage diverse learning styles and enhance retention.
- Foster entrepreneurial academia by guiding students to transform AI-generated songs into entrepreneurial ventures, such as digital releases or collaborations with non-governmental organisations (NGOs), aligning with NALI's industry-academia synergy.

NALI Approach

Novelty: The activity's novelty lies in its pioneering integration of AI-driven music creation into environmental education. While AI lyric generators and composition tools exist for general or elementary educational use, no structured postgraduate syllabus combines AI with environmental advocacy through songwriting. Existing applications focus on basic lyric exercises or non-academic environmental campaigns, lacking the depth of sustainability themes or interdisciplinary rigor. This activity introduces a novel educational paradigm by embedding AI creativity within a structured curriculum, enabling students to address complex global issues through an innovative artistic lens.

Creativity: Creativity is central, transforming AI into a catalyst for artistic innovation. Students input unconventional prompts, such as ecological datasets or personal narratives, into AI systems to generate lyrics with emotional depth. This activity encourages remixing AI outputs, incorporating diverse music genres (e.g., rock, jazz, ballad) or cultural elements. Collaborative activity simulats professional songwriting, fostering divergent thinking. By addressing AI's limitations, such as bias in generated content, students infuse human ingenuity, creating original works that resonate culturally and environmentally, aligning with NALI's emphasis on diverse learning materials.

Innovativeness: The activity's innovativeness stems from its adaptive, hybrid learning ecosystem, which reimagines educational delivery within the NALI framework. It employs real-time AI feedback loops for creative iteration, blending computational tools with humanistic elements, such as collaborative songwriting class activities. Unlike traditional courses, it treats AI as a collaborative partner, enabling experimentation with emergent technologies such as semantic search for lyric inspiration and multimodal AI for melody generation. This approach pushes pedagogical

boundaries,fostering skills in AI ethics, digital creativity, and interdisciplinary problem-solving. By integrating virtual simulations and industry-relevant outputs, the module innovates in preparing students for dynamic, technology-driven skills.

Applicability: The activity is highly applicable across academic and practical domains. It serves as a scalable template for interdisciplinary programs in sustainability, arts, or technology education. Practically, AI-generated songs can be deployed in environmental campaigns through media platforms or partnerships with NGOs, amplifying messages on issues such as pollution. The use of accessible, low-cost AI tools ensures adaptability for diverse institutions. Entrepreneurial elements prepare students for collaboration in edutainment or green tech, where AI-assisted content creation is increasingly valued. The activity's outputs could also influence policy by shaping public opinion on solutions like carbon pricing, thereby demonstrating the societal role of education.

Impact: The activity delivers a multifaceted impact. For students, it enhances their proficiency in AI, advocacy through art, and fosters a fun learning environment, strengthening teamwork and cultivating entrepreneurial skills and ventures. Environmentally, the songs could reach a broad audience, inspiring actions such as community recycling initiatives. Societally, it contributes to the United Nations' Sustainable Development Goals, particularly SDG 13 (Climate Action) and SDG 4 (Quality Education), by innovating pedagogical approaches. In the long term, it fosters environmentally conscious leaders equipped with cutting-edge tools. Impact was measured through pre- and post-reflections on the application of AI to generate songs, integrated with students' collaborative efforts in creating lyrics, addressing environmental issues, and ensuring tangible contributions to academia and society.

Research Methodology

The 'Sing for the Planet: AI-Crafted Advocacy' activity is delivered in a single, intensive 3-hour session, designed to maximize student engagement within the NALI framework's student-centered and blended learning philosophy. The session begins with a 30-minute interactive briefing on global environmental problems (e.g., climate change, types of pollution, and their impact) and potential solutions (e.g., renewable energy, e-waste management, and policy reforms), delivered through a combination of concise lectures and multimedia visuals to contextualize the issues. Students are then organized into small groups (4 to 5 members) and assigned the task of collaborating to create meaningful song lyrics and a short song addressing a specific environmental issue and its solutions. Each group selects a unique issue to ensure diverse perspectives, such as soil, water, and air pollution. Using accessible AI tools, groups have 1 hour to research their chosen issue, input prompts into the AI, and refine outputs into a cohesive song. Collaboration is emphasized, with students encouraged to blend AI-generated content with personal creativity, such as incorporating cultural metaphors or local contexts.

Following the creation phase, each group presents their song in a 45-minute showcase, performing or playing the song via pre-recorded audio while displaying lyrics on a shared screen for accessibility. Presentations last approximately 5 to 7 minutes per group, allowing time for setup and transitions. After each performance, other groups provide constructive feedback (15 minutes total), focusing on the clarity of the environmental issue raised, the effectiveness of proposed solutions, and the song's emotional impact. This peer review fosters critical thinking and aligns with NALI's emphasis on collaborative learning. The session concludes with a 30-minute reflective discussion, during which all students evaluate the effectiveness of the activity in the teaching and learning process. Guided by prompts (e.g., "How did AI enhance your creative process?" or "What impact could such songs have on public awareness?"), Students share insights on AI's role, the collaborative experience, and the potential of music as a tool for advocacy. Reflections are captured via a shared digital platform to encourage multimodal expression and inform future iterations.

Findings and Discussion

Table 1: AI-Generated Songs Addressing Environmental Issues by Genre and Theme

Group	Song title	Genre	Theme
Group 1	Ripple of change	Rock	Water pollution
Group 2	Steel into soil	Rock	Soil pollution
Group 3	Clear the air	Jazz	Air pollution
Group 4	Supernatural	Ballad	Soil pollution

Table 1 shows four groups, each with a unique song title, musical genre, and associated environmental theme. Group 1's "Ripple of Change" is a rock song addressing water pollution, while Group 2's "Steel into Soil," also in the rock genre, focuses on soil pollution. Group 3's "Clear the Air" is a jazz piece that tackles air pollution, and Group 4's "Supernatural," a ballad, also centers on soil pollution. This table highlights how different musical styles are used to convey messages about specific environmental concerns, with rock being prominent for water and soil issues, jazz for air pollution, and a ballad for soil pollution. Overall, students experienced a meaningful impact resulting from this activity, including proficiency in AI, environmental advocacy through art, a fun learning experience, strengthened teamwork, and the development of entrepreneurial skills and ventures. This will be further elaborated in the following paragraphs.

Proficiency in AI: The students admitted that through this activity, they gained the skills to use AI. An international student from the Faculty of Built Environment and Surveying named Gao (pseudonym) said: "*This is the most interesting and novel task. We utilized AI to help generate theme songs for environmental protection. It made me feel the power of AI technology. Its ability is not only used for text generation, but also has made amazing progress in the fields of video, image, music, and even art. In the past, people often believed that art was the biggest barrier for AI to surpass human consciousness and thinking, but not now*."

In addition, a local student from the Faculty of Management named Priyanka (pseudonym) shared a similar thing: "As the final class activity, Dr. Faizah gave us a fun and engaging task, we had to prepare a song with lyrics that explain

the impact of pollution and how to control it. Our group chose to focus on air pollution. With the help of my team member, we utilized an AI tool to create the song. It was a new and exciting experience for me, and I enjoyed learning how to use the AI application. I never knew such tools existed, and I found it fun and creative to use technology in this way. Overall, I learned that raising awareness about pollution can be done in different and creative ways, and I gained a valuable skill in using AI."

Another international student named Junjie (pseudonym) from the Faculty of Electrical Engineering said, "What amazed me was using the AI to create both lyrics and the actual song! I was shocked by this technology. The lecturer seemed to have been familiar with this tool for a long time, but to me, it was completely new. I felt delighted learning about something I had never known existed. The capabilities of this AI tool are truly remarkable. It can create melodies with the lyrics our group composed in such a natural way. Our song "Ripple of Change" turned out way better than any of us expected, especially with the AI's help in creating the music. I learn a new AI skill today." This aligns with the study conducted by Chiu et al. (2023) and Bergdahl et al. (2020), which found that integrating teaching and learning activities inside the classroom with AI can increase students' proficiency in AI.

Environmental advocacy through art: The activity also enables students to advocate for environmental issues through music, which can be a powerful medium for delivering the message to the public. This is reflected in the narratives of another international student named Chan (pseudonym) from the Faculty of Civil Engineering, as he said: "*My group focused on the topic of air pollution, and in the course of my research, I read data from many environmental organizations. I learned about the causes of air pollution, including industrial emissions and traffic congestion, as well as the connection between ecological consequences and public health. When environmental protection becomes an art form, it is more likely to touch people's hearts. I used to think that environmental protection was the sole responsibility of scientists, and it was the domain of policy reports. However, this lyric writing made me realize that art is a bridge to awaken social consciousness. We do not write lyrics to be touching, but to make people want to listen, understand, and start caring. This experience made me more convinced of the power of words and music, and it also inspired me to participate in social advocacy in creative ways in the future*."

Similar experience was also found in the narratives of another international student from the Faculty of Civil Engineering, named Huifen, as follows: "This creative task was surprisingly powerful. I was not confident in writing lyrics, but once I started thinking about climate change in terms of emotion, urgency, and identity, the words came more easily. I learned how art can become a tool of social awareness and resistance. Our song was about rising sea levels and water pollution. I still remember the chorus. It was not just an assignment; it felt like a message to the world." The abovementioned findings align with those observed by Shen et al. (2025), who found that instructors' use of art songs, which blend classical poetry and music, enriches classroom activities by deepening students' cultural understanding and providing a creative medium for expressing emotions. Similarly, Cipta et al. (2024) found that integrating AI- powered music creation into music education enhances students' creativity and engagement by fostering cognitive, affective, and psychomotor skills, while supporting effective learning through teacher and peer assessments.

Fun learning experience: Students further expressed their true feelings about having fun while learning about serious environmental issues. This can be seen from what was shared by a local student named Farhan from the Faculty of Mechanical Engineering as follows: "*Through this activity, I learned a lot about air pollution, including its causes and effects, and how important it is to raise awareness about it. As a group, we not only discussed the issue but also explored actionable solutions that individuals and communities can take. What made this experience unique and enjoyable was that we expressed our ideas creatively by turning them into song lyrics. This was my first time transforming lyrics into an actual song using AI, and I found the process both interesting and fun. It opened my eyes to how technology and creativity can work together to promote meaningful messages*."

Another local student named Nubhan from the Faculty of Civil Engineering shared the same experience: "*Climate change, deforestation, pollution…It was a lot, but it connected everything we learned. It was so much fun! I loved learning to make a song with AI. It was amazing way to finish!*" The findings are found to corroborate those of studies conducted by Zulmaidi et al. (2024) and Ho et al. (2019), who stated that students found the activity using AI to be fun and not boring compared to traditional learning methods.

Strengthen teamwork: Students also shared how this activity increases their teamwork with their group members. This is reflected in the narratives of Marlia (pseudonym) from the Faculty of Social Sciences and Humanities: "*The activity started with us creating the lyrics together. We combined our ideas and came up with some wonderful lyrics from our perspectives. Then, one of my group members used AI to generate the melody and music for our lyrics, and I was shocked at how good it turned out. It was exceptionally well done and stood out from other groups. I would say our group's music sounded refreshing and trendy. We thoroughly enjoyed the entire process of completing this activity. It was different, but we still learned something from it. Beyond the fun, I realized how powerful creativity can be. I never thought a song could be that impactful and informative. This was the week that I will remember the most*."

Orkid (pseudonym), a local student from the Faculty of Science, further added: "*I worked closely with my teammates to write meaningful lyrics based on real data and case studies. It helped me develop my teamwork skills*." These findings align with studies conducted by Jony and Hamim (2024), who found that AI significantly enhances virtual collaboration and teamwork in higher education, transforming traditional educational approaches. AI is being leveraged by educators and technologists to transform virtual teamwork, striving to replicate the collaborative essence of traditional classrooms in digital environments (Jony & Serradell-López, 2021).

Foster entrepreneurial skills and ventures: Students express how the activity enhances their entrepreneurial skills for potential collaboration with NGOs and digital releases to promote industry-academia synergy. This is reflected in the narratives of Emir (pseudonym), an international student from the Faculty of Civil Engineering: "*Songwriting taught me how to communicate urgency without jargon. I learned the skill of communicating complicated ecological facts through a strange but effective skill. It also provides me with new tools for understanding and composing songs using*

AI, as well as gaining insight into environmental campaigns promoted through entertainment, such as music, which effectively attract and spread awareness among society. I might be using the media social platform for this cause."

Another enthusiastic student named Nubhan from the Faculty of Civil Engineering also shared a similar thing: "*I cannot stop humming Ripple of Change, this incredible song about saving our rivers and oceans. It has got me thinking about how much our waters are suffering. Rivers choked with industrial waste, oil, and trash, hurting fish and dimming the ocean's sparkle. The lyrics hit hard, saying it is "overdue" for us to step up, but they also fill me with hope. The chorus is stuck in my head: pick up trash, making rivers flow 'blue and clear' again, and knowing every little action matters. I love how it calls us to work together, like in the bridge where it talks about turning the tide "one by one" with "hearts open wide." It is a reminder we can clean up the mess we have made and make the future brighter. I am inspired to join a cleanup or at least spread the word. This song is not just music. It is a call to action!*" These findings corroborate with studies conducted by Al-Mamary (2025) and Mikhaylov et al. (2018) on how AI is leveraged to foster entrepreneurial ventures and NGO collaborations.

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ID 90: NottAlone: Promoting Mental Health Literacy among University Students through a Gamified Digital Toolkit

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Highlights: NottAlone is a gamified interactive toolkit designed to raise mental health awareness and literacy among university students. This innovative toolkit utilises a game-based learning approach to engage students in understanding emotional well-being, making empathetic decisions, and recognising the ways to seek professional help from our university facilities. This project aligns with the New Academia Learning Innovation Model (NALI) by combining digital literacy with socio-emotional education in an accessible, creative, and interesting format.

Keywords: Mental health literacy; Gamification; Digital innovation; Student engagement

Introduction

Mental health problems among youths continue to rise, with the addition of academic stress, university students are often faced with various mental health challenges (Despande et al., 2020; Pedrelli et al., 2015). Stigmatisation and mental health illiteracy often prevent help-seeking behaviours which may lead to negative outcomes (Alipanopoulos et al., 2020; Ibrahim et al., 2019). In Malaysia, mental health awareness is not commonly delivered in a formal and structured manner despite the rising awareness and need for more inclusive and accessible information on this subject. Delivering mental health education in classrooms tend to create a passive voice with accessibility of the information specific programmes or outsourced interventions which limits the promotion of good literacy and accessible mental health education to a much wider audience.

To address this issue, NottAlone was developed as part of the Teaching and Learning Research Project efforts to promote mental health awareness through co-design approach via creativity and participation among the students at the University of Nottingham Malaysia. NottAlone is a story-driven and gamified tool in promoting early understanding of issues surrounding mental health powered by Scratch. NottAlone is design with attractive elements using Nottingham's popular mascot, Gilbert the goose, to make it interactive and catchy for the young generation. NottAlone places students in the roles of various characters navigating through different scenario of everyday emotional stressors that are relatable to university students. The game prompts its players to engage in learning and exposure to mental health literacy knowledge through decision-making approach by making individuals identify their responses to different real-life scenarios that has implications to their mental health.

The novelty of this innovative project lies in its ability to improve mental health literacy through interactive learning in casual set up which fits to the needs of the younger generation that highly prefers user-centred, fun and aesthetic- driven learning environment. The story-based approach in NottAlone with player choices and multiple endings showcases the thoughtful, yet creative process involved in the production of this game especially to educate young generation. The toolkit displays high innovativeness by enabling mental health literacy to a more casual, interactive, and gamified learning and user centred mental health education. NottAlone is highly accessible which integrates digital literacy and mental health education in a well-packaged dialogue format that can be distributed or access through link or QR scan method. Furthermore, according to the NALI Model, NottAlone takes the scenario-driven learning aspect as one of its underlying guide through story drive scenarios that explores multiple endings and outcomes. Through this simple toolkit, NottAlone aims to encourage peer empathy, promote a wider emotional vocabulary, and empower self-awareness among university students specifically tailored to the unique need, focus and issue faced by the young generation.

Objectives

In Malaysia, mental health awareness in educational aspect often adopts a formal method. Whilst formal method is a good medium to deliver knowledge, it often limits students' active engagement and understanding towards the actual information related to mental health. This is especially true within today's context whereby students often sought out information or rely on digital information via social media which can expose them to inaccurate or generalised information. Therefore, the NottAlone project seeks to address this gap by offering a digital and gamified experience.

The main objective of NottAlone is to improve students' mental health literacy in a format that resonates with university students. NottAlone has been designed to promote active engagements and high-interactivity to enable students to experience maximal learning within a short-time span. Through immersive gameplay and interactive storytelling, users are exposed to real-

life situations such as dealing with stress, anxiety, peer pressure, and isolation. The game encourages players to make decisions that affect the storyline, prompting critical thinking about emotional responses and peer support. It also provides a safe space for students to explore the topic of mental health in a non-threatening, fun, and self-paced environment.

NALI Appraoch

In alignment with the New Academia Learning Innovation (NALI) model, NottAlone incorporates several key elements: novelty, creativity, applicability, and student impact. The game is novel in which it introduces mental health literacy using game-based learning. The creativity its design and learning through narrative paths and choices to foster empathy and reflection. The game is applicable across various educational settings including civic education, counselling modules, and digital literacy classes. Additionally, the game is also a handy toolkit for students to always have. Most importantly, the innovation has demonstrated positive impact on students by promoting mental health literacy, engagement and knowledge delivery, and interactivity in learning. NottAlone has also demonstrated its ability as a source of stress relief among university students.

Research Methodology

The development of NottAlone was through a university competition for students under the category of interactive toolkit. Students were informed on general terms including the need to design the toolkit based on scenarios and factors associated to mental health which includes but not limited to 1) underlying mental health factors, 2) coping strategies, 3) help seeking behaviours, 4) issues such as study-life balance, managing family and relationship, academic and healthy behaviour among others. This particular NottAlone is designed as a game prototype which was created using Scratch. It uses gamification and co-creation conception using both combined input from literatures and students as main stakeholders. The NottAlone game is operationalised using story-based gamification. It requires the users to answer multiple questions from characters in the game which faces differing mental health challenges relatable to the life of university students, especially those just entering university life. After testing and refining the NottAlone project, a survey form was distributed to a total of 27 university students via Qualtrics to test and provide feedback on the NottAlone's feasibility and usefulness.

Findings and Discussion

A total of 27 university students were invited to test NottAlone and asked to provide their comment on feasibility and usefulness of the toolkit via Qualtrics. The questions are: 1) How helpful is the toolkit for promoting mental health literacy? 2) How helpful is this toolkit for promoting engagement and knowledge delivery on mental health? 3) How helpful this toolkit for promoting interactivity in learning?, 4) How helpful this toolkit for stress relieving purpose? Table 1 summarises the result.

Table 1: Feasibility and usefulness of NottAlone

Aspect	Score (out of 5)
How helpful is the toolkit for promoting mental health literacy?	4.15
How helpful is this toolkit for promoting engagement and knowledge delivery on mental health?	4.22
How helpful this toolkit for promoting interactivity in learning?	4.26
How helpful this toolkit for stress relieving purpose?	4.19

In general, the average score for all aspect were above 4 which indicates usefulness and effectiveness of NottAlone to increase mental health literacy for the student population. The high scores signal potential from the existing NottAlone toolkit to be developed further in making it more friendly and accessible for the user. The existing potential and ability of NottAlone to attract students across different background and programme to develop mental health literacy in much fun, interactive and causal ways of learning.

Conclusion and Commercialisation Potential

NottAlone holds significant potential for commercialisation as an innovative, gamified digital toolkit that addresses the rising need for accessible, engaging, and student-friendly mental health literacy solutions. Its interactive storytelling, relatable scenarios, and culturally relevant design makes it ideal for expansion beyond the University of Nottingham Malaysia into education, workplace well-being, and community outreach. In universities, it could be licensed for student induction, counselling services, or well-being programmes, with customisation for institutional branding and local context. Secondary schools could adopt tailored versions to prepare students for the transition to higher education.

Beyond academia, NottAlone could support workplace mental health initiatives, particularly for young professionals. Partnerships with NGOs, government agencies, and advocacy groups could integrate it into public awareness campaigns, funded by grants or sponsorships. A free model could provide a basic free version alongside a paid premium edition with extended scenarios, analytics, and learning platform integration. Migrating from Scratch to mobile and web platforms would expand accessibility and monetisation options, including scenario packs or subscriptions.

Pilot testing showed strong acceptance, with average ratings of above 4 out of 5 for mental health literacy promotion, engagement, interactivity, and stress relief. This evidence supports market viability and offers a compelling case forinstitutional adoption. The game has a lot of room for improvement that can be achieved through enhanced

graphics, expanded storylines, platform migration for wider accessibility, and integration of feedback-based features to increase engagement and learning impact. The game's 'Gilbert the Goose' mascot design also opens merchandising opportunities, creating supplementary revenue streams.

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ID 91: AI Integrated Learning Management System for Enhancing Student Learning

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Highlights: This study explored the integration of Artificial Intelligence (AI) into the Learning Management System (LMS) to enhance students' learning experience. Through a content analysis review, the research examines AI features such as intelligent chatbots, adaptive learning pathways, predictive dashboards, and AR/VR technologies. The findings indicated that the features enable personalized learning, real-time feedback, and improve engagement and interaction, while supporting teachers with data-driven insights.

Keywords: Artificial intelligence; Learning management system; Student learning

Introduction

Learning Management System (LMS) plays an important role in managing the teaching and learning process, providing a centralized repository of resources, and enabling the tracking of student learning progress. LMS is supposedly the most advanced tool for facilitating learning because it is built to support learner-centered approaches with integrated learning activities based on learning objectives, regardless of the delivery method (Rottmann et al., 2020). The teaching and learning process has changed significantly as a result of the rapid development of educational technology, especially with the use of LMS. Higher education institutions frequently use LMS platforms like Google Classroom, Moodle, and Canvas to administer assessments, deliver course materials, and track student progress (Zawacki-Richter et al., 2019). However, traditional LMS platforms usually offer static, uniform content materials regardless of the needs, backgrounds, or performance of each student, which limits their ability to personalize the learning experience. This approach can lower student engagement and hinder meaningful learning.

As stated by Chen et al. (2020), the creation of computers with some degree of intelligence that can carry out human- like tasks, such as cognitive, learning, decision-making, and environmental adaptation, is referred to as artificial intelligence. Artificial intelligence (AI) facilitates the advancement of adaptive learning through the application of data mining, intelligent teaching systems, learning analytics, and real-time analysis (Huang et al., 2021). According to Alotaibi (2024), AI features in LMS can provide adaptive assessments, augment personalized learning paths, and offer data-driven insights that help improve the educational process and learning results. The results demonstrate how to integrate AI and LMS to transform and enhance the educational experience for students from diverse backgrounds. This study focuses on how AI features in LMS can help improve students' learning experience and the development of the system.

Objectives

The objectives of this study are:

i. To identify how AI features in LMS can help improve students' learning experience.
ii. To explore ways AI can make learning more engaging and personalized.

NALI Approach

The novelty of this research lies in introducing new ideas on how AI features in LMS improve the student learning experience. Unlike traditional LMS platforms that deliver standardized content to all learners, an AI-integrated LMS adapts to the unique needs, habits, and performance of each student. This customized approach improves engagement, supports skill development, and fosters a more fun learning environment. According to Chen et al. (2020), the integration and features of AI in LMS such as intelligent chatbots, automated grading and assessment, adaptive learning pathways, tailored content recommendations, and real-time feedback. These characteristics give LMS platforms the ability to monitor learning progress, identify areas that need improvement, and customize instructional materials to meet the needs of specific students. Additionally, AI can help with the analysis of student data to produce insights for teachers, facilitate self-directed learning, and improve student engagement with immersive and interactive technologies like simulation and virtual reality.

Creativity

AI chatbots such as ChatGPT, Google Gemini and DeepSeek have the potential to overcome many gaps in both online and traditional educational systems, especially in the areas of each student learning and engagement and, teacher's load of works. Having hard time in answering their questions are a common problem for students, particularly in online or large class settings. Lack of interactive and support causes a large percentage of students to lose interest in their studies. Access to educational materials and teacher assistance may be difficult for students, especially those who live in rural areas. Besides that, students with disabilities and non-native speakers frequently struggle to understand the course materials. By promptly giving students and engaging and dynamic learning environment, AI chatbots have the potential to close these gaps and modernize the educational system (Davar et al., 2025). AI chatbots features built into LMS can serve as virtual tutors, providing

immediate topic explanation, responding to frequently asked questions, and assisting students with course material at anytime and anywhere. This demonstrates how AI chatbots can handle administrative and educational duties, help each student assistance and facilitating support (Popenici & Kerr, 2017).

The potential of AI features in LMS to evaluate student data and offer insights on their learning progress and addressed students' learning problems, which dashboards can display it using machine learning analytics. With the help of the system, teachers can track student's learning progress, level of knowledge and obtain insights based on the whole learning environment. These observations are frequently converted into visual dashboards that assist teachers in tracking student progress, identify areas where student's learning is lacking and help where needed. Furthermore, AI features that examine course materials and syllabuses can produce dashboards or reports to help teachers assess and create each student learning plans. AI can assist in identifying the best teaching strategy for every student based on their individual characteristics, strong points and enhancing skills. All students can benefit and have fun in the learning experience this way. It helps students develop a knowledge system with enhanced learning skills and creativity in addition to expand their knowledge (Chen et al., 2020).

Innovativeness

The use of AI chatbots in education is growing in popularity. AI chatbots can serve as conversational tools and help students with text or voice responses to questions about their course materials. How a chatbot is designed and implemented can vary based on the technology system. AI chatbots can talk in a natural language that is similar to humans, as they are made to function as human conversational agents. They can be accessed at any time and from anywhere, providing students with ongoing assistance (Davar et al., 2025).

Adaptive assessments and personalized learning are two benefits of integrating AI into LMS. Although these potentials are in line with recent developments of AI in education, the case for their viability and significance can be strengthened by offering additional real-world examples of how it has been used within LMS platforms. Through AI features and Augmented Reality (AR)/Virtual Reality (VR) technologies, students can benefit from personalized support and improve their learning. These tools can also help students with physical disabilities. It shows how integrating AI and LMS may transform and improve students' learning process, leading to better academic results and performance (Alotaibi, 2024).

Applicability

In order to provide more interesting and personalized learning experiences, the AI features in LMS include predictive analysis dashboards, intelligent chatbots, and adaptive learning pathways. By examining information such as interactions, learning preferences, and behavioural trends, AI generates comprehensive learner models or profiles. By offering focused and individual assistance, this profile improves students' achievement and engagement. Furthermore, AI features customize the educational process by suggesting activities and content that are specific to each student's profile. These keep track of students' progress in real time and modify the level of difficulty as necessary. It seeks to evaluate students' data and optimize learning paths to produce a more efficient, effective, and personalized learning environment (Zawacki-Richter et al., 2019).

Impact on Students' Learning

The impact of AI-integrated LMS can help students' learning by implementing AI chatbots to provide customized content and guidance, which could improve each student's learning experiences. AI features can track student progress and engagement over time, giving prompt feedback and assistance about learning materials (Popenici & Kerr, 2017). AI can detect which students are having difficulties or failing early on through learning analytics, enabling prompt intervention to improve students' results. AI features like chatbots, AR/VR technologies in LMS boost student engagement and interaction and provide ongoing support in order to improve engagement and interactivity. AI promotes equal access to proper education by accommodating students with physical disabilities or different learning styles (Alotaibi, 2024).

Research Methodology

This study is identified by conducting content analysis. It provides a synopsis of how AI-integrated LMS enhances student learning experience. By offering personalized, flexible, and data-driven learning experiences, an AI-integrated LMS improves student learning. Chatbots provide immediate academic assistance, virtual dashboards monitor students' progress and spot learning gaps, and adaptive learning paths modify learning content to suit each student's needs. With the help of these tools, students may take more responsibility for their education since they boost engagement, make learning more fun and accessible, and provide fast feedback. AI-LMS improves learning outcomes, facilitates better understanding of the study by utilizing automation and intelligent analytics.

Further research should focus on assessing the effectiveness and use of AI-integrated LMS in actual institutional settings. The measurable impact of AI features like chatbots, adaptive learning, and virtual dashboards on student engagement and learning outcomes requires empirical research involving pilot projects, case studies, or experimental designs. Future research might also look into the cost-effectiveness of adoption, the scalability of AI-LMS in other educational contexts, and the ethical issues surrounding AI use in education, such as algorithmic bias and data privacy. It is also necessary to study how AI-LMS may be enhanced over time using cutting-edge technologies like generative AI and learning analytics.

Conclusion

In conclusion, by combining data-driven decision making, intelligent automation, and personalization, the integration of Artificial Intelligence (AI) into Learning Management Systems (LMS) provides an innovative method of improving students' educational experiences. AI-LMS platforms may offer diverse student support, real-time feedback, and equal

access to high-quality education through features like adaptive learning pathways, intelligent chatbots, predictive dashboards, and immersive AR/VR tools. This study highlights how AI-LMS overcomes the limitations of traditional LMS, encouraging more participation and helping teachers to create knowledgeable educational materials, and potential to significantly improve student learning.

Awards Received

Title of Project: Canvas LMS: A Tool for Personalized Learning. Bronze Award in New Academia Learning Innovation (NALI) 2024 Exhibition and Competition, UTM.

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ID 92: Innovating Coding Learning Experience via GeoTrees Hackathon

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Highlights: This project replaces the traditional coding class project with a five-week hackathon, aligning with the NALI 2025 principles. It introduces a real-world, challenge-based approach that fosters creativity through collaborative design and rapid problem-solving. The shift from individual work to team-based development encourages innovation and mirrors industry practices. By integrating authentic, hands-on learning, the hackathon enhances students' engagement and collaboration. It empowers them to take ownership, think critically, and apply their skills in meaningful ways. This model not only strengthens technical and problem-solving abilities but also prepares students with industry-relevant competencies essential for future careers.

Keywords: GeoTrees; Hackathon; Situated learning; Geographic information system (GIS)

Introduction

The GeoTrees Hackathon project showcases a novel approach to academic learning innovation, transforming a traditional coding class into a dynamic, challenge-based environment. Its uniqueness stems from the replacement of standard project assignments with a five-week, time-limited hackathon that reflects real-world industrial practices. By emphasising creativity, students were pushed to collaborate and test novel ideas under tight timelines, imitating actual problem-solving circumstances. The approach's innovativeness is demonstrated by how it shifts student learning from isolated outputs to iterative teamwork, emphasising both individual contributions and collaborative integration. This structure embodies the NALI concept by emphasising hands-on learning and iterative development via a systematic, multi-phase journey from ideation to pitch.

The hackathon concept is instrumental in coding education because students are already familiar with fundamental programming abilities. The project closely aligns with professional workflows by engaging students in a realistic software development cycle that includes proposing improvements to the current GeoTrees app (Fauzi et al., 2024; Idris et al., 2022), designing interfaces, coding modules, integrating them via collaborative tools such as GitHub, and presenting to an industry panel. The impact was significant: students gained ownership of their initiatives, which boosted their confidence and decision-making ability. The experience helped them improve their critical thinking, problem-solving, and communication abilities, while also encouraging deeper involvement through peer cooperation and real-world application. Finally, the GeoTrees Hackathon improved students' technical talents while also preparing them for future industrial challenges by instilling critical 21st-century skills.

Objectives

Objectives of this project are:

i. To provide students with authentic exposure to web GIS coding and web development challenges in a competitive yet supportive environment.
ii. To cultivate critical 21st-century skills in coding ecosystems that include collaboration, problem-solving, critical thinking, and innovation.

Research Methodology

The hackathon is organised for 5 weeks. The activity was executed within a constrained five-week period to replicate actual industry challenges. Figure 1 elucidates the GeoTrees Hackathon methodology, whilst the specifics of each weekly mission are detailed in Table 1. Each week, each group is required to conduct a minute meeting to document the group's discussion.

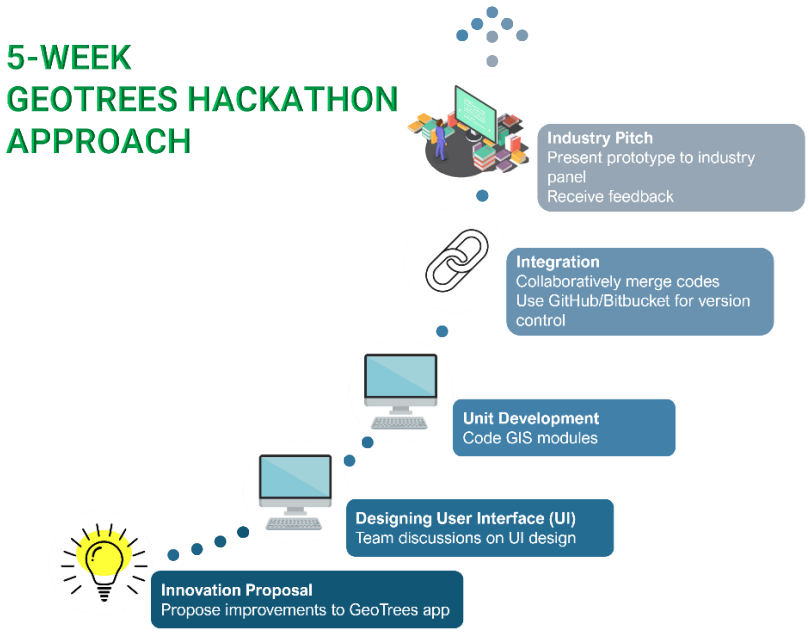


Figure 1. Simplified 5-week GeoTrees Hackathon approach.

Table 1: GeoTrees Hackathon processes.

Week	Stage	Task
1	Innovation Proposal	Students were required to propose improvements to the existing GeoTrees app at its early stage of development.
2	Designing User Interface	Discussing the design of the user interface with the team.
3	Unit Development	Students began by coding individual modules to address specific GIS-related tasks. This week, each group will demonstrate their progress in front of the lecturer.
4	Integration	Teams of two collaborated to merge and integrate their codes into a single working prototype. They are required to use GitHub or Bitbucket for collaborative coding.
5	Industry Pitch	Each team presented their working prototype to an industry panel for feedback.

Findings and Discussion

Following the GeoTrees Hackathon, a questionnaire survey was conducted using Google Forms to analyse the impact on student acceptance and perception. The survey was divided into two main sections: (a) student empowerment and engagement, and (b) student reflections. The output showed that GeoTrees Hackathon demonstrates a clear positive impact on both student engagement and empowerment (see Figure 2). The empowerment and engagement impacts illustrates significant gains in three aspects, (i) level of confidence in using programming languages to build web or mobile GIS platforms, (ii) level of innovative thinking to develop a web or mobile GIS solution that addresses a real-world geospatial issue, and (iii) level of participation in completing assigned tasks in a team-based GIS project among students after they participated in the GeoTrees Hackathon compared to those before hackathon (i.e. in conventional project approach). From the analysis, students responded positively to the implementation of the hackathon concept for a new learning innovation approach.

i. *Impact on students' empowerment and engagement*

The survey results show that the GeoTrees Hackathon significantly increased students' confidence in using programming languages to create web or mobile GIS solutions (Figure 2a). Before the hackathon, students reported lower levels of confidence, with many indicating limited ability to use coding effectively in a real-world setting. However, following their involvement in the hackathon, there was a noticeable increase in confidence. According to this study, 95% of students reported an increase in their confidence level when using programming languages to build web or mobile GIS platforms. The hackathon's hands-on, time-constrained, and problem-solving nature gave students actual opportunities to apply their programming knowledge, increasing their confidence in designing GIS applications.

Similarly, the hackathon helped students improve their innovative thinking skills when designing web or mobile GIS solutions that address real-world geospatial concerns (Figure 2b). Before the hackathon, respondents indicated that students' ability to produce innovative ideas was limited, reflecting a more conventional and restricted approach to project work. After completing the hackathon activities, 95% students displayed significantly higher levels of creativity and problem-solving. Working together, integrating codes, and pitching solutions to an industry panel inspired students to look beyond theoretical exercises and embrace innovation as a crucial component of GIS solution creation.

Likewise, the analysis of student responses to their level of participation in completing assigned tasks within a team-based GIS project shows a significant improvement after the GeoTrees Hackathon when compared to before (Figure 2c). In the traditional project approach, students' participation levels looked inconsistent, with some claiming little involvement in group work and others reporting just moderate contributions. This suggests that in traditional settings, students may have been less motivated or confident in taking on active roles, leading to unbalanced task distribution and decreased collaboration within teams. In contrast, following the GeoTrees Hackathon, the distribution of replies turned significantly towards greater involvement. The number of students who indicated "Very good" increased dramatically, while the percentage of "Poor" or "Very poor" responses declined to a minimum. This shows that the hackathon's time-constrained, task-focused design promoted accountability and teamwork, resulting in more consistent student participation. Weekly progress reporting, coding integration through GitHub or Bitbucket, and prototype pitching to an industry panel all required ongoing input from all group members, lowering the probability of unfair task sharing.

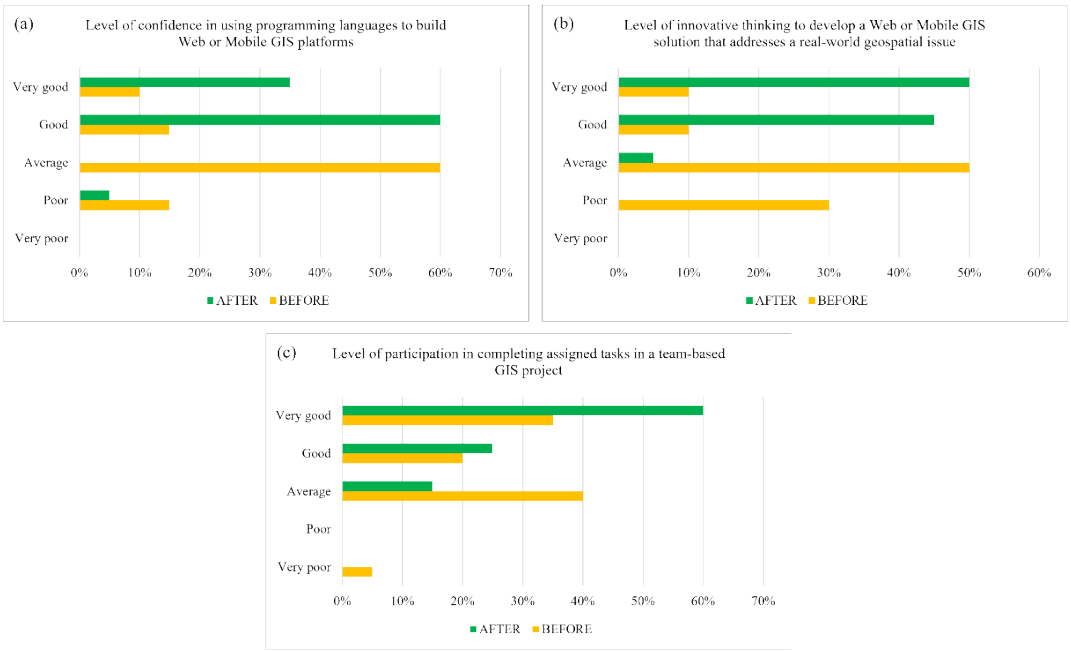


Figure 2. Impact on student empowerment (a, b) and engagement (c) before vs. after the GeoTrees Hackathon.

ii. *Students' reflections on GeoTrees Hackathon*

The GeoTrees Hackathon provided students with an intensive, hands-on learning experience that extended beyond traditional classroom assignments, enabling them to apply programming, problem-solving, and teamwork skills in a real-world setting. During this intensive five-week exercise, students were able to reflect not only on their technical development, such as enhanced coding confidence and innovative thinking, but also on their collaborative experiences in accomplishing team-based projects under time limitations. These observations show how the hackathon facilitated personal and professional development, providing students with vital insights into their learning processes and preparing them for future geospatial difficulties:

"Sebelum mengikuti kursus Web GIS, saya tidak tahu bagaimana sistem Web GIS dibangunkan secara keseluruhan. Namun, selepas tamat kursus ini, saya telah mempelajari cara menggunakan AJAX untuk komunikasi data tanpa perlu muat semula laman, membina User Interface menggunakan FlutterFlow, dan memahami peranan backend seperti FastAPI dalam pemprosesan data geospatial. Saya juga telah belajar bagaimana menjalankan Functionalities Acceptance Test untuk memastikan setiap fungsi sistem berfungsi dengan betul. Tambahan pula, saya kini tahu cara menggunakan GitHub untuk berkongsi dan mengurus kod secara kolaboratif bersama ahli kumpulan."

"Before the Web GIS course, I didn't know how to create interactive maps or connect real-time data to a website. Now, I can upgrade our old carbon tree project with dynamic features, like clickable maps, data filters, and live updates, making it more useful for tracking trees and their environmental impact. This turns our simple idea into a powerful tool for sustainability."

"Disebabkan project ini banyak mengunakan minda, teamwork, malah untuk memilih tajuk sahaja susah, jadi dalam komunikasi sesama teammates mencapai keberkesanan, bekerja dlm kumpulan sampai apabila saya & tey joyce saling melengkapi coding untuk menghasilkan satu navigation from our location to tree locations. Apabila teamwork, kerja dilakukan dengan sempurna oleh itu keyakinan kami dalam pembentangan kepada panel industry meningga, Conclusion disini, komunikasi, teamwork itu adalah kunci kejayaan projek kami."

"The Geotrees Hackathon project improved my understanding of Web GIS development, particularly in handling tree age estimation. I gained hands-on experience in using Leaflet to visualize spatial tree data and learned how to integrate JavaScript, PHP, and MySQL for real-time data input and display. The project strengthened my skills in form handling, map interaction, and using GeoJSON to store and manage tree attributes. It also deepened my understanding of growth rate

factors, DBH (diameter at breast height), and how they relate to tree age, allowing me to build a functional system that estimates and categorizes tree age effectively."

Commercialisation Status

The current GeoTrees v4 system was copyrighted as "GeoTrees Mobile Application Version 4" with filing number LY2024J09066 dated 24 December 2024.

Acknowledgement

The authors wish to express their sincere gratitude to the Nusajaya Natural Heritage Trust, the operator of SIREH Park Nusajaya, for their unwavering support and collaboration in the implementation of the GeoTrees initiative.

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ID 93: Integrating AI for Smart Hydroponics for STEM Education: Eco-Sight Botanic

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Highlights: Eco-Sight Botanic STEM integrates AI, IoT, and solar-powered hydroponics to transform STEM education for primary and secondary students. Through hands-on design, programming and system operation, students develop critical thinking, creativity, problem- solving and digital literacy aligned with the curriculum. Structured across seven phases including Training of Trainers, mentorship, STEM education, student-centred learning, experiential learning, community engagement and entrepreneurial academia. The program also engages teachers and the community. Students gain exposure to sustainability, renewable energy and entrepreneurship, while AI-driven predictive management and IoT monitoring reinforce computational thinking. By connecting classroom knowledge to real- world applications and SDGs, Eco-Sight: Botanic STEM prepares future-ready, socially responsible learners.

Keywords: STEM education; Student-centred learning; Experiential learning; Community engagement; Entrepreneurial academia

Introduction

The integration of AI with smart hydroponics through Eco-Sight: Botanical STEM is transforming STEM education by shifting learning beyond textbooks into real-world applications. Through hands-on design, programming, and operation of the system, students actively engage in experiential learning that strengthens critical thinking, creativity, and problem-solving while connecting science, technology, engineering, and mathematics (Li et al., 2022); (Portillo- Blanco et al., 2024). This innovation not only sparks curiosity in the classroom but also extends its impact to the community, as students share prototypes with teachers, parents, and local audiences, fostering awareness of sustainability and digital technology. By embedding elements of entrepreneurship and innovation, Eco-Sight: Botani STEM nurtures early social responsibility and prepares students to apply their knowledge in meaningful and future-ready ways (Wan & Wang, 2021).

Objectives

This innovation, Eco-Sight: Botanic STEM, aims to advance STEM education through the development of an AI-integrated smart hydroponic system, serving as a transformative platform that fosters student-centred learning through hands-on, real-world applications. By involving students in the design, programming, and operation of automated hydroponics, Eco-Sight: Botani STEM promotes experiential learning that strengthens problem-solving, creativity, and critical thinking skills. Extending beyond the classroom, it also enhances research-informed practices and interdisciplinary collaboration, positioning students to integrate knowledge across science, technology, engineering, and mathematics. Furthermore, it nurtures an entrepreneurial academia culture by inspiring students to translate their knowledge into impactful, future-ready solutions for society.

NALI Approach

The implementation of the NALI (New Academia Learning Innovation) approach in this research is evident through its integration of novelty, creativity, and applicability in advancing STEM education. The AI-integrated smart hydroponic system innovation introduced a novel teaching tool that goes beyond conventional classroom practices by combining agriculture, IoT, AI, and renewable energy into a single, experiential platform. Its creativity and innovativeness are reflected in the way complex digital technologies were simplified and contextualiz ed for primary school learners, while simultaneously training teachers and UTM students as facilitators of knowledge transfer. The applicability of the innovation extends to real-world challenges such as food security, sustainability, and digital transformation, providing learners with hands-on opportunities to connect theory with practice. Most importantly, the impact of the NALI approach is demonstrated through heightened student engagement (87% reporting increased excitement in STEM), enhanced problem-solving skills, and strengthened teacher capacity, while also cultivating leadership and entrepreneurial values among UTM students.

Eco-Sight Program: Cultivating Sustainability through Digital Agriculture Innovation

The Eco-Sight Program, led by Universiti Teknologi Malaysia (UTM), integrates sustainability, smart agriculture, and digital innovation into education through experiential, student-centred, and community-engaged learning. Anchored in the Malaysia Education Blueprint 2013–2025 (PPPM), the program highlights the use of an AI-integrated Smart Hydroponic System as a platform for teaching and promoting sustainability.

Through this initiative, 28 UTM students, 20 teachers, and 60 primary students were involved in hands-on learning, mentoring, and classroom integration, creating a collaborative ecosystem of knowledge transfer. UTM students gained leadership and entrepreneurial skills, teachers adopted applied STEM strategies, and primary pupils experienced real-world science through hydroponic prototypes. Eco-Sight demonstrates UTM's commitment to embedding sustainability and innovation in education, preparing learners and educators to address real-world challenges while fostering long-term academic and societal impact.

Research Methodology

The methodology for implementing the AI-integrated smart hydroponic system was structured into six interrelated phases. Each phase aligns with key pedagogical pillars—Training of Trainers (ToT), Mentorship, STEM education, Student-centred learning, Experiential learning, Community engagement, and Entrepreneurial academia—to ensure scalability, inclusivity, and long-term sustainability of the initiative. Figure 1 illustrates the AI-integrated hydroponic system brings together AI, IoT, solar PV, and STEM education.

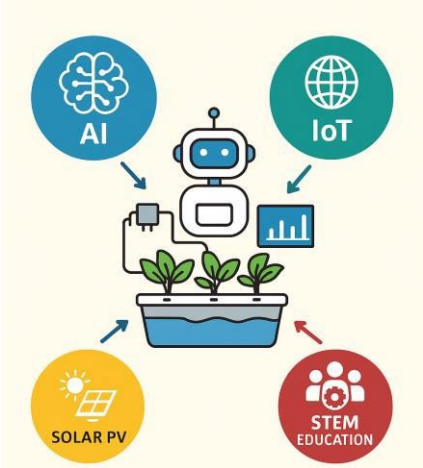


Figure 1: AI-integrated hydroponic system combining AI, IoT, solar PV, and STEM education

The AI-Integrated Hydroponics initiative, under Eco-Sight: Botanical STEM, is a hands-on STEM program for primary and secondary students. It combines artificial intelligence (AI), Internet of Things (IoT), and solar-powered systems into an experiential learning platform. The program is structured around seven phases: Training of Trainers (ToT), mentorship, STEM education, student-centred learning, experiential learning, community engagement, and entrepreneurial academia, supporting holistic development for both teachers and students. Participants design, program, and operate smart hydroponic systems using microcontrollers, sensors, cloud dashboards, and AI-driven predictive management. This approach equips learners with digital, problem-solving, and entrepreneurial skills while fostering innovation and sustainability awareness. The methodology can be summarized as follows:

Phase 1: Training of Trainers (ToT)
Teachers were introduced to the AI-integrated hydroponic system through structured ToT sessions. These workshops provided hands-on guidance in setting up microcontrollers, configuring nutrient sensors, operating cloud dashboards, and applying AI-driven predictive management. Educators gained the technical skills to manage AI, IoT, PV-powered systems, and hydroponics, while also being empowered to facilitate technology-driven STEM learning. This foundation ensures the program's sustainability, as teachers can continue guiding students in applying digital innovation to real- world challenges.

Phase 2: Mentorship
Students received continuous support through direct mentorship from teachers and external professionals, including academics, engineers, and agricultural technologists. Small-group mentoring focused on practical skills such as programming sensors, managing IoT dashboards, and interpreting AI outputs. This personalized guidance strengthened students' confidence, curiosity, and problem-solving abilities, bridging classroom learning with real-world applications.

Phase 3: STEM Education
The hydroponic system was integrated into the school curriculum, connecting science, mathematics, and ICT while aligning with the Pelan Pembangunan Pendidikan Malaysia (PPPM). Students explored plant growth, ecosystems, and sustainability in science; data analysis and measurement in mathematics; and coding, IoT management, and AI applications in ICT. This approach built interdisciplinary skills and provided hands-on exposure to digital agriculture.

Phase 4: Student-Centred Learning
Students became active learners, taking ownership of smart hydroponic projects by designing, assembling, and troubleshooting kits with minimal teacher intervention. This fostered creativity, independence, and responsibility. As a result, 87% of students reported increased excitement and curiosity toward STEM.

Phase 5: Experiential Learning
The system served as a living laboratory, giving students practical experience with AI, IoT, and PV technologies. Students monitored plant growth, adjusted nutrient levels, and analyzed AI predictions. About 82% of learners reported being able to connect classroom concepts to real-life problem-solving, enhancing their critical thinking and computational skills.

Phase 6: Community Engagement
The initiative involved parents, teachers, and local stakeholders through school exhibitions, presentations, and discussions. This allowed students to showcase prototypes and raise awareness about sustainable agriculture. About 76% of community participants recognized the system's value, promoting early adoption of smart agriculture concepts.

Phase 7: Entrepreneurial Academia
Students were encouraged to transform their hydroponic prototypes into potential products or services. Guided exploration of AI-powered hydroponics enabled commercialization through school-based kits or sustainable food ventures. This phase fostered entrepreneurial mindsets, preparing students to become future-ready problem solvers with both technical and business skills.

Findings and Discussion

Table 1 summarizes the key outcomes of Eco-Sight: Botanical STEM, showing its impact on student engagement, experiential learning, community involvement, AI functionality, sustainability, and IoT monitoring. The implementation of an AI-integrated smart hydroponic system demonstrated significant potential as a platform for advancing STEM education by combining agricultural technology with digital innovation. A survey conducted with 60 primary school students showed that 87% reported greater excitement and curiosity toward STEM subjects when exposed to hands- on hydroponic and AI integration activities. This suggests that learning framed around real-world challenges, such as food sustainability, strongly supports the principles of student-centred learning at an early age. By directly interacting with simple sensors, microcontrollers, and AI-driven decision-making processes, learners engaged in experiential learning, where 82% of participants agreed that they could better connect what they learned in class with real-life applications.

The Eco-Sight: Botany STEM innovation encouraged community engagement, with students presenting their hydroponic prototypes to teachers, parents, and local stakeholders. Feedback showed that 76% of participants recognized its value for raising early awareness of smart agriculture, demonstrating its relevance beyond classrooms and promoting a culture of sustainability at home and in the community. The project also fostered an entrepreneurial mindset, as students explored ways to introduce small-scale smart hydroponic kits as school innovations or potential income-generating ideas. A key strength of the system lies in its AI-powered nutrient predictive management. Rather than just automating processes, the AI analyzes data from electrical conductivity (EC), pH, and plant growth stages to forecast nutrient needs, recommending adjustments before problems arise. Over time, the AI improves through learning, allowing students to witness machine learning in action and reinforcing computational thinking skills. The system emphasizes sustainability, powered by solar photovoltaic (PV) energy. Solar panels provide renewable electricity for pumps, sensors, and microcontrollers, showing students how food production can be environmentally friendly. By combining solar energy with hydroponics, learners gain early exposure to green technology and energy efficiency, fostering environmental responsibility (Rahman & Rahman, 2024). Integration with the Internet of Things (IoT) creates a connected learning ecosystem. Students and teachers can monitor parameters such as nutrient levels, pH, temperature, humidity, and light intensity through cloud dashboards. Alerts notify users if values go out of range, and historical data supports trend analysis, scientific observation, and data-driven problem-solving.

Table 1: Eco-Sight: Botany STEM Results – Highlights student learning, community engagement, AI use, and sustainability outcomes

Key Area	Findings	Percentage / Evidence
STEM Excitement	Students reported greater excitement and curiosity in STEM.	7% of 60 students
Experiential Learning	Learners connected classroom knowledge (science, math, ICT) with real-life applications.	82% agreed
Community Engagement	Students presented prototypes to teachers, parents, and the local community.	76% of community found it beneficial
AI Features	AI predicted nutrient needs using EC, pH, and growth stages; proactive adjustments recommended.	Ongoing system learning
Sustainability	Hydroponic system powered by solar PV (pump, sensors, controllers).	Renewable energy adoption
IoT Monitoring	Cloud dashboards monitored nutrient levels, pH, humidity, light; alerts for anomalies.	Real-time monitoring

This innovation also enhances curriculum learning. In science, students explore plants, ecosystems, and the environment; in mathematics, they practice measurement, graphing, and patterns; and in ICT, they learn coding, data management, and automation. Alongside academic knowledge, the system builds 21st-century skills such as creativity, collaboration, and problem-solving in an engaging, hands-on way. Furthermore, Eco-Sight: Botany STEM aligns with the United Nations Sustainable Development Goals (SDGs): SDG 2 (Zero Hunger) through sustainable food production, SDG 4 (Quality Education) via experiential learning, SDG 7 (Affordable and Clean Energy) with its solar- powered system,

SDG 9 (Industry, Innovation, and Infrastructure) through AI and IoT, and SDG 13 (Climate Action) by promoting eco-friendly practices. By combining AI, IoT, and solar-powered hydroponics, Eco-Sight: Botani STEM provides a transformative STEM learning experience, nurturing curiosity, responsibility, and sustainability awareness while preparing students to be future-ready from their formative years.

Conclusion

The integration of AI into a smart hydroponic system through Eco-Sight: Botani STEM offers a practical platform for enhancing STEM education in primary schools. The AI not only automates plant care but also analyzes sensor data, predicts nutrient needs, and recommends adjustments, allowing students to see how machines learn and improve over time. This hands-on experience develops computational thinking, problem-solving, and digital literacy aligned with the syllabus. With IoT-based monitoring and solar-powered sustainability, the system demonstrates how emerging technologies can support student-centred and experiential learning. Aligned with the Pelan Pembangunan Pendidikan Malaysia (PPPM), it fosters creativity, innovation, environmental awareness, and entrepreneurial thinking. By linking classroom knowledge with real-world applications and the United Nations Sustainable Development Goals, Eco-Sight: Botany STEM prepares students to be future-ready, equipping them with the mindset and skills needed for the digital era.

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ID 94: Immersive Urban Sketches: Redefining Urban Planning with AI- Driven AR

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Highlights: This project pioneers the integration of Artificial Intelligence (AI) and Augmented Reality (AR) in teaching urban planning. Students' hand-drawn urban sketches were digitally transformed using AI animation and brought to life through AR. The innovation enriches visualization, strengthens creativity, and enhances digital competency.

Keywords: Artificial intelligence; Augmented reality; Urban sketching; Experiential learning; Urban planning studio

Introduction

The field of urban planning, which is a combination of art and science, is characterized by the diverse academic backgrounds of first-year students, with only a minority possessing prior drawing skills. Consequently, many students find sketching and reflective captioning based on their urban experiences challenging. This innovation reconceptualises these challenges as opportunities for creativity and exploration, thereby fostering enthusiasm, confidence, and active engagement through the integration of AI and AR technology. This project integrates AI-powered animation and AR technology into traditional urban sketching, creating a new form of immersive learning. Aligned with NALI's criteria, this initiative showcases how emerging technologies can transform student learning experiences.

This study is grounded in Experiential Learning Theory (Kolb, 1984) and operationalized through studio pedagogy, the foundation of urban planning education. The framework emphasizes learning as a process of *doing, reflecting, conceptualizing, and experimenting* by students engaging in individual and collective reflection, both in the city and back in the studio (Wong, 2023). Through multiple critique sessions, students develop an understanding of how their sketches, captions, and AR explorations represent the lived experience of the urban public realm. By integrating AI and AR technologies into traditional sketching, the framework enhances both the depth of learning and the enjoyment of the learning process, making the first-year studio more fun, interactive, and motivating (Al Balushi et al.,2024).

Objectives

The aim of this project is to develop an innovative learning approach that integrates AI-powered animation and AR technology with traditional sketches for a more immersive and enjoyable learning experience.

The objectives are:

i. To foster creative learning through innovative sketching practices by integrating AI powered animation and AR technology.
ii. To evaluate how immersive sketching influences students' learning outcomes, motivation, enjoyment and understanding.

NALI Approach

This project presents an innovative teaching method for first-year urban planning studios by integrating AI-animated sketches with augmented reality (AR). The novelty of this approach lies in transforming traditional sketching into digital animation and AR, enabling students to visualize their concepts within the urban environment. This reimagines a familiar task, offering a novel way to experience and comprehend spatial dynamics. The creativity is evident in the fusion of analog and digital techniques, where personal sketches and reflective captions are transformed through AI storytelling prompted by the students and projected into augmented reality (AR). The innovation stems from advancing beyond static drawings and traditional critiques to create an interactive, immersive learning experience, allowing students and peers to engage with animated urban life scenarios. The method's applicability is robust, as it can be extended to 3D urban layout visualization, master plan testing, or placemaking simulation, directly benefiting urban planning practice. The impact is profound, enhancing creativity, motivation, and enjoyment, while also advancing spatial literacy, reflection, and digital fluency.

Research Methodology

The project was conducted in Semester 1 of the 2024/2025 academic year within the First-Year Studio 1: Experiencing Cities and Human Settlements course (SBEW1215) at the Department of Urban and Regional Planning, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia. Selected sketches from Project 1 in Johor Bahru and Project 3 in Melaka were subsequently digitized and integrated with AI-powered animation and Augmented Reality applications. Students first conducted on-site observation and produced analogue urban sketches that documented spatial structure, activity patterns, and distinctive urban elements. These sketches were then digitised and enhanced

through AI-based micro-animation to improve narrative clarity while preserving the original linework. The animated assets were authored into augmented reality, with image triggers and interaction behaviours configured and tested

for reliable mobile delivery. The AR-embedded sketches were subsequently curated and presented in a public exhibition, where visitors engaged the "living sketches" via a smartphone application. Then, students' understanding was evaluated exclusively during AR/AI engagement through a targeted suite of post-intervention questionnaires (n=43); involving conceptual knowledge checks embedded in AR tasks; rubric-based ratings of applied visual reasoning on AR-enhanced posters; and a brief survey of communicative confidence, yielding a robust, point-of-use profile of learning outcomes.

Findings and Discussion

The AR urban sketch project revealed its influence on enjoyment and motivation compared to conventional studio projects where urban public realms were only represented through static drawings. Students reported that combining sketches with AR overlays encouraged them to observe urban environments more closely and articulate human–environment interactions with greater clarity (see Table 1). Many expressed increased confidence in explaining these interactions (Mean: 4.72) and presenting place-based insights (Mean: 4.72), suggesting that the technology strengthened their ability to translate field observations into communicable insights. The immersive qualities of AR further enhanced the learning process by making sketches more interactive and enjoyable, with the highest gains recorded in creativity and enjoyment (Mean: 4.78 each). Visualizations allowed students to simplify and convey complex urban interactions more effectively (Mean: 4.56), while the dynamic overlays revealed new dimensions of human activity that static sketches alone could not capture. Overall, the integration of AR not only deepened students' understanding of urban life but also cultivated motivation, interactivity, and critical observation skills, positioning immersive digital tools as a valuable complement to experiential and studio-based learning in urban planning education.

The findings show that using AR with urban sketches made learning more engaging and enjoyable, while also sharpening students' observation skills, helping them better understand how people and urban spaces interact, and boosting their confidence in explaining complex ideas. AR proved to be a powerful tool that not only made learning clearer but also inspired creativity, motivation, and critical thinking - skills essential for shaping the future of cities.

Table 1: Student Feedback on Augmenting Urban Sketches

	Items	Mean Score
1.	I can explain how people and the built environment influence each other in urban spaces.	4.50
2.	I notice more details about how urban design affects human behavior after engaging with AR	4.61
3.	AR helped me see aspects of human - environment relationships that I had not considered before	4.39
4.	The sketches effectively capture how people interact with the urban environment	4.67
5.	Using AR overlays deepened my understanding of human activity in the spaces.	4.50
6.	I feel more confident identifying human - environment interactions when combining sketches with AR.	4.72
7.	I can clearly explain what the sketches reveal about urban life to others.	4.56
8.	AR visualizations improved my ability to communicate complex urban interactions in a simple way.	4.56
9.	I feel confident using sketches (with AR support) to present place-based insights.	4.72
10.	Using sketches and AR together encouraged me to think more creatively about urban spaces.	4.78
11.	The integration of AR made learning about urban environments more enjoyable.	4.78
12.	Using AR with sketches increased my motivation to learn about human-environment relationships.	4.72

Conclusion

This project demonstrates how immersive technologies can open up design-based learning, enabling all students, not just those with strong drawing skills, to meaningfully engage with urban environments. By merging sketches with AI-powered animation and Augmented Reality, students produced interactive outcomes that enhanced creativity, confidence, and the ability to communicate complex urban experiences. The method contributes to studio pedagogy by lowering barriers to participation and enriching experiential learning with digital innovation. The impact goes beyond classroom learning, revealing a scalable method that can be adapted for community engagement, heritage promotion, and eventually commercialized as an AI+AR educational toolkit, making urban learning more accessible, engaging, and impactful across diverse contexts.

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ID 95: Dynamic Augmented Reality-Based Mathematics Learning Module to Enhance Metacognitive Skills and Problem Solving

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Highlights: This project develops a dynamic mathematics learning module with Augmented Reality (AR) to enhance secondary school students' problem-solving and metacognitive skills. Many students struggle with complex non-routine questions in the KSSM curriculum due to limited ability to plan, monitor, and evaluate their learning. Building on a previous framework, the module integrates pen-and-paper exercises with AR features such as 3D objects, animations, and video explanations to provide guided support without replacing traditional methods. The research involves content design, AR application development, integration, and pilot testing. Expected outcomes include improved student achievement, greater self-directed learning, and a prototype with commercialization potential that supports SDG 4: Quality Education.

Keywords: Augmented reality; Mathematics learning; Problem solving; Metacognition

Introduction

Previous studies show that Malaysian students have difficulties in mathematics problem solving (Abdullah et.al, 2017). One of the factors is because of the lack of metacognitive skills among student (Lestari et.al,2019). It is agreed among researchers that metacognitive skill helps to improve students' performance (Abdullah et.al, 2017; Ariffin,2020). Metacognitive skill is a thinking ability that contributes to positive developmental change in student's decision making as they plan, monitor and evaluate the mathematics problem solving process they undergo (Hartman,2001).

As the world engages with technologies, many tools and applications have been introduced in mathematics education research. The current in-trend technology is Augmented Reality (AR). Based on previous studies, AR is suitable to be implemented in education due to its user friendliness to facilitate the teaching and learning process (Ibanez et.al,2020). The approach used by AR which superimposes computer-generated images on the student's real- world perspective will lead to the understanding of complex concepts especially those involving mathematics topics. This will help to support and trigger the process of metacognitive skills. This situation will make students eager to learn and more focused as they already understand the content and just need guidance to arrange their knowledge and strategies accordingly by planning, monitoring and evaluating in the problem-solving process (Ibanez et.al,2020).

Objectives

The following are the objectives of this project:

i. To develop the content and AR application of dynamic mathematics learning module
ii. To merge the mathematics module with AR application
iii. To implement to real target users

NALI Approach

Novelty

The novelty of this project lies in its integration of Augmented Reality with metacognitive regulation which are planning, monitoring, and evaluating to directly support students' problem-solving processes. Unlike existing AR applications that focus mainly on content delivery or motivation, this module is specifically designed to scaffold metacognition in mathematics problem solving. It adopts a hybrid learning approach that blends authentic pen-and-paper tasks with AR triggers, ensuring alignment with Malaysia's paper-based examination system while enriching it with interactive digital support. Furthermore, the module is designed for low-cost, smartphone-based use, making it practical and accessible for Malaysian classrooms without the need for advanced laboratory facilities.

Applicability

The AR-integrated mathematics module is highly applicable within the Malaysian education system as it is designed to align with the Form 4 Mathematics curriculum under KSSM. Its structure allows seamless integration into classroom teaching, where teachers can combine AR features with traditional pen-and-paper learning. Beyond the classroom, the module also supports independent learning, enabling students to self-study at home using the AR application together with the workbook. In addition, it serves as a valuable remedial tool, providing targeted support for weaker students to strengthen their metacognitive and problem-solving skills.

Creativity

The creativity of the AR module lies in its unique scaffolding approach, where the technology does not provide direct answers but instead guides students' learning through the metacognitive strategies of planning, monitoring, and evaluating. To enhance engagement, the module incorporates avatars that act as virtual guides, providing prompts and encouragement as students' progress through problem-solving tasks. In addition, interactive AR activities are carefully designed to trigger learning in each metacognitive phase, ensuring that students develop stronger cognitive awareness while solving mathematical problems.

Research Methodology

This study employed a quantitative, quasi-experimental design using a pre-test and post-test control group approach to investigate the integration of augmented reality (AR) in enhancing students' metacognitive skills and mathematical problem-solving. Two groups of students (n=60) were assigned as the experimental group (integrated AR) and the control group (module). Data were collected using the Metacognitive Awareness Inventory (MAI) adapted from Schraw and Dennison (1994), which measured three components: planning, monitoring, and evaluating. Due to the non-normal distribution of data, the Mann-Whitney U test was used to compare differences in metacognitive skills and performance between the two groups before and after the intervention through pre-test and post-test.

Findings and Discussion

Data were collected using the Metacognitive Awareness Inventory (MAI) adapted from Schraw and Dennison (1994) to measure students' metacognitive skills in planning, monitoring, and evaluating. Since the data were not normally distributed, the Mann–Whitney U test was used to compare pre- and post-test scores between the control and experimental groups.

Table 1: Mann-Whitney U Test Results Comparing Student Performance Between Experimental (AR) and Control Groups

Test	Group	Sample	Mean	Mean Rank	U Value	P-value	Sig
Pre-test	Control	30	10.13	31.75	412.5	0.578	not sig
	Experimental		9.27	29.25			
Post-test	Control	30	11.67	21.42	221.0	<.001	sig
	Experimental		18.20	39.58			

The analysis showed no significant difference in pre-test scores between the experimental group (AR integration) and the control group (module), $U = 412.5$, $p = .578$. This indicates that both groups started at a similar baseline. In contrast, the post-test results revealed a significant difference, $U = 221.0$, $p < .001$, with the experimental group achieving higher scores. Across all three components of metacognitive skills, the experimental group consistently obtained higher mean ranks compared to the control group ($p < .001$). Low U-values and large negative Z-scores confirmed substantial differences between groups. These results suggest that integrating augmented reality (AR) as a learning tool significantly improved students' metacognitive skills during problem-solving.

Table 2: The difference of student metacognitive skills using Mann-Whitney U Test

Variable	Group	Mean	U statistic	Z score	Mean Rank	P-value sig (2-tailed)
Planning	Control	5.75	140.00	-5.007	20.88	<.001
	Experimental	16.63			44.13	
Monitoring	Control	4.34	112.00	-5.386	20.00	<.001
	Experimental	15.50			45.00	
Evaluating	Control	2.16	41.50	-6.364	17.80	<.001
	Experimental	18.93			47.20	

Integrating an AR in learning showed students greater ability to plan problem-solving strategies, monitor progress, and evaluate performance, compared to those who relied on module based instruction. These findings support previous research by Naik & Panda (2024) that emphasizes the effect of AR-based learning environments on metacognitive awareness. Moreover, large effect sizes ($r > 0.5$) highlight the practical significance of the intervention beyond statistical differences. Overall, integrating AR in learning mathematics can actively engages learners in reflective thinking and self-monitoring (Kuncoro et al., 2024), making it a powerful tool for developing metacognitive skills (Rahman& Setyaningrum,2022). However, this study is limited by its sample size. Future research should examine the long-term effects of AR-based learning and explore its application across different mathematical topics and grade levels.

Conclusion

This process improves their mathematical problem-solving performance. The statistical analysis demonstrated significant differences between the experimental and control groups, confirming that intervention AR as learning tools can effectively foster deeper cognitive engagement and better learning outcomes. These findings highlight the potential of AR technology to enrich educational practices in mathematics and suggest further exploration of its applications across different subjects and other mathematics topics.

Acknowledgement

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ID 98: Write, Play, Repeat: AI-Assisted Gamified Writing with ZEP Quiz

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Highlights: ZEP Quiz is redefining how ESL writing preparation can be conducted in today's classrooms. Instead of relying on static drills or memorized prompts, learners enter gamified quiz rooms where writing questions are generated using free AI tools such as ChatGPT and Gemini. Each session offers a variety of fresh tasks that encourage students to approach writing as a challenge rather than a chore. This combination of AI-generated content and ZEP Quiz's gamified design allows learners to practice in a playful, low-stress environment while still receiving instant feedback and retry opportunities. Teachers benefit from reduced preparation time and can focus more on guiding and supporting learners. Classroom observations revealed that students remained highly motivated, actively requested additional activities, and showed greater willingness to tackle new writing prompts. These outcomes suggest that blending AI-assisted content creation with gamified design does more than boost participation. It builds confidence, fosters resilience, and points toward a future where writing practice is both effective and enjoyable.

Keywords: Gamification; Artificial intelligence; ESL writing; Student Engagement

Introduction

ESL writing preparation has always played a critical role in language classrooms, particularly for learners facing high- stakes assessments such as the Cambridge Linguaskill Test. Conventional approaches like drills and structured practice tasks have served their purpose well in reinforcing writing form and accuracy. However, in the Gen Z era, these methods present new challenges for instructors: sustaining motivation among digital-native learners, meeting their expectations for interactivity, and providing timely, personalized feedback. Gamification has consistently been shown to enhance student performance and motivation, making it a highly relevant approach for addressing these challenges (Zeng et al., 2024). Students today often seek variety, instant responses, and engaging formats that align with how they naturally interact with technology.

To address these challenges, this project integrates free AI tools such as ChatGPT and Gemini to generate writing questions, which are then delivered within ZEP Quiz's gamified environment. Learners enter quiz rooms as avatars, respond to diverse AI-generated tasks, and receive real-time feedback. The combination of AI-generated content and gamified design delivers a fresh, adaptive, and motivating learning landscape that redefines writing preparation and helps build learner confidence.

Objectives

The objectives of the teaching innovation are:

i. To transform conventional writing drills into an AI-assisted gamified experience that sustains learner motivation.
ii. To enhance students' writing confidence and performance through instant, personalized feedback.

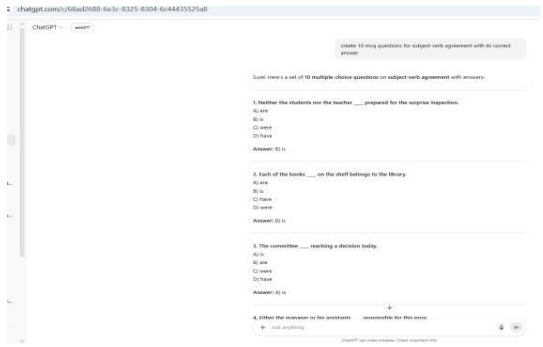
NALI Approach

This project leverages AI-generated writing prompts delivered through ZEP Quiz to create a fresh and engaging model of practice. Instead of relying solely on teacher-prepared drills, the system provides varied prompts that are refreshed for each session, reducing preparation time while offering adaptive challenges. Writing activities are framed as mission-style challenges with avatars, sounds, and leaderboards, making practice both interactive and immersive. Learners benefit from retry options, instant scoring, and task variety, while teachers gain insights from analytics. The approach is flexible across different writing topics and proficiency levels, low-cost, and simple to implement. Classroom observations showed that learners remained motivated, requested additional sessions, felt less anxious, and became more willing to attempt challenging prompts. This demonstrates how AI-assisted practice delivered through ZEP Quiz can empower and transform the writing experience.

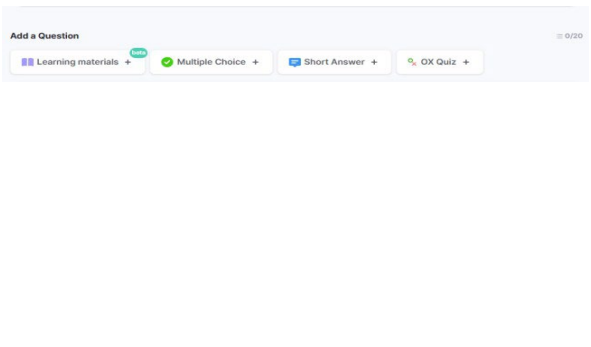
Research Methodology

The project was implemented in an Intensive English Programme (IEP) classroom with international ESL students (CEFR A2–B2) preparing for the Cambridge Linguaskill Writing Test. Teachers generated varied writing prompts using AI tools such as ChatGPT and Gemini, then delivered these prompts through ZEP Quiz by designing gamified quiz rooms with avatars, maps, and other game elements. Students entered these quiz rooms and responded to AI-generated tasks in an immersive, playful environment. Qualitative data were collected from student reflections and short surveys, while instructor observations

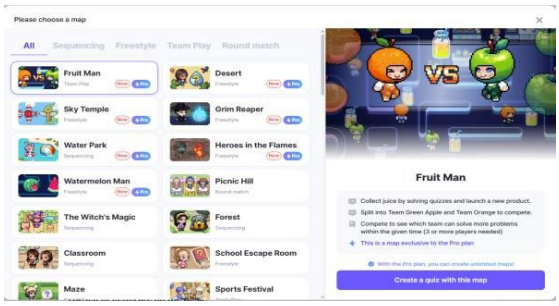
documented engagement, motivation, and confidence. Analysis focused on learners' responses and instructors' reflections on efficiency and scalability of the approach.



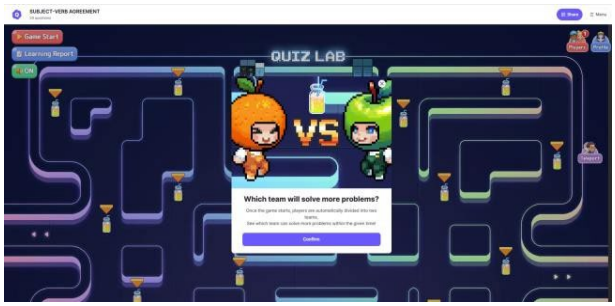
Step 1: Generate questions using AI tools



Step 2: Import questions into ZEP Quiz



Step 3: Customization of the map and publish



Step 4: Enter and prepare to play

Findings and Discussion

Student reflections revealed that playing AI-assisted questions within ZEP Quiz significantly reshaped their writing experience. Learners consistently described the activities as joyful, fun, and engaging, noting that the competitive elements such as avatars, missions, and leaderboards sustained their motivation throughout the module. Several students highlighted that the variety of AI-assisted prompts helped them recall writing points better and made practice feel fresh, rather than repetitive. Importantly, some students reported reduced stress (Jaramillo-Mediavilla et al., 2024) and greater willingness to attempt challenging tasks when writing was framed as a game-like experience. At the same time, a few expressed initial confusion and suggested the need for clearer instructions or additional writing-based tasks, emphasizing opportunities for refinement. Overall, gamified practice with AI-assisted questions maintained motivation, fostered confidence, and encouraged additional sessions, proving its transformative potential. These findings align with recent research showing that gamification has a significant positive impact on student engagement and performance. In ESL and EFL contexts, game elements such as avatars, missions, and leaderboards have been shown to reduce anxiety and enhance persistence (Zhang & Hasim, 2023; Chan & Lo, 2024).

From the instructor's perspective, the AI-assisted question creation process allowed for rapid generation of varied prompts, enabling swift responses to students' requests for more practice. This efficiency reduced preparation time and allowed teachers to focus on guiding and supporting learners. Observations also showed that students became highly engaged and competitive when navigating ZEP Quiz maps, often striving to overtake their peers, which further fueled persistence and participation. These insights reinforce how combining gamified design in ZEP Quiz with AI- assisted content creation can transform writing practice into a dynamic and motivating experience. The approach is also highly scalable, as similar activities can be replicated easily across other courses and proficiency levels.

Commercialization Potential

Beyond classroom implementation, the innovation holds potential for broader dissemination and practical application. Integrating AI-assisted question creation with gamified writing tasks on ZEP Quiz can be packaged into professional development workshops and training modules for ESL instructors, equipping educators with practical strategies to implement engaging, adaptive writing practice in their own classrooms. Additionally, a repository of AI-assisted writing quizzes tailored to different proficiency levels could be developed as a digital resource for institutions. By combining training, resource development, and consultancy, this approach can be scaled beyond individual classrooms to support diverse ESL and IEP programs, demonstrating both educational impact and real-world applicability.

In addition, the project is closely aligned with the presenter's role as a Global ZEP Quiz Ambassador, which provides a unique platform to advocate for innovative teaching practices. By showcasing this project in national innovation competitions and through professional networks, the initiative has the potential to increase visibility, encourage uptake

among Malaysian educators, and position Malaysia more prominently in the global gamification and AI- driven learning community.

Conclusion

This project demonstrates how gamification through ZEP Quiz can transform writing instruction from repetitive drills into engaging and meaningful practice. The approach enhances learner motivation, strengthens writing accuracy, and provides a scalable model that can be adapted across ESL and IEP contexts. These findings align with recent studies confirming that gamification and AI-driven learning design significantly improve engagement and academic performance (Zeng et al., 2024; Zhang & Hasim, 2023). Furthermore, the author's role as a ZEP Quiz Global Ambassador highlights the project's potential for international visibility and uptake, especially in Malaysia where adoption remains limited compared to neighboring countries. Ultimately, this innovation contributes to the global conversation on technology-enhanced learning by merging classroom needs with digital practices that are both impactful and sustainable.

Acknowledgement

We would like to express our sincere gratitude to the Language Academy, Faculty of Social Sciences and Humanities, for sponsoring and supporting our participation in NALI. The presenter also acknowledges the Global ZEP Quiz Ambassador platform, which has provided opportunities to showcase, scale, and advocate for the integration of AI-driven gamification in language education both locally and internationally.

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ID 101: Empowering Students with Disabilities through AIU's 3Zero Project: A Community-Based Innovation in Skill Development and Social Entrepreneurship

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Highlights: This project empowers students with disabilities at PDK Telok Chengai, PDK Tanjung Bendahara, and PDK Mutiara Indah through hands-on training in eco-friendly soap-making, upcycled product creation, and transforming used cooking oil into candles. Facilitated by the Student Empowerment and 3Zero Committee of AIU's School of Business and Social Sciences, the initiative engages university students under the 3Zero philosophy to nurture entrepreneurial skills, self-reliance, and community-based social enterprise models. It also showcases how inclusive communities can contribute to climate change mitigation, embrace low-carbon lifestyles, and advance the Sustainable Development Goals (SDGs) while fostering sustainability, empowerment, and resilience.

Keywords: Community Engagement; Students with Disabilities; Empowerment; Social Entrepreneurship; Student-Centered Learning; Inclusive Innovation

Introduction

The "Solutions in Action" initiative by Albukhary International University (AIU) introduces an innovative approach to inclusive education and community empowerment. Through the 3Zero Project, international and local students from AIU collaborated to deliver hands-on training in eco-friendly soap-making, upcycling, and scented candle production for students with disabilities at PDK Telok Chengai, PDK Tanjung Bendahara, and PDK Mutiara Indah. At PDK Telok Chengai, participants learned to produce eco-friendly soap with the potential to be developed into a social business. At PDK Tanjung Bendahara, the training focused on repurposing discarded fabrics into mats, dusters, and recycled bags from unused clothes, while at PDK Mutiara Indah, participants explored transforming used cooking oil into scented candles.

These programmes not only promoted sustainable crafting and eco-friendly entrepreneurship but also nurtured creativity, innovation, and real-world entrepreneurial skills among participants. The initiative integrates novelty (community-based skill training), creativity (upcycled product design), innovativeness (social enterprise model), applicability (practical entrepreneurial learning), and impact (student and community empowerment). By aligning with the NALI framework, this effort reinforces AIU's commitment to inclusive education, sustainability, and building resilient communities.

Objectives

The primary objective of this dual-site initiative was to empower students with disabilities in Kedah by equipping them with practical, skill-based training that fosters both economic independence and environmental sustainability. Through hands-on workshops in eco-friendly soap-making, upcycled product creation, and scented candle production using recycled cooking oil, the project introduced low-cost entrepreneurial skills that participants could readily apply in their daily lives. This approach not only built self-reliance and confidence among PDK students but also offered AIU students meaningful experiential learning opportunities in the field of community development.

By engaging directly with the communities at PDK Telok Chengai, PDK Tanjung Bendahara, and PDK Mutiara Indah, AIU students were able to apply classroom knowledge in real-world contexts, enhancing their leadership, empathy, and teamwork skills. The initiative also explored the potential for establishing community-led social enterprises, creating pathways for sustainable long-term impact. Furthermore, the project strengthened university-community partnerships while embodying AIU's 3Zero Philosophy: Zero Poverty, Zero Unemployment, and Zero Net Carbon Emission, reaffirming the university's commitment to inclusive growth and sustainable development.

NALI Approach

This project exemplifies the New Academia Learning Innovation (NALI) framework by integrating novelty, creativity, and impact within a community-based, experiential learning context. The initiative introduced a novel three-site model, engaging disabled participants at PDK Telok Chengai, PDK Tanjung Bendahara, and PDK Mutiara Indah in hands-on workshops that were both skill-oriented and socially meaningful. Each programme showcased creativity in reimagining everyday or discarded materials into functional products: eco-friendly soap at Telok Chengai, upcycled mats and dusters from fabric remnants at Tanjung Bendahara, and scented candles derived from used cooking oil at Mutiara Indah. These activities not only promoted sustainable practices but also encouraged participants to view waste as a resource for innovation.

The innovativeness of the project lies in its integration of skill-building with elements of social entrepreneurship. Beyond production, participants were exposed to aspects of product development such as pricing, packaging, and potential

marketing strategies, thereby positioning the training as a bridge between learning and livelihood opportunities. The applicability of the approach is evident in its responsiveness to local needs and its potential for scalability, as the skills imparted are directly transferable to income-generating ventures. The impact was multidimensional: PDK participants enhanced their confidence, independence, and employability, while AIU students developed empathy, leadership, and teamwork through immersive service learning experiences. Overall, the project aligns with inclusive and student- centred pedagogical practices (Winthrop et al., 2019) and contributes to sustainable, community-based entrepreneurship (Zeleke et al., 2020).

Research Methodology

This project adopted a participatory and experiential learning model that emphasised collaboration, contextual relevance, and reflective practice. A comprehensive needs assessment was first conducted to examine the skills, resources, and interests of disabled participants across three community rehabilitation centres (PDKs). The findings informed the design of context-specific training modules jointly developed by AIU faculty and students. Three programmes were subsequently implemented: soap-making at PDK Telok Chengai, fabric upcycling at PDK Tanjung Bendahara, and the transformation of used cooking oil into scented candles at PDK Mutiara Indah. Each programme was delivered through practical, hands-on workshops that allowed participants to directly engage with the materials, experiment with techniques, and enhance their confidence in applying newly acquired skills.

Post-training, structured reflection and feedback sessions were conducted to critically assess the learning outcomes, capture participants' experiences, and identify areas for improvement. Continuous mentorship was provided by members of the Students Empowerment and 3Zero Committee, who offered guidance on the potential scaling of these initiatives into sustainable social enterprises. This methodological approach not only facilitated skill acquisition but also enabled mutual learning and strengthened collaborative ties between the university and the local communities (Kolb, 2014; Bringle & Hatcher, 2011).

Findings and Discussion

The three-site community engagement initiative generated a range of meaningful outcomes for both the PDK participants and the AIU student facilitators. At PDK Telok Chengai, the soap-making workshop was met with high levels of enthusiasm and interest. Several participants indicated a desire to continue producing soap as a potential source of income, suggesting the programme's viability as a micro-entrepreneurial activity. At PDK Tanjung Bendahara, the fabric upcycling workshop fostered creativity and environmental awareness, as participants successfully transformed discarded textiles into functional household items such as mats and dusters. This not only promoted sustainable practices but also instilled a sense of pride in producing items with practical value. Meanwhile, at PDK Mutiara Indah, the scented candle-making activity, which repurposes used cooking oil, sparked curiosity among participants and highlighted innovative approaches to waste reduction. The initiative demonstrated how locally available materials can be reimagined to generate new economic and social value.

For AIU students, the engagement was transformative, offering an opportunity to apply classroom-based knowledge in authentic, community-driven settings. Students reported notable growth in empathy, communication, teamwork, and leadership, while also deepening their understanding of the complexities of community development and inclusive education. This outcome aligns with experiential learning theory, which emphasises the importance of active participation and critical reflection in fostering meaningful learning experiences (Kolb, 2014).

The initiative also contributed to strengthening institutional-community linkages. Feedback from participants, facilitators, and community leaders emphasised the programme's relevance, accessibility, and effectiveness in enhancing local skills. The mentorship provided by the Student Empowerment and 3Zero Committee further reinforced participants' confidence in exploring the potential of these activities as small-scale social enterprises. Beyond immediate skill acquisition, the project highlighted the adaptability and low-cost scalability of the model, making it a promising framework for replication in other PDK centres. Importantly, its alignment with the principles of inclusive development and the United Nations Sustainable Development Goals positions the initiative as both socially responsible and forward-looking (Bringle & Hatcher, 2011; UNESCO, 2020).

Other Information

The three-site initiative at PDK Telok Chengai, PDK Tanjung Bendahara, and PDK Mutiara Indah demonstrates strong potential for commercialisation and long-term sustainability. The products developed an eco-friendly dishwashing soap, upcycled household items such as mats and dusters, and scented candles made from repurposed cooking oil, and they are not only practical but also resonate with the growing demand for environmentally responsible goods. With appropriate branding, continuous skills training, and access to local and digital markets, these outputs could be transformed into viable community-based social enterprises. Their unique value proposition lies in combining functionality with social and environmental impact, thereby appealing to both mainstream and socially conscious consumers.

The initiative has received institutional endorsement from Albukhary International University (AIU) leadership and support from ACE-SEDI, underscoring its credibility and alignment with AIU's broader mission. Its innovative integration of inclusive education, sustainability, and community empowerment positions it as a strong contender for future recognition in the areas of social entrepreneurship, sustainability, and educational innovation. Furthermore, the project reflects the university's 3 Zero Philosophy, which includes the Zero Poverty, Zero Unemployment, and Zero Net Carbon Emission by promoting skill-based empowerment, low-carbon practices, and circular use of resources. The replicable and cost-effective model strengthens

its scalability across other PDKs and similar community settings, expanding its relevance and impact well beyond the initial implementation.

Acknowledgement

We would like to express our heartfelt gratitude to the communities of PDK Telok Chengai, PDK Tanjung Bendahara and PDK Mutiara Indah for their enthusiastic participation and openness to collaboration. Special thanks to the Department of Social Welfare (JKM) for their continued support in facilitating these community engagement programs. We also acknowledge the invaluable contributions of the Students Empowerment and 3Zero Committee under the School of Business and Social Sciences (SBSS) at Albukhary International University (AIU). Their dedication, creativity, and leadership were instrumental in the success of this initiative.

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ID 102: Modul Kenali, Ekplorasi dan Refleksi Kecerdasan Buatan (AI)

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Sorotan: AI dalam Pendidikan perlu diterapkan seawal mungkin bagi menyediakan generasi akan datang yang Celik AI, berintegriti serta cakna mengenai kemampuan AI. Modul Kenali, Eksplorasi dan Refleksi Kecerdasan Buatan AI yang berasaskan pendekatan pembelajaran berasaskan projek dan pertandingan untuk meransang kreativiti, penglibatan holistik, dan etika penggunaan AI telah dihasilkan. Modul telah digunakan oleh 60 orang pelajar menengah rendah dan dapatan menunjukkan lebih 90% pelajar mencapai peningkatan kognitif, afektif, psikomotor, dan penglibatan, manakala lebih 95% menyedari kepentingan etika penggunaan AI. Modul ini juga berjaya merangsang kreativiti pelajar dalam menghasilkan animasi dan buku cerita elektronik yang menerapkan nilai murni dalam kalangan pelajar.

Kata Kunci: Kecerdasan buatan; Kreativiti; Modul

Pengenalan

Perkembangan teknologi digital yang pesat, khususnya kecerdasan buatan (AI), menuntut pelajar membina literasi teknologi sejak awal. Walaupun AI semakin banyak diaplikasikan dalam kehidupan seharian, pendekatan sistematik untuk memperkenalkan AI di peringkat menengah rendah masih terhad. Projek ini memfokuskan kepada penghasilan **modul pembelajaran kendiri berasaskan projek** yang menyepadukan asas pengetahuan AI, eksplorasi aplikasi generatif, nilai murni dan etika serta integriti.

Modul ini menekankan peranan guru sebagai fasilitator, manakala pelajar diberi ruang untuk bereksperimen, mencipta, dan merefleksi. Dengan menggabungkan aktiviti kreatif seperti penghasilan animasi dan buku cerita elektronik menggunakan AI, modul ini bukan sahaja meningkatkan pengetahuan kognitif, malah mengembangkan keterampilan afektif, psikomotor, kreativiti, serta kesedaran etika. **Keaslian modul ini terletak pada pedagogi berasaskan projek mengitegrasikan aplikasi AI, nilai murni dan integriti serta mesra pelajar menengah rendah.**

Objektif

Objektif projek ini ialah:

i. Memperkenalkan konsep asas AI dalam kalangan pelajar sekolah menengah rendah
ii. Menganalisis penglibatan pelajar dalam pembelajaran menggunakan AI
iii. Menerapkan kesedaran etika dalam penggunaan AI
iv. Menganalisis kesan pembelajaran menggunakan AI terhadap kreativiti pelajar

Pendekatan NALI

Keaslian:

Keaslian modul ini terserlah melalui **pendekatan pembelajaran berasaskan projek yang mengintegrasikan AI** dan disesuaikan dengan pelajar menengah rendah, di samping memasukkan elemen pertandingan untuk menarik minat serta perhatian mereka. **Modul ini juga unik kerana ia bukan sahaja mendedahkan pelajar dengan aplikasi AI untuk meningkatkan kreativiti dan penglibatan pelajar secara holistik (kognitif, afektif dan psikomotor), malah ia memupuk nilai etika dan integriti penggunaan aplikasi AI.**

Inovatif:

Modul ini direka bentuk sebagai **modul pembelajaran kendiri dengan pendekatan pedagogi berasaskan projek** yang disertakan dengan elemen permainan. Ia mengintegrasikan penggunaan AI bagi merangsang dan meningkatkan kreativiti pelajar melalui aktiviti interaktif dan penghasilan produk digital.

Kebolehgunaan:

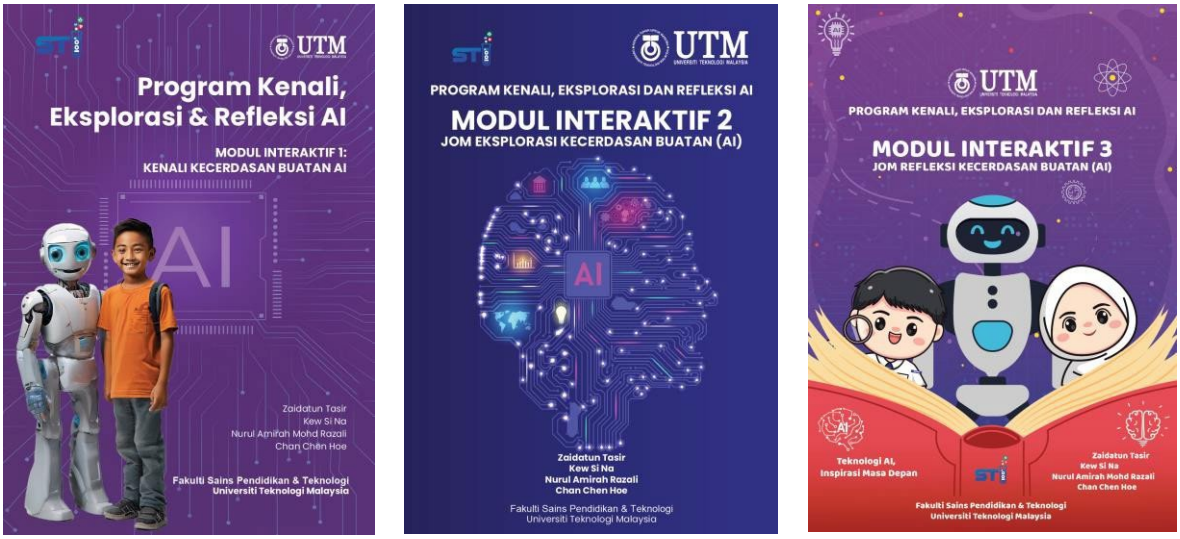
Modul ini boleh digunakan secara kendiri oleh pelajar untuk **meningkatkan kreativiti mereka** dalam pembelajaran, di samping berfungsi sebagai modul pengajaran yang boleh dimanfaatkan oleh guru bagi membimbing pelajar meneroka aplikasi AI dengan cara yang berstruktur dan menyeronokkan.

Modul ini mempunyai 3 siri seperti yang dinyatakan dalam Jadual 1.

Jadual 1: Modul

Modul	Kandungan
Modul 1: Kenali Kecerdasan Buatan AI	Kenali AI menerusi aplikasi Grab, penggunaan ChatGPT dalam menghasilkan bahan pembelajaran

Modul	Kandungan
Modul 2: Eksplorasi Kecerdasan Buatan AI	Eksplorasi aplikasi AI dalam menghasilkan animasi seperti hailuoai.video, Canva, ChatGPT, Veed, CapCut, FlexClip, Ai Music, AiVOOV, D-ID AI Presenters etc.
Modul 3: Refleksi Kecerdasan Buatan AI	Kemahiran menghasilkan buku cerita kanak-kanak secara elektronik yang memfokuskan kepada topik persahabatan, nilai murni, penjagaan alam sekitar etc. Refleksi AI juga memfokuskan kepada etika dan integriti menggunakan AI dan pelajar akan menghayati penggunaan AI sepenuhnya.



Rajah 1: Modul

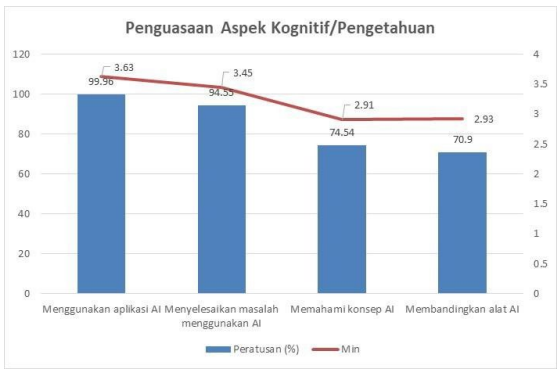
Metodologi Kajian

Kajian ini menggunakan pendekatan kuantitatif yang melibatkan pemungutan data menerusi soalselidik. Analisis deskriptif iaitu min dan peratus digunakan untuk menganalisis data bagi menjawab objektif kajian. Kajian dilaksanakan sebanyak 3 sesi yang berbeza dan setiap sesi mengambil masa 3-4 jam. Seramai 60 orang pelajar menengah rendah terlibat dalam kajian menguji kesan modul dalam pembelajaran pelajar.

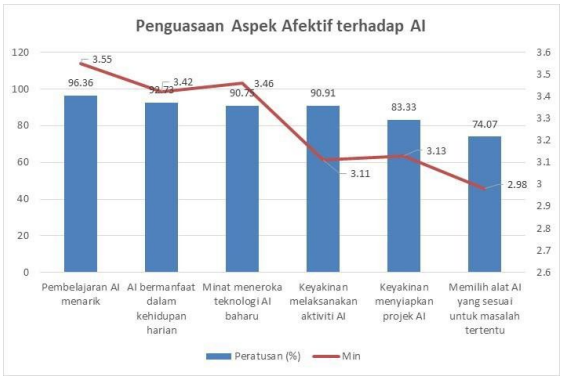
Dapatan Kajian dan Perbincangan

i. *Penguasaan Kognitif tentang AI*

Pelajar menunjukkan tahap keyakinan tertinggi dalam menggunakan aplikasi AI (99.96%, min = 3.63) dan menyelesaikan masalah menggunakan AI (94.55%, min = 3.45). Walau bagaimanapun, tahap penguasaan lebih rendah dalam memahami konsep AI seperti model keputusan (74.54%, min = 2.91) dan membandingkan alat AI untuk situasi tertentu (70.90%, min = 2.93). Secara keseluruhan, pelajar menunjukkan penguasaan kognitif yang baik tentang AI, dengan beberapa aspek yang masih memerlukan penambahbaikan (Rujuk Rajah 2).



Rajah 2



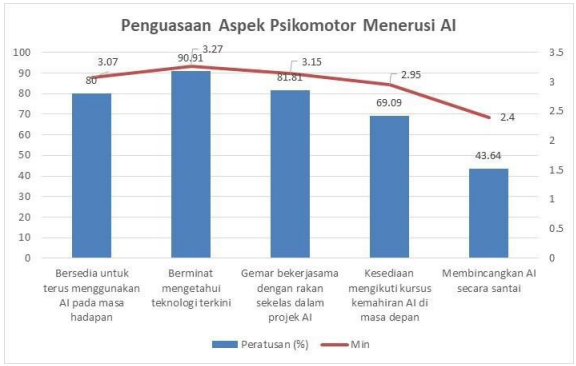
Rajah 3

ii. *Penguasaan Afektif tentang AI*

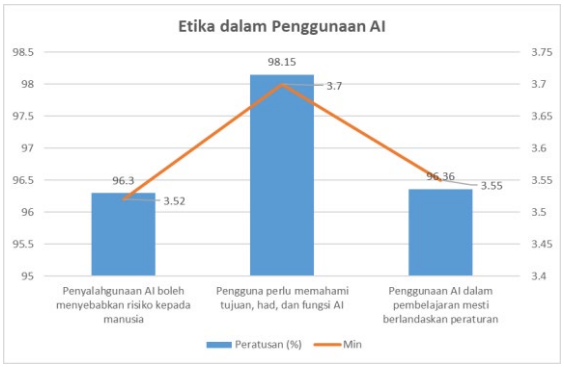
Pelajar mempunyai sikap yang sangat positif terhadap AI dan menganggap pembelajaran AI bukan sahaja menarik (96.36%, min = 3.55), malah bermanfaat dalam kehidupan harian mereka, sama ada untuk sekolah atau hobi (92.73%, min = 3.42). Minat terhadap teknologi AI juga mengagumkan, dengan ramai pelajar bersetuju bahawa mereka ingin meneroka teknologi AI yang baharu (90.75%, min = 3.46). Majoriti yakin mereka boleh melaksanakan aktiviti AI dengan baik (90.91%, min = 3.11), keyakinan terhadap kemampuan menyiapkan projek AI (83.33%, min = 3.13) dan memilih alat AI yang sesuai untuk menyelesaikan masalah (74.07%, min = 2.98) masih berada pada tahap sederhana (Rujuk Rajah 3).

iii. *Penguasaan Psikomotor tentang AI*

Pelajar menunjukkan tahap penguasaan psikomotor yang positif terhadap Kecerdasan Buatan (AI). Sebahagian besar pelajar bersedia untuk terus menggunakan AI pada masa hadapan (80%, min = 3.07) dan berminat mengetahui teknologi terkini (90.91%, min = 3.27). Selain itu, mereka juga gemar bekerjasama dengan rakan sekelas dalam tugasan atau projek AI (81.81%, min = 3.15). Walaupun begitu, kesediaan untuk mengikuti kursus kemahiran AI di masa depan agak sederhana (69.09%, min = 2.95), menunjukkan keperluan untuk lebih banyak program yang menarik minat pelajar dalam mendalami kemahiran ini. Namun, AI masih belum menjadi topik yang sering dibincangkan secara santai dalam kalangan pelajar, dengan hanya 43.64% yang bersetuju atau sangat bersetuju (min = 2.4). Ini mencerminkan perlunya usaha untuk menjadikan AI lebih relevan dalam kehidupan harian mereka, seperti melalui aktiviti interaktif atau perbincangan Santai (Rujuk Rajah 4).



Rajah 4



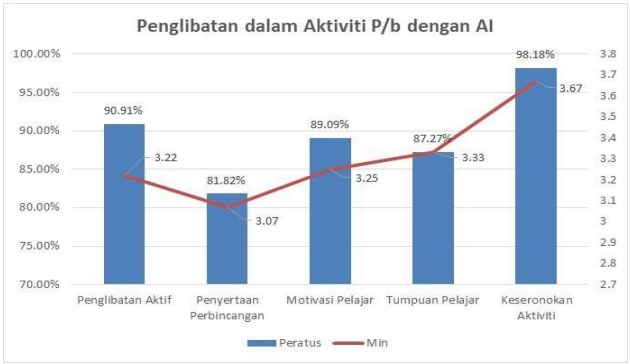
Rajah 5

iv. *Etika dalam Penggunaan AI*

96.3% pelajar bersetuju atau sangat bersetuju (min = 3.52) bahawa penyalahgunaan AI boleh menyebabkan risiko kepada manusia. Ini menunjukkan pemahaman yang baik tentang potensi bahaya AI jika disalahgunakan. Selain itu, 98.15% pelajar bersetuju atau sangat bersetuju (min = 3.70) bahawa pengguna perlu memahami tujuan, had, dan fungsi AI. Ini menekankan kepentingan literasi digital dalam memastikan AI digunakan secara bertanggungjawab. Di samping itu, 96.36% pelajar bersetuju atau sangat bersetuju (min = 3.55) bahawa penggunaan AI dalam pembelajaran mesti berlandaskan peraturan. Ini menunjukkan kesedaran yang jelas tentang keperluan panduan etika untuk mengelakkan penyalahgunaan teknologi dalam konteks Pendidikan (Rujuk Rajah 5).

v. *Penglibatan dalam Aktiviti Pembelajaran berasaskan AI*

90.91% pelajar bersetuju atau sangat bersetuju (min = 3.22) bahawa mereka terlibat secara aktif dalam aktiviti yang diberikan, manakala 81.82% pelajar bersetuju atau sangat bersetuju (min = 3.07) bahawa mereka mengambil bahagian dalam perbincangan aktiviti. Selain itu, 89.09% pelajar bersetuju atau sangat bersetuju (min = 3.25) bahawa mereka bermotivasi untuk menyiapkan aktiviti yang diberikan, menunjukkan komitmen yang tinggi terhadap tugasan yang dilakukan. Dalam aspek tumpuan, 87.27% pelajar bersetuju atau sangat bersetuju (min = 3.33) bahawa mereka sentiasa menumpukan perhatian dalam aktiviti yang diberikan, sementara 98.18% pelajar bersetuju atau sangat bersetuju (min = 3.67) bahawa mereka merasa seronok dengan aktiviti tersebut. Secara keseluruhan, dapatan ini mencerminkan keberkesanan aktiviti pembelajaran berasaskan AI dalam meningkatkan penglibatan, motivasi, dan keseronokan pelajar, walaupun terdapat sedikit ruang untuk memperbaiki penyertaan dalam perbincangan dan tumpuan sepenuhnya (Rujuk Rajah 6).



Rajah 6

vi. *Kreativiti pelajar dalam menghasilkan aktiviti bengkel*

Majoriti responden memberikan maklum balas positif terhadap peranan AI dalam meningkatkan kreativiti penghasilan animasi. Secara keseluruhan, peratusan responden yang bersetuju (Setuju dan Amat Setuju) adalah sangat tinggi, melebihi 80% untuk setiap soalan. Contohnya, 93.94% responden bersetuju bahawa AI membantu mereka mencuba pelbagai gaya dan teknik baharu dalam penghasilan animasi (Q3), dan 100% responden bersetuju bahawa AI membantu mencipta animasi yang lebih unik dan berbeza daripada rakan-rakan mereka (Q4). Selain itu, 90.91% responden juga bersetuju bahawa penggunaan AI memberi mereka lebih banyak masa untuk fokus pada aspek kreatif (Q6), manakala 90.91% bersetuju bahawa AI membantu menghasilkan animasi dengan cepat tanpa

mengurangkan kreativiti (Q10). Responden turut merasakan bahawa AI memudahkan mereka menghasilkan animasi yang lebih kompleks (90.91%, Q8) dan memberikan inspirasi untuk mencipta jalan cerita atau konsep yang lebih kreatif (93.94%, Q9).

Kesimpulan

Secara keseluruhan, tahap penguasaan pelajar dalam pembelajaran berasaskan AI adalah seimbang dan positif merangkumi aspek kognitif, afektif, psikomotor, etika, dan penglibatan. Dari segi kognitif, pelajar menunjukkan kemampuan yang baik dalam memahami, menganalisis, dan melibatkan diri secara aktif dalam aktiviti pembelajaran. Dalam aspek afektif, pelajar mempamerkan motivasi yang tinggi serta emosi positif, menjadikan mereka lebih bersemangat dan seronok dalam menyelesaikan tugasan. Dari sudut psikomotor, pelajar berjaya mengaplikasikan kemahiran praktikal dengan baik, menunjukkan penguasaan yang berkesan dalam melaksanakan aktiviti secara fizikal. Dalam dimensi etika, pelajar menunjukkan sikap bertanggungjawab, komitmen, dan profesionalisme sepanjang proses pembelajaran. Akhir sekali, dari aspek penglibatan, pelajar mengambil bahagian secara aktif dalam aktiviti dan perbincangan, walaupun terdapat ruang untuk memperbaiki interaksi yang lebih mendalam. Secara keseluruhannya, pelajar menunjukkan penguasaan yang baik dalam semua aspek pembelajaran, menjadikan pendekatan ini berkesan untuk pembangunan holistik mereka.

Maklumat Lain

Projek ini telah menerima dana permulaan projek daripada MOSTI menerusi Projek STI 100³: Saintis Turun ke Sekolah. Hasil akhir pelajar boleh dicapai menerusi pautan https://padlet.com/jharun2017/pertandingan-buku-cerita- interaktif-qqeey6xlybww0w3g

Potensi Komersialisasi

Modul berpotensi dikomersialkan sebagai modul cetakan atau elektronik.

Penghargaan

Penghargaan kepada pihak MOSTI yang menaja projek ini dan juga SMK Bandar Tenggara 2 sebagai sekolah rintis.

Hak Cipta

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Rujukan

Guo, D., & Pan, Q. (2024). Research on the effectiveness of project-based learning promoted by the integration of ChatGPT and argument mapping. *Advances in Educational Technology and Psychology, 8,* 204–219. https://doi.org/10.23977/aetp.2024.080530

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ID 103: AI and Culture in Action: Student Engagement and Learning through FIGURA'25

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Highlights: Fiesta Gegar Razak 2025 (FIGURA'25) is Kolej Tun Razak UTM's signature annual event. Usually it is known as an entrepreneurial showcase, but this year it takes on a cultural dimension, highlighting AI-driven educational innovations. In short, this year's concept has turned a conventional festival into an experience learning platform by incorporating AI-powered reflection tools for enhancing a student-centred digital festival hub and promoting AI-assisted cultural performances. The objective of FIGURA'25 is to introduce UTM students to a variety of experiences and activities outside of the classroom. Through the range of events planned by student organisations this festival-based program: the centrepiece of Kolej Tun Razak's event, indirectly develops student networks, promotes holistic development, and develops leadership abilities. In addition, FIGURA'25 increases UTM's and Kolej Tun Razak's visibility both on and off campus. These developments encourage participation through digital media, by integrating cultural heritage with contemporary AI applications, and offer students reflective tools to acknowledge their own learning. The method, which is in line with NALI's structure, drives forward innovation in teaching and learning.

Keywords: AI in education; Experiential learning; Student engagement; Soft skills, Culture

Introduction

In keeping with the NALI 2025 theme, "Accelerating Innovation in Teaching & Learning with AI", FIGURA'25, the AI- Driven Festival, used AI to enhance teaching, learning, and reflection while also fostering cultural expression, digital participation, and the development of soft skills. The festival featured an AI-enhanced cultural showcase, which included *syair* and *sajak* that combined tradition with contemporary inventiveness, as well as performances that included AI-generated elements. Additionally, it also presented AI-Enhanced Festival Learning Hub which was a mobile platform that combined vendor marketing (auto-generated Instagram repost stories), and AI-powered navigation with festival activities.

The purpose of FIGURA'25 was to introduce UTM students to a variety of extracurricular activities and experiences. Through multi-genre activities engaging a variety of experienced participants, this initiative, which now continues to be the annual highlight of Kolej Tun Razak, not only builds stronger student networks but also fosters higher-order thinking, soft skills, and holistic development. Every task had a purpose and moral values shaping participants personalities, emotional intelligence, and cognitive abilities.

With a strong focus on excellence and rooted in UTM's core values of Integrity, Synergy, Excellence, and Sustainability (ISES), FIGURA'25 encouraged students to make an effort for high standards and achievement in the areas of teaching and learning, research, and innovation.

Objectives

AI and Culture in Action: Student Engagement and Learning through FIGURA'25 aimed as follows:-

i. To analyze students' participation levels across various activities in FIGURA'25.
ii. To evaluate the effectiveness of the blended learning environment created through the Festival Hub.
iii. To examine the development of soft skills among students through their participation in FIGURA'25.
iv. To explore participants' perceptions of AI integration in cultural and learning activities, focusing on how students responded positively to the innovative blend of heritage and technology.

NALI Approaches

This project adheres to NALI approach by relating its impact into creating a rich and meaningful learning experience. What made this project a novelty is how it combined AI with reflective learning, festival planning, and traditional cultural performances such as *syair* and *sajak* recital, blending technology with cultural heritage in an innovative way. It brings in creativity by using AI to craft social media promotions, making the festival more accessible and engaging for everyone. FIGURA'25 was more than simply a fun event; it was a learning environment driven by AI that highlighted real innovation. Its adaptable and practical approach can also be applied to other university community projects, cultural events, and student activities. Most importantly, this project helps students build important digital skills, connect more deeply with their culture, and better understand their soft skills and all support the bigger goal of helping students grow in a well-rounded, meaningful way.

Research Methodology

This project's methodology was divided into two primary stages: design and development and implementation.

Together with the student committee, activities were developed during the concept and development stage to make sure the events were interesting and impactful. In order to facilitate easy navigation for attendees, a user-friendly Festival Hub was created as a mobile platform that offers interactive maps, pertinent information, and real-time updates. Furthermore, a tool for reflection was created to enable students to record, share, and think back on their experiences during the festival, similar to Instagram stories and TikTok updates.

During the implementation phase, the project was carried out at Pesona Warisan'25, where AI enhanced performances such as *syair* and *sajak*, added a fresh and dynamic dimension to cultural expression. The Festival Hub was set up to assist participants stay informed and connected by providing real-time updates and promoting booths and exhibitors. To assess outcomes, data was collected after each activity, capturing both participation levels and students' reflections on their experiences.

Findings and Discussion

Enhanced Cultural Performance

The integration of AI tools and collaborative environments notably deepened students' interaction with traditional cultural expressions such as syair and sajak performances. This is most evident in the Pesona Warisan'25 activity, which recorded the highest participation with 120 students engaged. The positive perception of AI's role in these cultural activities (100 out of 140 respondents) indicated that students embraced this innovative blend of heritage and technology. Figure 1, showing the number of participants in each activity, clearly emphasized how Pesona Warisan'25 attracted the largest audience (120 participants), demonstrating strong engagement in AI-enhanced culturaL performances.

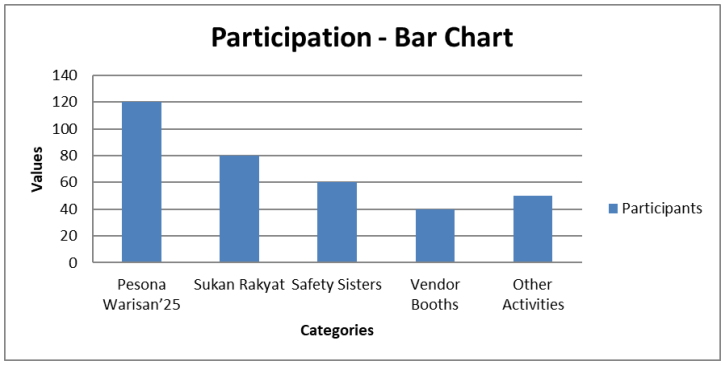


Figure 1: The number of participants in each activity in FIGURA 25'.

Achieved Blended Learning Environment

The Festival Hub created a dynamic mixed learning environment by successfully bridging the gap between digital interaction and the real-world festival atmosphere. A review of social media engagement provided support for this, showing significant online participation with over 5,000 reaches and 1,200 likes across platforms. Additionally, 25 out of 30 vendors expressed satisfaction with the connectivity and digital promotion offered, indicating that vendor response was quite good.

Frequency of Soft Skills Development

Table 1 below highlights the frequency of soft skills that students reported strengthening through their involvement in the project.

Table 1: The frequency of soft skills that students reported strengthening through their involvement in the project.

Soft Skill	Frequency
Communication	90
Teamwork	85
Leadership	70
Critical Thinking	60
Creativity	50

According to the data presented in Table 1, students' involvement in FIGURA'25 shows that the most often reinforced skill was communication (90 students), closely followed by teamwork (85 students). Leadership (70 students) was also frequently noted, indicating that many participants actively participated in task organisation. In contrast, no less significant were critical thinking (60 students) and creativity (50 students), demonstrating how AI-enhanced cultural events promoted creative expression and problem-solving. Overall, these results show that by encouraging critical interpersonal and cognitive abilities, FIGURA'25 not only enhanced cultural learning but also helped in students' overall growth.

Participants' Perceptions of AI Integration in Cultural and Learning Activities

Several significant FIGURA'25 outcomes were uncovered by the interview replies obtained from students, performers, vendors, and student volunteers. These opinions demonstrate how integrating AI was viewed favourably as a novel instrument for education and cultural expression.

Student volunteers consistently reported improvements in communication, leadership, and teamwork. One volunteer reflected that "*saya rasa lebih yakin bila berinteraksi dengan orang ramai… saya kena cepat buat keputusan dan kerja dalam kumpulan*." Similarly, a participant in Sukan Rakyat commented, "*saya belajar kepentingan strategi dan kerja sama…*" reflection tool highlighting teamwork and leadership. These accounts illustrate how interpersonal and leadership skills were strengthened through both scheduled activities and AI-enabled reflection tools.

Pesona Warisan'25 performers highlighted how AI improved cultural expression. As one observed, "We used AI to produce backdrops that responded to the voice of the syair… allowing heritage to be portrayed in a modern way", and "warisan lama boleh dipersembahkan dengan cara moden". These observations imply that AI was viewed as a creative tool for reinventing and upholding tradition rather than as a danger.

Student volunteers also discussed their experiences integrating AI capabilities into the Festival Hub app. One acknowledged that "the biggest challenge was training my peers to use the Festival Hub app… but once they did, it was convenient because all the information was in one place". In addition to making festival management easier, this technique improved the organisers' leadership, problem-solving, and computer literacy.

Conclusion

Overall, FIGURA'25's project findings show that the festival was enhanced as a platform for culture and education by the incorporation of AI. Cultural traditions were refreshed by AI-enhanced performances like *syair* and *sajak*, which made it possible for them to be expressed in appealing ways. By connecting the digital and physical dimensions, the Festival Hub further highlighted the potential of blended learning, producing significant online engagement and vendor satisfaction. At the same time, participants, performers, and suppliers all reported favourable opinions of AI as a tool for innovation and connectedness, while students' reflections showed notable improvements in leadership, teamwork, and communication.

Other Information

This project aligns closely with several key Sustainable Development Goals, underlining its broader social and educational impact. First, it supports SDG 4: Quality Education by offering practical, AI-enhanced learning experiences that promote both skill-building and reflective thinking among students. By combining cultural heritage with modern technology, the project creates accessible learning opportunities, addressing SDG 10: Reduced Inequalities by ensuring inclusive access to both cultural and digital education for all students. The innovative integration of digital tools with physical community events also contributes to SDG 11: Sustainable Communities, fostering stronger communal bonds and shared cultural appreciation. Finally, the project exemplifies SDG 17: Partnerships through active collaboration between UTM, industry players, and local community partners, creating a supportive ecosystem that advances educational innovation and community development.

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ID 104: Constructive Alignment in Action: Transforming a Guided Lab into an Open-Ended Learning Experience

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Highlights: This innovation focuses on improving the alignment between Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs) in the Separation Processes Laboratory I course at Universiti Teknologi Malaysia (UTM). The course was redesigned from a fully guided format to include predominantly open-ended experiments, supported by revised CLOs and standardised rubrics. Grounded in constructive alignment and experiential learning theory, the innovation responds to EAC 2024 accreditation requirements. Matched entry–exit surveys show improved student understanding of experimental planning, methodology, and analysis, demonstrating enhanced achievement of learning outcomes in a student-centred learning environment.

Keywords: Open-ended laboratory experiments; Curriculum innovation; Outcome- based education; Experiential learning; Engineering accreditation

Introduction

This innovation involves the redesign of the Separation Processes Laboratory I course in the undergraduate Chemical Engineering programme at Universiti Teknologi Malaysia (UTM). Previously conducted as fully guided experiments, the course was restructured to include predominantly open-ended experiments, aligning more closely with the Programme Learning Outcomes (PLOs) and the Engineering Accreditation Council (EAC) 2024 requirement for open- ended laboratory work. The redesign is grounded in the principles of constructive alignment and experiential lea rning, enabling students to take greater ownership of their learning while developing skills in problem-solving, experimental design, and data analysis. New Course Learning Outcomes (CLOs) were developed to emphasise higher-order thinking and independent investigation, and were mapped more explicitly to the relevant PLOs. These changes are supported by standardised rubrics and survey-based evaluation to measure students' understanding and achievement. The same framework has since been extended to Separation Processes Laboratory II and the equivalent laboratory for the Chemical Engineering (Bioprocess) programme, demonstrating its adaptability and scalability.

Objectives

This research aimed to redesign the Separation Processes Laboratory I course in the undergraduate Chemical Engineering programme at Universiti Teknologi Malaysia (UTM) by transitioning from fully guided experiments to a predominantly open-ended format. The innovation sought to:

- Foster student-centred learning by encouraging independent, hands-on exploration, supported by constructive alignment and experiential learning principles.
- Strengthen alignment between Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs), in accordance with the Engineering Accreditation Council (EAC) 2024 Standard.
- Promote higher-order thinking, critical analysis, and real-world problem-solving skills.
- Improve assessment consistency and fairness across multiple course sections through structured rubrics.
- Serve as a scalable model for laboratory-based curriculum reform in engineering education.

NALI Approach

This innovation is novel in its deliberate restructuring of a traditionally guided laboratory course to strengthen alignment between Course Learning Outcomes (CLOs) and Programme Learning Outcomes (PLOs), a critical yet often overlooked dimension of engineering curriculum design. Grounded in constructive alignment (Osen et al., 2025; Biggs, 1996) and experiential learning (Kolb, 1984), the course now adopts a predominantly open-ended format that promotes student ownership, critical thinking, and inquiry-based learning — moving beyond procedural experimentation.

Creatively, the innovation balances structure and flexibility. Standardised rubrics for proposals, reports, and instructor observations ensure consistent assessment across sections (Elibox and Khan, 2025; Hristov et al., 2023), while instructors retain autonomy in how students present their experimental plans. This is complemented by a peer evaluation adjustment system, in which individual student marks are scaled based on self- and peer-assessed contribution factors, adding a level of transparency and accountability rarely formalised in engineering labs (Hoehn et al., 2021).

Its applicability is reinforced by direct alignment with the Engineering Accreditation Council (EAC) 2024 Standard, which emphasises open-ended laboratory work (Engineering Accreditation Council Malaysia, 2024) to support the development of complex problem-solving, independent inquiry, and student-centred learning. The same structure has been adopted in two additional laboratory courses within the programme, demonstrating its scalability. The resulting impact

includes improved CLO clarity, fairer assessment practices, and stronger student engagement, supported by reflections and matched survey data showing gains in planning, methodology, and collaborative work.

Research Methodology

This innovation adopted a design-based educational research approach to guide the development, implementation, and evaluation of the redesigned Separation Processes Laboratory I course. The transformation was guided by Kolb's Experiential Learning Cycle, which emphasises learning through active experimentation and reflective observation (Kolb, 1984), and Biggs' Constructive Alignment, which promotes coherence between intended learning outcomes, instructional activities, and assessment methods (Osen et al., 2025; Biggs, 1996). The course revision also responds directly to the Engineering Accreditation Council (EAC) 2024 requirement for engineering programmes to incorporate open-ended laboratory work that nurtures complex problem-solving skills (Engineering Accreditation Council Malaysia, 2024; Murray et al., 2019).

In the redesigned structure, students were required to develop and submit detailed experimental proposals prior to conducting their experiments. These included the identification of objectives, literature-supported methodology, experimental design, and safety considerations. This marked a clear departure from the previous guided model, where procedures were predetermined and student planning was minimal. The revised approach enabled more direct alignment between the Course Learning Outcomes (CLOs) and the Programme Learning Outcomes (PLOs), particularly in areas related to independent investigation, teamwork, and technical communication.

To support this transition, a set of standardised rubrics was introduced for assessing experimental proposals, final reports, and instructor observations during experimental execution. These rubrics explicitly map to the CLOs and were applied consistently across all six course sections to ensure fairness and clarity in expectations, while allowing instructors some flexibility in how proposals were presented (e.g. oral, written, or in-lab briefings).

To evaluate the impact of the redesigned course structure, surveys were administered at the beginning and end of the semester. These included both Likert-scale and open-ended questions designed to assess students' initial understanding of open-ended experimentation, and any changes in perception, confidence, and learning outcomes by the end of the course. A total of 20 students completed both the entry and exit surveys, forming the basis of a matched-response dataset used for comparative analysis. The results were analysed to identify shifts in cognitive understanding and affective response, with specific reference to CLO achievement and perceived learning gains under the new structure.

Findings and Discussion

The observed improvements in student understanding can be directly linked to the course's transformation from fully guided to predominantly open-ended laboratory experiments. A matched survey analysis of 20 students, conducted at the beginning and end of the semester, revealed clear gains in both cognitive and affective learning domains. In the guided structure, students followed fixed procedures with minimal opportunity to define objectives or make experimental decisions. The redesigned structure placed students at the centre of the learning process, requiring them to formulate experimental proposals, justify methodologies, and interpret data independently. These shifts embody the principles of Student-Centred Learning (SCL) and Kolb's Experiential Learning Cycle, where students learn by doing, reflecting, and refining their understanding through authentic tasks (Kaput, 2018; Kolb, 1984).

At the start of the course, most students expressed a preference for guided experiments and showed limited understanding of core components such as experimental objectives, scope, methodology planning, and literature review. Their responses were often vague or procedural. By the end of the semester, however, students demonstrated greater conceptual clarity and independence in describing these same components. Evidence from the matched entry and exit surveys, as shown in Table 1, reveals meaningful conceptual gains across key Course Learning Outcomes (CLOs). For example, in relation to CLO1, students initially defined lab proposals in vague, procedural terms, but later demonstrated a more comprehensive understanding of their purpose and structure. Similarly, gains in CLO2 were reflected in deeper explanations of data analysis — from generic answers to more analytical responses that recognised patterns, errors, and validation. The survey responses also suggest better planning and anticipation of equipment use (CLO3), as well as a heightened awareness of fair contribution and teamwork (CLO5).

Table 1: Representative examples of students' responses before and after the course (minor corrections made to correct grammar and spelling errors).

CLO	Question	Student	Entry Response	Exit Response
1	What do you understand about lab proposals?	S5	Show the **prior planning** of experiments	Serve as the documentation to propose what we actually have to conduct to **achieve the objectives**.
		S10	Approved proposal is a **guideline** when carrying out the lab.	A prior preparation for real experiment to **check the feasibility and practicality** of the planned experiment
	What do you think you will get out of/have obtained from preparing lab proposals?	S2	To be checked by the lecturer to see if our planning can be used for the experiment and **receive feedback** from the lecturer to **improve and refine** the experiment.	**Deeper understanding** about **theoretical and practical** things in experimental design. Teach me how to design our own objective, our manipulate variable that need to be consider before doing the experiment also for the formulation, methodology and safety precautions.

CLO	Question	Student	Entry Response	Exit Response
		S6	More **understanding** on a certain experiments	Preparing lab proposals improved my research planning, method design, and critical thinking skills.
	What is the purpose of outlining the objectives before planning the experiment?	S2	It provides a clear goals for the experiment which lead the methodology so the outcomes align with the goals.	Outlining the objectives first helps us know exactly what we're trying to find out or **prove** in the experiment. It keeps everything **focused** so we don't waste time doing things that aren't needed. It also makes it **easier to plan the steps**, **choose the right materials, and know what kind of results to look for**. Basically, it gives the whole experiment a clear purpose.
		S12	Knowing what to **achieve.**	Guide the experimental design. Ensure that the research stayed focused and that the outcomes are measurable and relevant.
	What is the purpose of identifying the scope in planning the experiment?	S12	**Outline** the parameters	Defining the scope helps to manage time, resources, and expectations. It also avoids unnecessary complexity or deviation.
2	How do/did you go about analysing your experimental findings? What do/did you need to address/cover?	S7	Organize data, identify trends and patterns as well as check if the findings aligns with the hypothesis	I looked at the data I got from the experiment and made sure it was correct and complete. I used **graphs, numbers, and comparisons to see patterns and results**. I checked if the **results matched what I expected or what other studies showed**. I also looked at any **errors or strange results and explained** what they meant.
		S19	Data Organization & Processing, Comparing with Literature & Theoretical Expectations	I compared the **results with the objectives and theory**, looked for **patterns or errors**, and explained what the data meant.
3	For each manipulated variable (MV) in an experiment, how many points do you think should be investigated, at the minimum?	S2	At least three points to find the **average** for an **accurate result** and to plot the data accurately	At least 3 points. Because if we only test one or two, we might not see the **full trend** or pattern. With three or more, we can **better understand how the variable affects** the results.
	Why do you think that many points are required?	S6	At least 3 points should be investigated to **observe trends** clearly and **ensure reliable, meaningful analysis**.	Minimum will be 3, so that I can **establish a trend**, whether is it **linear/ non linear effects**. Beside I also can **avoid misleading conclusion** as I think 2 points only show correlation
5	Do you think peer rating is important, and why? How often do you think peer rating should be conducted?	S4	Peer rating is important as the marks are to be **distributed according to the workload** to all group members. I think peer rating could show **higher influence** to the total marks, as the peer rating marks are **not sufficient** to pressure the group members to do more works.	Yes, Peer rating is important as it encourages teamwork and self reflection, it allows group members to do the task fairly and give constructive feedback to help improve performance and collaboration. It also gives Dr an understanding of what happens in the group, ensuring a fair evaluation of individual efforts. I believe peer rating should be done at the end of each experiment which is the current trend now. This allows team members to reflect on their performance on that particular experiment and how they can improve in the next experiment. Regular peer rating also promotes continuous engagement and responsibility throughout the coursework.
		S19	Yes. Peer rating should be conducted **at least 2-3 times per course cycle.**	Yes, peer rating is important because it encourages accountability, improves teamwork, and provides diverse feedback for growth. Peer rating should be conducted at the end of each experiment or every few months to ensure timely and relevant feedback.

These findings reflect successful constructive alignment, as course learning outcomes, instructional methods, and assessment rubrics were all revised to support complex, open-ended learning tasks. This growth aligns with the course's shift toward experiential learning, where students engage in iterative cycles of planning, experimentation, and reflection (Taber, 2019). Moreover, the course redesign is aligned with the EAC 2024 accreditation standard, which calls for laboratory experiences that nurture student competence in handling complex problems, investigating solutions, and collaborating effectively (Engineering Accreditation Council Malaysia, 2024). By requiring students to plan, execute, and justify their own experimental designs, the new structure fosters critical thinking, lifelong learning, and team-based skills consistent with Outcome-Based Education (OBE) goals.

Other Information

This innovation was implemented in the Separation Processes Laboratory I course within the undergraduate Chemical Engineering programme at Universiti Teknologi Malaysia (UTM). It aligns with the Engineering Accreditation Council (EAC) Standard 2024, particularly in its emphasis on open-ended laboratory work, constructive alignment, and complex problem-solving. The redesigned structure has proven scalable and has since been adopted in two other laboratory courses: Separation Processes Laboratory II for the same programme, and the corresponding Separation Processes Laboratory for the Chemical Engineering (Bioprocess) programme. Across these courses, a consistent framework of CLOs, assessment rubrics, and student engagement strategies has been used to ensure coherence and standardisation.

The design and implementation approach are adaptable to other engineering laboratory courses seeking to embed experiential learning and meet updated accreditation criteria. Standardised rubrics, proposal templates, and entry– exit surveys developed for this course can serve as transferable tools to support similar curriculum reforms.

The innovation has also been recognised at the international level. A full-length paper detailing the design, implementation, and impact of the course transformation has been tentatively accepted for publication, pending minor revisions. The same work earned the Best Presenter Award at the 2025 International Conference on Engineering and Built Environment Education for sharing this innovation, highlighting its relevance and potential impact in engineering education discourse.

Future improvements include the refinement of the survey instruments to include more structured Likert-scale measures for tracking cognitive and affective gains, as well as efforts to monitor long-term impact through follow-up studies in advanced courses. There is also potential for collaborative scaffolding through seminars in the Final Year Project I course, where students concurrently develop research proposals. The alignment between project and laboratory proposal expectations offers an opportunity to reinforce planning, justification, and communication skills across courses.

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ID 105: Integrating Generative AI Reflection into Higher Education Assignments: A Pedagogical Innovation

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Highlights: This innovation pioneers a Generative AI Usage Declaration and Reflection framework within postgraduate assignments, positioning UTM at the forefront of ethical AI integration in higher education. Students are not only required to disclose their use of generative AI tools (e.g., ChatGPT, Copilot) but also to critically reflect on how these tools shaped their thinking, writing, and learning. By embedding guided reflection as part of the assessment, the initiative transforms AI from a "black box shortcut" into a pedagogical opportunity that fosters deeper learning, stronger academic writing, and heightened awareness of originality and data governance. Preliminary results show more than 80% of students voluntarily disclosed AI use, with over half producing insightful self-critiques—clear evidence of enhanced AI literacy, ethical reasoning, and responsible academic practice.

Keywords: Generative AI; Reflective learning; Academic integrity; AI literacy

Introduction

The rapid expansion of generative AI in higher education presents both opportunities and challenges for student work. Tools such as ChatGPT can support writing, yet uncritical reliance raises concerns over academic integrity and diminished learning (Lodge et al., 2023). Instead of prohibiting AI, there is an urgent need for pedagogical strategies that embed these tools responsibly and ethically into the learning process. The objective of this innovation is to harness generative AI as a *learning aid* rather than a cheating shortcut, by requiring students to openly declare their AI usage and reflect critically on its impact.

Objectives

This approach aims to normalize transparent AI use in coursework (promoting honesty and ethical practice) while adding a reflective step that compels students to engage their cognitive skills (Evangelista, 2025). Through this reflection, students learn *with* AI instead of delegating their learning *to* AI.

NALI Approach

The innovation is novel in that it embeds a formal AI-reflection component into assessments. It creatively redesigns a conventional assignment by integrating an AI literacy exercise, thus innovatively changing how students approach writing tasks. The approach is highly applicable to modern higher education, aligning with the "Accelerating Innovation in T&L with AI" theme of NALI 2025. By engaging students in reflecting on AI's role, the innovation has a clear impact on learning: it actively engages students and empowers them to become more critical, ethical users of technology.

In summary, the project addresses the NALI criteria of Novelty (a reflection process), Creativity (using AI use as a teaching moment), Innovativeness (redefining assignment practice with AI integration), Applicability (directly relevant to current AI-in-education challenges), and Impact on Students' Learning (improving engagement, metacognition, and integrity).

Research Methodology

Postgraduate students are required to complete a "Generative AI Usage Declaration & Reflection" as part of their written assignments. This takes the form of a short addendum accompanying each assignment. In it, students must explicitly state whether they used any AI tools in researching, writing, or editing their work. The students are expected to elicit critical thinking about the AI's contribution towards their learning. For example, students indicate *which* AI tool was used and *for what purpose*.

This process was conducted in the MRTB1113 Data Governance postgraduate course with 24 students at Faculty of Artificial Intelligence, UTM, as part of a post-module assessment (PMA) in 2025. In this course, where topics of data management, privacy, and ethics are central, introducing an AI-reflection component was especially pertinent. Students were free to use any generative AI tools, with options such as ChatGPT, Google Gemini, Copilot, DeepSeek, and NotebookLM introduced during class discussions. No single platform was mandated, but students were reminded of data governance responsibilities, for instance, avoiding the input of sensitive information into public tools and verifying AI outputs for accuracy. This emphasis on privacy, ethics, and verification directly supported the course learning outcomes on data governance.

The instructor integrated the declaration & reflection requirement into the assignment instructions in the e-learning. This section was given a small weight in the grading rubric to emphasize its importance. Students were assured that using AI is *not* penalized instead, undeclared or unethical use would be a concern. The grading criteria for the reflection focused on

honesty, depth of insight, and critical evaluation of AI use (for instance, a "meaningful reflection" would explain the student's process of using the tool and critically analyze the outcomes, whereas a poor reflection might

be vague or purely positive with no critical insight). Based on the given instructions, students' PMA submissions particularly the AI reflections were systematically observed and evaluated. These reflections, combined with assignment results and student feedback, were analysed to assess the effectiveness of the approach.

Findings and Discussion

The introduction of AI usage reflection had notable results in the Data Governance class. Over 90% (22 students) declared using at least one generative AI tool during their assignment. This high number suggests that most students were in fact leveraging AI assistance when given the chance to do so openly, rather than in secret. Among the tools, OpenAI's ChatGPT was the most commonly used, cited by a majority of the class for help in generating ideas, outlines, or even draft text. A few students experimented with Gemini, and some used Google's NotebookLM (an AI notebook/research assistant) to analyze source materials. Notably, DeepSeek, a newer chatbot known in 2025, was mentioned by several students, demonstrating that learners were actively exploring a range of AI platforms beyond just the well-known ChatGPT. This variety in tool usage highlights the importance of teaching AI literacy: students need to evaluate which AI tools are appropriate for which tasks (Malik et. al, 2025).

The reflective declarations varied in depth, but about 25% (6 students) provided meaningful reflections that met or exceeded the expected depth. These students did more than just say "I used ChatGPT to help me write", they critically examined how AI influenced their work. For instance, many described how they verified AI-generated content: some cross-checked facts and references provided by ChatGPT against academic sources, finding and correcting a few inaccuracies. Others mentioned using similarities checkers to ensure their final submission was primarily their own words (even if AI helped generate early drafts). Several students reflected on the need to adapt AI outputs to their own writing style for example *"I rewrite complex explanations to make my writing sound coherent and clear."* Such remarks show that students were not simply copy-pasting AI content, but actively curating and editing it, which is a positive sign of critical engagement.

The rest of the students, over 60% of them (16 students) reflections were cursory. They provided only minimal detail, for example just noting they "*used an AI tool for grammar help*" without elaboration. Interestingly, those who gave very superficial reflections tended to be the same students whose assignments had a high proportion of AI-like writing. In two cases, the instructor's assessment (and Turnitin's AI-writing indicator) suggested the student heavily relied on AI- generated text, and indeed their reflections were poor, essentially failing to explain how the content was produced. This aligns with recent research findings that students with very high AI-generated content often "could not give credible explanations of use" of the tools (Combrinck and Loubser, 2025). In contrast, students who thoughtfully reflected generally relied less on fully AI-produced text, using the AI more for support rather than replacement, echoing the observation that reflective students "relied less on generated content" (Combrinck and Loubser, 2025). These outcomes reinforce the value of the reflection requirement: it creates accountability and self-checking. If a student cannot explain the work, that is itself a red flag for overreliance on AI.

These findings contrast with prior research (Combrinck & Loubser, 2025), which combined AI detection with reflection to manage integrity in large cohorts. Our approach was pedagogical rather than detection-driven, embedding reflection in a postgraduate Data Governance course with bonus marks as incentive. This led to clear behavioural patterns (no, minimal, critical reflection), offering insight into student AI literacy and ethical engagement.

Overall, the class reported that this exercise made them more aware of how they use AI and its limitations. Through their reflections, students identified specific benefits of generative AI, such as getting quick grammar and clarity improvements or using ChatGPT to rephrase sentences. They also recognized limitations: notably, several students commented that AI often lacked contextual understanding, for example, *"the AI's answer sounded plausible but didn't fully address the case study specifics, so I had to adjust it."* Some students decided not to use large chunks of AI text because *"it did not sound like me,"* preferring to maintain their own voice, an encouraging outcome for originality. The process of reflecting appeared to spur a more critical mindset: as one student wrote, *"the results are different when I ask same questions and just different days. So, I verified the facts by using academic articles."* Such meta- cognitive realizations are exactly what the innovation hoped to achieve, students recognizing the difference between merely accepting AI output and learning from AI output.

Moreover, tying the reflection to course content on data governance yielded additional educational benefits. A few students explicitly mentioned data privacy and ethical considerations in their write-ups, for instance noting that they avoided inputting real institutional data into the AI, or wondering whether using a cloud AI service could violate any policies. This indicates growing digital responsibility and awareness of data governance, a key 21st-century skill, directly fostered by the assignment's design. The exercise thus not only helped students with the immediate assignment, but also prompted them to think about *how* and *when* to appropriately use AI tools in an era of data regulations.

From the instructor's perspective, the innovation provided greater transparency into student work. Having students disclose their AI use meant the instructor spent less time guessing or interrogating unusual phrasing in essays; instead, the focus shifted to evaluating how students integrated the AI assistance. This aligns with Watkins' (2024) report that requiring open disclosure saves instructors from "staring into tea leaves" to discern AI usage and instead centres on teaching ethical use. In our case, the reflections opened up honest conversations, for example, in one class discussion we collectively reviewed an instance where ChatGPT had given a fictitious citation, reinforcing to all why verification is crucial. Students generally appreciated the policy; many reported feelings *relieved* that they could use new tools like ChatGPT openly as long as they took responsibility for their learning. This suggests that clear guidelines and reflection can channel students' usage of AI into a positive learning experience rather than a clandestine activity (Singh et al., 2024).

Implications for 21st-Century Skills

This pedagogical innovation contributes to developing several 21st-century skills in students:

- **AI Literacy**: By actively using and evaluating AI tools, students build their understanding of how AI works and its appropriate applications. They learn to critically interpret AI outputs, an ability increasingly recognized as essential for modern learners. Instead of treating AI as a magical oracle, students approached it as a tool to be questioned and verified, a hallmark of AI literacy (knowing how to use AI effectively and responsibly). Over the course, students became more adept at prompt strategies, at recognizing AI's errors or biases, and at deciding when not to use AI. These are practical competencies that will benefit them in a workforce where AI is ubiquitous.
- **Ethical Reasoning and Academic Integrity**: The requirement to reflect on AI usage inherently prompts ethical reasoning. Students had to consider plagiarism and originality. For example determining how much AI assistance is "too much" and justify that their work remained their own. In doing so, they indirectly engaged with academic integrity principles. They also grappled with questions of fairness (is it fair to use AI when others might not?) and transparency (being honest about one's process), thus strengthening their ethical decision-making skills. The assignment turned what could be an academic honesty grey area into an opportunity for guided ethical reflection. As research suggests, such self-reflection can be a powerful tool in fostering academic integrity in the age of AI (Combrinck and Loubser, 2025).
- **Digital Responsibility**: Because this innovation took place in a Data Governance course, it also emphasized responsible data practices. Students had to be mindful of what data or prompts they fed into AI systems (protecting any sensitive information), aligning with the principle of digital responsibility. They also considered the reliability and source of information provided by AI, learning not to accept digital content at face value. These habits contribute to their broader digital literacy and responsibility as citizens and professionals.
- **Critical Thinking and Metacognition**: Requiring students to evaluate how they completed their work (with AI's help) injects a meta-cognitive element into the assignment. Students practiced reflecting on their own learning process and analyzing the quality of their work critically, rather than just focusing on the end product. This reflection cultivates critical thinking. The students had to question the AI, question themselves, and synthesize an answer that stands up to scrutiny. In essence, the task made them consciously pause and think about their thinking, which is invaluable training for lifelong learning.

In summary, the GenAI reflection turned the presence of AI from a potential academic threat into a teachable moment. It helped students become more AI-savvy, ethically grounded, and reflective learners, aligning with the skills needed in the 21st century.

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ID 107: Toys for Friends (TFF): Uniting Privileged and Underprivileged School Communities Through Pen Pal Letters

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Highlights: Toys for Friends (TFF) is a community engagement project designed to not only improve primary school students' English writing skills, but also instil a sense of social responsibility in them. The project brought together two schools from two different social circles through pen pal letters. TFF involved reciprocal learning, toy giving, letter writing, facilitator support and Google Search support learning. The findings of the study showed that the project was beneficial in improving the quality of students' writing as well as developing their social responsibility. The project showcases a community engagement learning model that uses a novel, creative and innovative approach to produce future-ready students at a young age.

Keywords: Toys for friends (TFF); Pen pal letter writing; Reciprocal learning; Google search (Generative Ai in search); Future-ready students

Introduction

Preparing students to be future-ready is not just about equipping them with academic competence but also social competence. This is to ensure that the country's future talents are not only academically smart but also socially skilled in any situation. While the focus for preparing students for the future is often on those in higher education, we should begin this exposure at a young age to more organically nurture future-ready individuals. To achieve this, for young students, community engagement projects are seen as an ideal platform where participating students fulfil their social responsibilities while improving their academic skills.

Another critical factor for being future-ready is the ability to master English. Therefore, this project focuses on improving students' English language skills. As suggested by the English Language Education Reform in Malaysia 2015-2025, any English-related program developed for students must go through a systematic and systemic plan where problem areas in language learning are identified before implementing improvement measures (English Language Teaching Centre, 2021). Therefore, a needs analysis was conducted to identify the English language skills that are most difficult for students to achieve before designing the project. Based on the needs analysis, writing skills were the most difficult skills for students to master.

Objectives

In response to the problem statement, the community engagement project, Toys for Friends, was designed to facilitate skill development while providing opportunities for participating students to fulfil their social responsibilities.

Toys for Friends (TFF): The Story Behind the Project

The concept of "university for the community" introduced by the Ministry of Higher Education Malaysia (2019) has encouraged the Language Academy (LA), Faculty of Social Sciences and Humanities (FSSH), Universiti Teknologi Malaysia (UTM) to serve the community by organizing projects that provide maximum benefits to the target community. Since most of the academic staff at LA are experts in teaching and learning English, this project involves providing opportunities for the target community to improve their English language skills. In selecting the recipients of the service for this project, the Academy decided to seek advice from the Johor State Education Department in finding schools that are less fortunate. The discussion led to the selection of Sekolah Kebangsaan Sungai Boh (SK Sg. Boh) in Pontian as the community to receive the service. This is because the school does not have enough resources with a very low number of enrolment at only around 100 students. This school is also recognized as one of the Primary Schools (SKM) in Malaysia. For the service provider to the target community, the Academy decided to collaborate an international school, namely Idrissi International School in Iskandar Puteri. The intention of connecting two different school communities from two different social environments is to provide opportunities for students to interact with peers who come from different worlds than their own. The Academy believes that through this interaction, students will have a broader perspective on life as they respect diversity in society, have more empathy for others and develop their social responsibility where they see themselves as agents to contribute to society. As defined by Low (2016), social responsibility is the moral commitment shown by an individual towards others who are influenced by social norms. Therefore, with this in place, it will prepare students in the future to function effectively in society.

This project has showcased a strategic partnership between four different stakeholders namely (1) Johor State Education Department, (2) Language Academy, (3) Sk Sg Boh and (4) Idrissi International School. These partners are actively involved in making this project a success where all parties take responsibility, share resources and gain mutual benefits. Policymakers (Johor State Education Department) and educators (academic staff from the Language Academy and/or school teachers from both schools) collaborated from the project's initiation to its implementation and evaluation.

Together, they linked the communities, identified community needs, and designed the project's framework and learning modules. This collaborative effort illustrates how active partnerships enable projects to be carefully designed to produce a future-ready community engagement curriculum.

Toys for Friends (TFF): A Novel, Creative and Innovative Community Engagement Project

This project involves three key players which are (1) the faculty, which is TFF organiser (academic staff of Language Academy), (2) the students, which is TFF service providers (the privileged students from Idrissi International School) and the community, which is TFF service recipients (the underprivileged students from SK Sg Boh). TFF is a unique community engagement project that avoids the typical one-way transfer of knowledge, skills, and services to passive recipients. In fact, TFF empowers all its key players by integrating a reciprocal element into the project, which is "an exchange of both giving and receiving between the server and the person or group being served" (Henry & Breyfogle, 2006, p. 27). This means that both groups (the students and the community) are active participants where they learn to improve their language skills and acquire valuable life and social skills through performing their social duties to their counterparts.

As for the TFF learning module, it was developed based on three theories used by Mc Ewen (1996) when designing the service learning syllabus, namely, (1) "cognitive development", (2) "moral development" and (3) "experiential learning" (Snyman, 2005, p. 134). The TFF learning module involves students learning academic content while performing service activities and, ultimately, reflects on their overall learning experience. Figure 1 (as cited in Mohd Sharif et al., 2023) shows the three components of the TFF learning module:

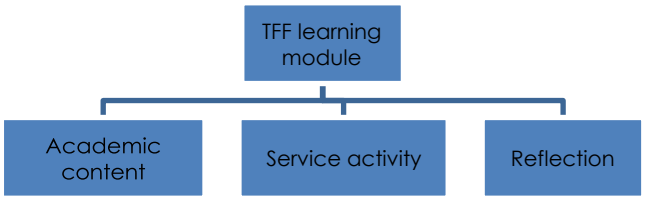


Figure 1: TFF learning module components

When deciding on academic content for students, the faculty looked at the aspects that participating students struggled with the most which is writing. The findings showed that students aged seven to nine, whether disadvantaged or advantaged, had difficulty writing simple sentences correctly, often struggling with their spelling or grammar. Therefore, the project introduced the concept of pen pal letter writing so that the two different communities could be connected through meaningful exchanges. To provide a genuine exchange of experiences and knowledge between students and the community, TFF developed two learning modules that stimulated real-life letter exchanges. Figure 2 (as cited in Abdul Wahab et al, in process) illustrates how the two components of the TFF learning module were implemented in the project.

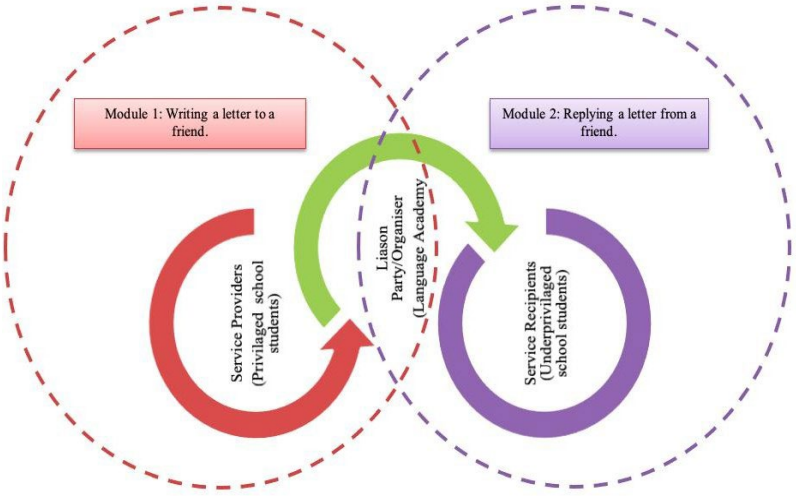


Figure 2: Implementation process of TFF learning modules

The TFF project is a two-phase project where the first phase involves the implementation of Learning Module 1 and the second phase involves the implementation of Learning Module 2. Table 1 summarizes the step-by-step implementation process of both modules:

Table 1: Step-by-step Implementation Process of the TFF learning modules

Learning Module 1 (developed for the students – the service providers)	**Learning Module 2 (developed for the community – the service recipients)**
i. Meet virtually with Peer	i. Receive a Toy and a Letter ii. Read the Letter (Academic Content)

Learning Module 1 (developed for the students – the service providers)	Learning Module 2 (developed for the community – the service recipients)
ii. Select a Toy with the help of Google Search (Generative Ai in Search) iii. Gift the Toy to Peer (Service activity) iv. Write a Letter to Peer (Service activity & Academic Content) v. Reflect on Learning (Reflection)	iii. Use Google Search (Generative Ai in Search) to Improve Letter Comprehension iv. Reply to the Letter (Service activity & Academic Content) v. Reflect on Learning (Reflection)

The act of giving toys to less fortunate peers helps to foster a sense of responsibility towards the less fortunate community among the more fortunate students (service providers). This helps them realize that they have the ability to give to those in need because they are more fortunate than them. For the service recipients, the act of responding to the letter to say thank you rather than just receiving the toy is their service activity. This is to foster a sense of responsibility to show appreciation among the less fortunate community when receiving services or help from others. This is important because the recipients should not be passive, they should go beyond just receiving, and try their best to give something in their capacity back to the giving community. This requires a healthy cycle of giving and receiving in the community.

The letter writing activity encourages students to be authentic, creative and critical in their expression. For example, for the service providers, they write about why they carefully chose the toy for their peers, and for the service recipients, they write about how grateful they are to receive and how much they love the toy. All of this produces genuine communication that requires better emotional engagement. Besides that, educators from the faculty act as facilitators to help students improve their English writing skills. They accompany the students and the community throughout the letter-writing process, ensuring accuracy in their work.

Research Methodology

To evaluate the extent to which TFF improved writing skills and instilled social responsibility among students, the faculty conducted focus group interviews with two groups of participants: (1) ten experts who were tertiary educators with over five years of experience in community engagement projects and (2) ten TFF stakeholder members In total, there were two expert groups and two stakeholder groups, each with five participants. Each participant was assigned a code. For example, EG1P1 is Expert Group 1 Participant 1, who is the first participant from the first expert group. All participants were in both phases of the TFF implementation, making them reliable individuals to provide insights into this topic. The interviews were conducted after the project was completed. The interviews were audio-recorded and transcribed verbatim. The transcriptions were analysed using Braun and Clarke's (2006) thematic data analysis method where recurring patterns from the data were identified before they were coded, grouped into categories, and then interpreted.

Findings and Discussion

Evaluating TFF: What do Experts and Stakeholders think about TFF? The following table, Table 2, summarises the experts and stakeholders' responses in the interviews:

Table 2: Emerging themes from the experts and stakeholders' interview responses

Improvement of Students' Writing Skills	Development of Students' Social Responsibility
Letter writing has a real-life purpose that it motivates students to write: i. "…letter writing make the (.) the students feel connected to their (.) their learning… write for purpose and to real friends…" – EG1P2 ii. "…students excited to write letters to a: (.) new friends… plus a: the friends from other school (.) so (.) they are motivated to a: to write good…" - EG1P4 iii. "...writing letter has a clear purpose…when they write they know what to write (.) [and] to whom the letter will be given to " - EG1P7 iv. "…letter writing is useful…they find English learning easy… it is fun for…to a: (.) write (.) write letters to new friends (.) so they are motivated to write…" – EG2P6	Gifting toy and writing letter to peers instil love for giving, compassion for others and gratitude: i. "…must make the students… find good reasons… and care about the others' feelings… this make them more responsible… socially responsible." – EG1P5 ii. "...to build the social responsibility among students… the modules can help students." – EG1P8 iii. "the giving of toys and letters will make them (.) love their friends more…(.) they feel responsible for them…I think a: even (a.) even after the programme…" - EG1P9 iv. "…this program taught the students to be grateful… to instil the feeling of giving and loving others (.) who they don't even know…they need to have that…I think they look content…not sure how to explain (.) to be good part of a (.) a functional society…" EG2P4 v. "…they will be aware of people… less fortunate than them…open their eyes (.) to lend help (.) when necessary…" – EG2P9 vi. "…when the students (.) doing this…many of them said they happy in their reflection to help others…that a::: (.) students (.) gaining the social responsibility…" – EG2P10

Improvement of Students' Writing Skills	Development of Students' Social Responsibility
Letter writing calls for both creative and critical thinking: i. "…the students have to think of their own letter content…it is (.) what up (.) to their own creativity…facilitator only ask them (.) why are you choosing this? (.) what do you feel…only question prompts… they have to think a lot about what to write (.) that is what (.) a:: (.) critical thinking…they…form their own (.) original ideas.." - EG1P1 ii. "…when they think of … what to write (.) the thinking is important (.) that help them to be creative (.) and of course critical… they have to come out with a: (.) the content on their own…" - EG1P5	Google Search (Generative Ai in Search) helps increase students' understanding i. "…some students (.) you know (.)…are weak in vocabulary, so they ask a::: (.) Google Search (.) help give meaning to the words (.) so that they can understand the letter…." – EG1P8 ii. "...I can see (.) they like to have Google Search (.) …they even ask (.) some questions that …about their toys…they have never seen them…(.) get more knowledge (.) they can write better…"– EG2P2 iii. "Google Search does become a useful tool (.) they are certain things that the students do not understand because of slang (.) that thing…(.) help to explain…" EG2P23
Close guidance from facilitators improve students writing quality: i. "…they learn to write correctly with (.) a:: proper help (.) from facilitators." – EG1P1 ii. "…they learn from feedback… to write right…they don't find this (.) a: stressful instead (.) they (.) keep asking the facilitators to check…" – EG1P3 iii. "...the students learn from their own mistakes… they will be (.) be more aware (.) to not commit the same ones in future…I see that (.) iv. they improve and learn to write better this way." – EG1P6	

From the findings of the study, TFF was indeed seen by the participants as a project that could improve English writing skills and instil social responsibility among primary school students. The pen pal concept successfully brought together two different school communities: the advantaged and the disadvantaged schools, in a meaningful and purposeful way. As stated by Adamson (2004), when students write, receive and read letters written to them by real people, they find meaning in the interaction.

In addition, letter writing requires students to compose their own content. This is because each student has different peers with different backgrounds and interests, different toys to give, and different reasons for choosing the toy. They have to think on their own, and this shapes them to be creative and critical. As Ellis (1994) states, when students are forced to put ideas into words, their cognitive processes become active. Content that is carefully thought out by students is authentic, which Cunningsworth (1995) states, authentic material elicits authentic responses from the recipients of the letter. This is not surprising since students do not really seek help from the facilitator during the writing process, but after they are finished with the letter, they always ask their facilitator to review and provide feedback so that they can improve their written product.

Participants agreed that TFF creates a sense of social responsibility among students. The project encourages them to care about others who are less fortunate and to be grateful for the things they have and receive from others, whether they are on the fortunate or the less fortunate end. This experience gave students a sense of giving, love for others, people and, responsibility to society. from their reflection activities Participants also stated that students were found to feel satisfied and happy after helping others. Although the use of Google Search was very minimal in this project, it played an important role in speeding up the thinking process for tasks that are not related to writing skills. In general, Google Search improves students' comprehension of their peers' letters by defining unfamiliar words, which helps them overcome their limited vocabulary. Not only that, because underprivileged students may be unfamiliar with the toys gifted to them by their peers, AI tools helped them learn more about those items. Participants found that using AI tools empowers students' learning.

Conclusion

In conclusion, the TFF project has shown that it is not impossible to bring together two school communities from different social backgrounds to learn skills that they both lack while carrying out their social duties. Its innovative approach - combining community engagement, the concept of reciprocal letter writing, facilitators as human learning aids and Google Search as technological learning aids - has not only improved students' writing skills but also empowered and improved the lives of their peers. Moreover, having real purpose and meaning when communicating with peers in the letters could encourage students to have real relationships outside the project, paving the way for the project to be sustainable in the long term with or without the presence of educators.

The researchers believe that TFF learning modules can be expanded as commercial teaching and learning kits for teachers. The modules can also be transformed into training packages for school teachers at both primary and secondary levels, as well as kindergarten teachers. The academic content is fluid in that it can be easily adapted to

different contexts - as long as the core values of the project remain, providing opportunities to enhance language learning with authentic communication and materials while carrying out social tasks for the community.

In short, it can be said that, TFF is a community engagement model developed based on a future-oriented curriculum, which requires active collaborative efforts from all stakeholders and key players to provide novel, creative, innovative, student-centred and socially driven learning experiences to produce future-ready students even at a young age.

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The authors would like to thank all active partners of the Toys for Friends (TFF), namely, (1) Johor State Education Department, (2) Language Academy (especially the committee members of TFF), (3) Sk Sg Boh and (4) Idrissi International School, in their collaborative efforts in making it a success.

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ID 108: AI-Driven Language Learning Solutions: Overcoming Malay and Indonesian Confusion for Korean Students

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Highlights: This project explores the integration of AI-based tools in the teaching and learning of the Malay language among Korean students, with a specific focus on distinguishing Malay from Indonesian. Due to the structure at institutions like Hankuk University of Foreign Studies, where both Malay and Indonesian are taught under the Malay-Indonesian department by Indonesian and Malay language instructors simultaneously, students often face confusion in learning both languages. The project aims to leverage AI-powered platforms, speech recognition, and customized learning paths to address these common language-learning challenges. The innovation seeks to improve pronunciation, reduce confusion between the two similar languages, enhance student engagement, and empower learners through interactive and personalized learning experiences.

Keywords: AI-based learning; Malay language education; Indonesian language distinction; language learning innovation; speech recognition

Introduction

This project presents a novel approach to teaching the Malay language to Korean learners, with a focus on distinguishing Malay from Indonesian, two languages that are often confused due to their similarities. At institutions like Hankuk University of Foreign Studies (HUFS), both Malay and Indonesian are taught within the same department, with Indonesian and Malay language instructors simultaneously teaching Korean students. This dual-teaching structure often leads to confusion, as students learn both languages at the same time and encounter challenges differentiating vocabulary, sentence structures, and usage nuances between the two.

To address these challenges, this project integrates AI-driven language tools to provide personalized learning experiences that enhance student engagement and language mastery. The use of various innovative technologies, including adaptive learning platforms, speech recognition systems, and AI-based language comparison tools, aims to increase the accessibility and effectiveness of language education. By combining technology with traditional teaching methods, the project enables students to overcome common obstacles, particularly the difficulty of distinguishing between Malay and Indonesian, thereby improving their language proficiency.

Aligned with the New Academia Learning Innovation Model (NALI), the project introduces novel ideas such as AI-powered language comparison, offers a creative design that merges technology with traditional learning methods, and provides a learning experience that is both relevant and impactful. The main objectives are to enhance students' understanding of Malay, reduce confusion with Indonesian, and focus on key areas such as pronunciation, grammar, and vocabulary differentiation.

Objectives

The primary objective of this project is to develop an AI-powered language learning model that helps Korean learners of Malay overcome common obstacles, such as confusion with Indonesian vocabulary, sentence structure, and pronunciation. By utilizing AI-driven feedback and interactive learning tools, the project aims to enhance student engagement, build confidence in speaking and writing in Malay, and foster an environment that promotes deeper language acquisition.

NALI Approach Implemented

- Novelty: The project introduces a unique combination of AI-based adaptive learning, speech recognition, and language comparison tools, specifically designed to help learners distinguish between Malay and Indonesian.
- Creativity: The design integrates real-time feedback through AI platforms, providing instant corrections on vocabulary and pronunciation while also utilizing visual aids to highlight language differences.
- Innovativeness: By using AI to offer personalized learning paths, the project ensures that Korean students can navigate the complexities of Malay in an interactive and engaging manner, setting it apart from traditional methods.
- Applicability: Aligned with the NALI framework, the model promotes student-centered learning, helping students build resilience and use technology while mastering the new languages. It also allows students to

simultaneously learn the differences and usage of Malay and Indonesian, enhancing their ability to distinguish between the two.

- Impact: This approach actively engages students by providing immediate feedback, fostering self-confidence in using the Malay language, and addressing common barriers to learning a second language.

Research Methodology

The methodology combines both qualitative and quantitative approaches to assess the effectiveness of AI tools in language learning. The study involves experimental groups using AI-based platforms, with their progress compared to control groups that employ traditional teaching methods. Data were collected through surveys, interviews, and classroom observations to measure engagement levels, improvements in pronunciation, and language differentiation between Malay and Indonesian.

Findings and Discussion

Initial findings suggest that AI-driven learning platforms significantly enhance student engagement and confidence. Students showed a better ability to differentiate between Malay and Indonesian vocabulary after using AI tools. Additionally, the speech recognition system proved effective in providing immediate feedback on pronunciation errors, which are a common challenge for students learning Malay. The adaptive learning features allowed for personalized lesson plans, improving retention and comprehension.

The results indicate that AI tools not only made learning more efficient but also more enjoyable. Students reported a higher level of satisfaction and confidence compared to traditional methods, citing the personalized feedback and interactive nature of the learning process as key factors.

Implemented Innovation

In addition to AI-driven learning tools, this project introduces an innovative product aimed at enhancing language learning through real-world application. By integrating a dual-language display into popular translation platforms such as *Naver E-dictionary, Papago or Kakao i* (voice support service) in South Korea, Korean students will have access to both Malay and Indonesian translations side-by-side. Malay will be displayed beneath the Korean text, while Indonesian will appear below the Malay translation. To clearly differentiate the two languages, Malay translations will be marked with an "Malaysia Flag" and Indonesian translations with an "Indonesia Flag." This visual distinction helps students immediately recognize the linguistic differences between Malay and Indonesian, making it easier to distinguish vocabulary, sentence structures, and contextual usage.

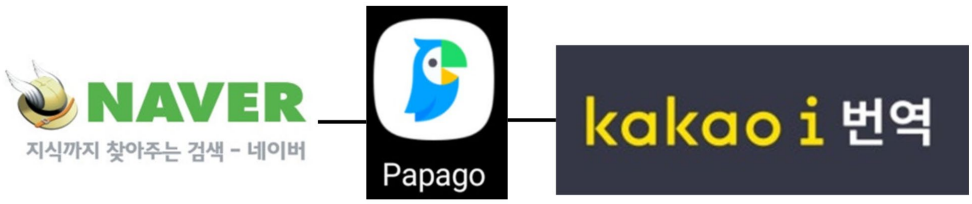
The core of this innovation is based on three key elements:

Dual Language Display with Distinction: In the three most widely used translation apps in South Korea, both Malay and Indonesian will be displayed alongside Korean text. To make the differentiation clear, "M" will be used for Malay, and "I" for Indonesian, facilitating easier recognition of language differences.

Example Sentences Using Both Languages: The platform will provide example sentences incorporating vocabulary from both languages. This feature helps students understand how words or phrases are used in different contexts, supporting practical language application and improving sentence-level comprehension.

Voice Support Service: Since Malay and Indonesian differ in tone and pronunciation, a voice support service will be included to help students distinguish between the two languages. This feature will offer accurate pronunciation examples, enabling students to learn proper intonation and articulation, and further assisting them in mastering both languages.

By integrating these features into widely used translation tools, this innovation bridges classroom learning with real-world language use, making it easier for students to internalize the nuances of each language and apply them confidently in everyday situations.













Conclusion

This innovative project provides a creative solution to the challenges faced by Korean students learning Malay, particularly in distinguishing it from Indonesian. By integrating AI technology with traditional learning methodologies, the project enhances both the engagement and effectiveness of language learning. The use of adaptive learning paths, speech recognition, and real-time language comparison tools empowers students to confidently learn Malay, ensuring that they can overcome the complexities of learning two similar languages. Through this approach, students not only gain a deeper understanding of Malay but also develop the skills necessary to engage with technology in language learning, setting the stage for more effective, personalized education.

Acknowledgement

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ID 111: ICCubeX: A Practice-Oriented and Theory-Driven Framework to Advance Transformative Research Translation in Malaysian Higher Institutions

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Highlights: The ICCubeX initiative strengthens researchers' capacity to transform academic work into market-ready innovation. Using a practice-oriented, theory-driven model, learning is iterative doing, reflecting, applying in real contexts. Guided by a Theory of Change and grounded in Schön's reflective practitioner and experiential learning, ICCubeX blends immersive workshops, case challenges and mentorship. 96 participants from academia, industry and government reported significant gains in IP management, commercialisation and industry alignment. Over 98% committed to concrete follow-up actions. Exceptional satisfaction and a 100% recommendation rate position ICCubeX as a scalable, evidence-based model bridging research with real-world impact and strengthening innovation ecosystems for Malaysia's Higher Education Institutions.

Keywords: research commercialisation; technology transfer; intellectual property management; industry-academia collaboration, capacity building

Introduction

Numerous studies have emphasized that while academic research often leads to the creation of novel technologies and intellectual assets, the transition from laboratory to market remains hindered by structural, cultural, and capability-related barriers (Siegel et al., 2007; Markman et al., 2008). In the Malaysian context, researchers have demonstrated strong competencies in producing high-quality publications and inventive technologies; however, they frequently encounter significant hurdles in navigating the complex processes of commercialisation, including intellectual property (IP) protection, regulatory compliance, market validation, licensing, and industry collaboration (Abdullah et al., 2019; Noor et al., 2021). These challenges are consistent with global findings that academic innovators often lack sufficient entrepreneurial skills, industrial networks, and institutional support mechanisms required for successful technology transfer (Wright et al., 2007; Perkmann et al., 2013). Addressing these systemic gaps necessitates structured capacity-building initiatives that go beyond traditional lectures, incorporating experiential and practice-oriented learning designed to equip researchers with both the theoretical knowledge and practical competencies required to effectively navigate the research-to-market journey (Kolb, 1984; UNDP, 2009; UNESCO, 2017).

The ICCubeX through A Practice-Oriented and Theory-Driven Framework for Transformative Research Translation in Malaysian Higher Institution (The Framework) was explicitly developed to respond to this need. Leveraging the award-winning ICCubeX experiential learning model—which won Gold at NALI 2024 competition—the Framework integrates expert-led lectures, evidence-based case studies, interactive group exercises, and structured post-workshop mentorship. Such a holistic approach aligns with best practices identified in the literature on technology transfer and academic entrepreneurship, which advocate for multi-component interventions that blend knowledge dissemination, mentorship, and hands-on practice (Yin, 2018; Van Burg et al., 2008). The Framework specifically targeted capacity enhancement in key areas of research commercialisation, including understanding and applying Technology and Business Readiness Levels (TRLs and BRLs), developing IP management strategies, negotiating licensing agreements, and aligning research outputs with industry and societal needs. These domains reflect widely recognised critical success factors for bridging academia-industry gaps, as highlighted by Etzkowitz and Leydesdorff's (2000) Triple Helix model, which stresses the interdependence of universities, industry, and government in driving innovation ecosystems.

This article presents an evaluation of the workshop's outcomes drawing on multiple sources of evidence, including pre- and post-assessment data to measure knowledge gains, participant satisfaction surveys, and a thematic analysis of post-event interviews. The findings contribute to the growing body of scholarship on research translation and commercialisation by providing empirical insights into the efficacy of experiential learning models in building innovation capacity among researchers. Ultimately, the analysis underscores that bridging the gap between research and industry is not merely a matter of individual researcher capability but requires systemic and institutional interventions that foster entrepreneurial mindsets, facilitate cross-sector partnerships, and embed ethical and sustainable innovation practices (Weiss, 1995; Connell & Kubisch, 1998). Through structured initiatives universities can play a pivotal role in ensuring that academic research progresses beyond publication and patents towards impactful, market-ready solutions that address pressing societal challenges.

Objectives

The objective for this project is to enhance the capacity of researchers, and technology transfer professionals in translating research outputs into market-ready innovations by providing a structured, experiential incubation programme, integrating transformative learning, techno-entrepreneurship training, mentorship, and pre-commercialisation funding, while measuring its effectiveness using a Theory of Change-based evaluative approach.



Figure 1: One of the activities during the program

NALI Approach

Novelty: The novelty of the Framework lies in its holistic and evidence-based approach to bridging the research-to-market gap through a unique integration of experiential learning, structured technology transfer training, and post-workshop mentorship. Unlike conventional one-off commercialisation workshops, ICCubeX adopts a multi-phase model comprising pre-needs assessments, expert-led lectures, real-world case studies, interactive exercises, and tailored mentoring, thereby ensuring both immediate and sustained capacity development. The programme is contextually designed for Malaysia's innovation ecosystem while incorporating global best practices, particularly through its collaboration with Aberystwyth University, and embeds ethical and sustainability principles into IP licensing and commercialisation strategies. Its operationalisation of the Triple Helix model by engaging academia, industry, and government stakeholders, coupled with rigorous pre- and post-assessment metrics, positions ICCubeX as a scalable and replicable framework for research translation. This combination of experiential pedagogy, cross-sectoral engagement, and impact-driven design represents a distinctive and innovative contribution to the field of research commercialisation capacity-building.

Creativity: The Framework demonstrates creativity through its innovative design and holistic implementation. It adopts a blended experiential learning model that combines expert-led lectures, real-world case studies, interactive exercises, and post-workshop mentorship to engage participants actively and build practical competencies. Its multi-phase structure, beginning with a pre-workshop needs assessment and continuing with personalised post-event mentoring, creatively addresses participants' varied backgrounds from academia, industry, and government while ensuring sustained impact beyond a single training session. By embedding ethical and sustainability principles into intellectual property and commercialisation strategies, and fostering cross-sector collaboration through the Triple Helix framework, ICCubeX goes beyond traditional capacity-building approaches. The incorporation of innovation workbooks, hands-on role-play, and an evidence-based evaluation framework further illustrates its creative pedagogy and impact-driven design, positioning it as a replicable and scalable model for effectively bridging the gap between research and market adoption.

Applicability: The Framework offers a practical, scalable model to bridge the gap between academic research and market adoption. Its adaptable framework—needs assessments, experiential workshops, and post-mentorship—makes it transferable across universities, research institutes, and TTOs in Malaysia and internationally. ICCubeX enhances institutional technology transfer by building competencies in TRLs/BRLs, IP management, licensing, and market validation, aligning research outputs with industry needs and national innovation policies. Its focus on ethical and sustainable innovation supports institutions integrating responsible research and innovation (RRI) principles. Practical tools like the Innovation Starter Workbook help participants develop actionable strategies, from spin-offs to licensing and industry collaborations. Beyond academia, ICCubeX serves policymakers and funders with its data-driven, measurable outcomes, informing innovation policies and priorities. Its cross-sector Triple Helix approach further promotes systemic collaboration and knowledge exchange. Overall, ICCubeX's flexible design and evidence-based evaluation make it a replicable global model for strengthening research translation, fostering entrepreneurship, and driving sustainable socio-economic impact.

Impact: The Framework delivers measurable impact at the individual, institutional, and societal levels while advancing UTM's vision of being a globally renowned centre of innovation and its mission to develop holistic talents for societal benefit. At the individual level, ICCubeX strengthens participants' competencies in TRLs, BRLs, IP management, licensing, market validation, and industry collaboration. Pre- and post-assessments show significant knowledge gains, with over 70% planning actionable steps such as market assessments, IP filings, and industry partnerships. At the institutional level, the programme enhances UTM's leadership in technology transfer and innovation by embedding ethical and sustainability principles, applying the Triple Helix model, and fostering academia–industry–government collaboration. Experiential learning and mentorship attract diverse stakeholders and support UTM's commercialization KPIs. At the societal level, ICCubeX contributes to Malaysia's innovation agenda and SDGs by generating market-ready technologies, potential spin-offs, and measurable economic and social value.Internationally, ICCubeX has

been recognized as an ASEAN and global reference model, producing award-winning techno-entrepreneurs, winning Gold (NALI 2024) and Bronze (INATEX 2024), and securing a GBP 19,937 British Council grant to scale. Overall, ICCubeX positions UTM as a regional leader in research translation and responsible innovation, driving sustainable socio-economic progress through impactful knowledge commercialization.

Research Methodology

The effectiveness of the workshop was evaluated using a mixed-methods approach grounded in the Theory of Change (ToC) framework to map programme activities to the outcomes. The ToC model ensured that the intervention directly addressed participants' needs and was responsive to their learning objectives. The approach emphasised participatory learning, with stakeholders actively engaged in co-creating solutions during the training. The evaluation focused on measuring changes in participants' knowledge, skills, and confidence before and after the workshop, as well as their intent to apply the acquired competencies. A purposive sampling strategy was adopted to ensure the inclusion of participants with direct involvement in research, innovation, entrepreneurship, or technology transfer, with eligibility criteria requiring active engagement in projects demonstrating commercialization potential and representation across academia, government, and industry. In total, 96 participants were recruited for the workshop. Data collection was undertaken in three phases. During the pre-workshop stage, a baseline survey was administered to capture demographic profiles and to assess participants' knowledge of Technology Readiness Levels (TRLs), Business Readiness Levels (BRLs), IP management, licensing, and market analysis. The workshop incorporated participant observation and real-time feedback mechanisms to evaluate levels of engagement and to identify emerging needs. In the post-workshop stage, follow-up mentorship sessions were conducted to examine the extent to which participants applied the acquired concepts, while action plans were reviewed and a post-survey administered to measure improvements in knowledge, confidence, and satisfaction. Quantitative survey data were analyzed using descriptive and comparative statistical techniques to evaluate competency enhancement, whereas qualitative data derived from interviews and open-ended responses were subjected to thematic analysis to identify recurring challenges, support requirements, and actionable recommendations.

Findings and Discussion

Out of 96 participants, 50 answered the survey. Pre-workshop data revealed limited to moderate familiarity with commercialisation concepts, particularly in licensing agreements (mean 2.82/5), TRL (3.44/5), and IP management (3.16/5). Post-workshop analysis indicated marked improvements as shown in Figure 2. Participants showed strong knowledge gains, with 90% rating TRL understanding at 4–5, 72% for BRL, and 81% for licensing agreements. Overall mean rating demonstrated a marked increase from 3.07 prior to the workshop to 4.10 following its completion, representing an improvement of 33.5%. In addition, 98% are likely to take action gained from this workshop. At the 95% confidence level, this upward shift is statistically significant, thereby substantiating the effectiveness of the workshop in enhancing participants' knowledge, skills, and perceptions. The majority of participants intend to take concrete steps after the workshop, with the highest focus on industry partnerships (26%), commercialization roadmaps (24%), and market assessments (22%), while 16% plan to pursue IP protection and 12% engagement with TTO, reflecting a clear commitment to advancing research commercialization. Satisfaction was high, with 100% recommending and satisfied with the workshop showing strong endorsement. Overall, the workshop effectively bridged theoretical knowledge with practical application, equipping participants with actionable tools and strategies. Embedding more advanced negotiation simulations, funding acquisition strategies, and continuous mentorship could further enhance outcomes.

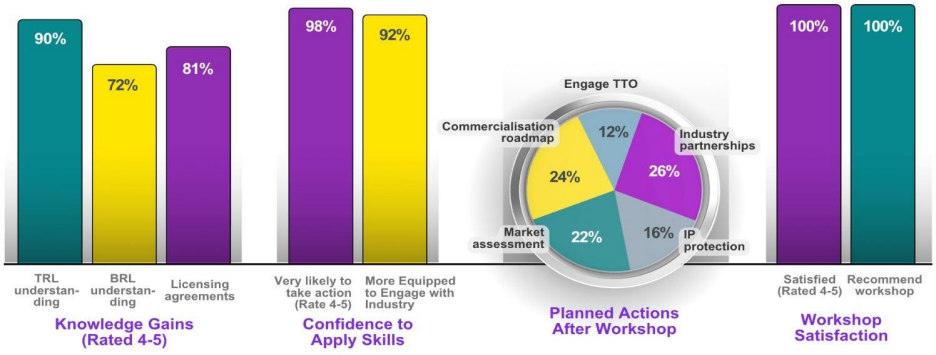


Figure 2: Post-workshop analysis result

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ICCubeX Playbook (**ISBN no: 978-967-26777-1-0**); ICCubeX Incubation Program (**LY2021E02634**); Technology Transfer Training Handbook - University's Best Practices with Real Case Studies (**LY2023J06439**); Technology Transfer Advanced Module: University's Best Practices with Real Case Studies (**LY2024J08796**); Technology Transfer Advanced Module: University's Best Practices with Real Case Studies (**LY2025J00803**); ICCubeX: Innovation Starter Logbook (**LY2025J00702**); Translating Research into Impactful Innovations: Case Study (**LY2025J00803**)

Commercialised Modules

The modules were successfully commercialised internationally through UTIM Sdn Bhd, generating gross sales of RM80,962.50 in 2023, RM125,500 in 2024, and RM60,159.10 in 2025, derived from training fees and handbooks.

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Awards

ICCubeX: Experiential Learning through the Transformational Incubation Programme, NALI2024, Gold Award

ICCubeX Ignite: Crafting Tomorrow's Solution, INATEX 2024, Bronze Award

Program Inkubasi Inovasi Pembelajaran Transformatif dan Pembangunan Teknopreneur, AINC 2024, 3rd Place.

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ID 112: SMART-IDP: A Digital-Integrated Design Studio for Sustainable Cities

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Highlights: Smart-IDP is a pioneering Digital Twin Lite workflow for the Integrated Design Project (ECC584), offering a cost-effective model while embedding digital fluency, sustainability, and authentic assessment. The innovation integrates multi-software simulations, cloud collaboration, role-play consultancy, MOOCs, automated feedback, and sustainability dashboards to replicate professional engineering practice. Evaluated with 111 students in Semester March-July 2025, findings show significant improvement in digital readiness, teamwork, communication, creativity, and workplace preparedness. Aligned with the Digital Education Policy (DEP 2023), EAC 2024 Graduate Attributes, and SDGs, Smart-IDP provides a scalable, inclusive model for higher education, TVET, and professional training towards industry-ready, future-proof graduates.

Keywords: Digital experiential learning; project-based learning; engineering education; sustainability; SDGs

Introduction

The evolving landscape of engineering education is shaped by demands for digital fluency, sustainability awareness, and problem-solving competencies aligned with the Fourth and Fifth Industrial Revolutions (IR4.0/IR5.0). In Malaysia, this expectation is reinforced by the Ministry of Education's Digital Education Policy (2023), UiTM's Education 5.0 framework, and the country's national commitment to achieve carbon neutrality by 2050. Employers increasingly emphasise that graduates must possess not only technical knowledge but also competence in digital tools, teamwork, and integrating sustainability. Nevertheless, many civil engineering programmes remain grounded in manual, fragmented, and document-heavy approaches that do not reflect industry practice. Students are therefore limited in their ability to visualise interdependencies across structural, geotechnical, infrastructural, and project management domains, while exposure to digital consultancy workflows remains minimal.

In response to these challenges, the Smart-IDP project was developed to transform the Integrated Design Project (ECC 584) into a digitally integrated design studio. Smart-IDP employs a "Digital Twin Lite" approach based on accessible multi-software integration and cloud platforms for teamwork collaboration. This makes the innovation more inclusive and scalable across the university and industry. The project redefines design education by integrating project-based learning and digital experiential learning, embedding simulation tools, collaborative dashboards, and sustainability-linked assessments into authentic consultancy-style tasks.

Objectives

The objectives of Smart-IDP are fourfold. First, it aims to strengthen students' ability to solve complex and integrated engineering problems through the use of digital tools. Second, it fosters multi-disciplinary collaboration in a simulated consultancy environment. Third, it embeds sustainability performance metrics such as carbon footprint, costing, and resource efficiency directly into student deliverables. Finally, it enhances students' digital competency in alignment with the Malaysian Qualifications Framework and the Digital Education Policy, ensuring graduates are future-ready.

NALI Approach

Novelty

Smart-IDP introduces a Digital Twin Lite workflow for capstone design projects, serving as a cost-effective learning model while retaining digital depth and professional authenticity (**Figure 1**). The novelty lies in its holistic integration of multiple digital components into a single learning ecosystem. Students collaborate through cloud-based platforms such as Google Drive and Microsoft Teams, supported by role-play consultancy exercises where students act as engineers, surveyors, and project managers, facilitators take the role of architects and general managers, and industry experts serve as clients. This simulated professional environment cultivates authentic teamwork and decision-making skills.

The innovation further embeds sustainability dashboards that visualise carbon emissions using MyCREST, a CIDB sustainability tool, allowing students to quantify and reflect on environmental impacts in their design. Learning is scaffolded by UiTM MOOCs to provide prerequisite knowledge in areas such as structural analysis and reinforced concrete design, supported by interactive platforms like Kahoot, Padlet, and Wayground. Assessment is streamlined through automated feedback in the U-Future Learning Management System, ensuring timely and consistent evaluation of digital submissions. At the technical level, the integrated design workflow links separate structural, geotechnical, infrastructural design, project costing and scheduling across multiple software, including AutoCAD, STAAD.Pro, Esteem, SkyCiv, SpaceGASS, and MS Project.

By merging these elements, **Smart-IDP** moves beyond manual, fragmented approaches, creating a digitally immersive design studio that mirrors consultancy practice while remaining accessible to students and institutions without BIM infrastructure. This marks the first structured initiative at UiTM to systematically embed digital experiential learning and sustainability-driven assessment into capstone projects, fully aligned with the New Academia Learning Innovation (NALI) model, the Digital Education Policy (2023), and Education 5.0@UiTM aspirations. Its novelty rests in demonstrating that meaningful digital transformation can be achieved inclusively, broadening access while directly addressing employer, accreditation (EAC Standard, 2024), and sustainability expectations.

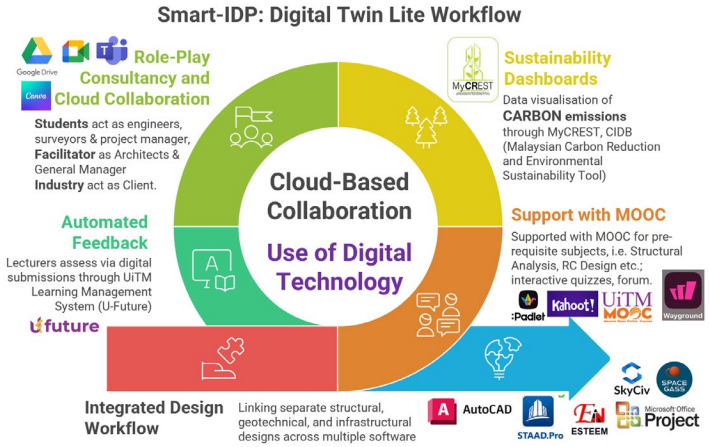


Figure 1: Digital Twin Lite in SMART-IDP project

Innovativeness and Applicability

The innovativeness of Smart-IDP lies in its ability to redefine the Integrated Design Project (IDP) as a digitally immersive learning ecosystem. Unlike conventional document-heavy approaches, Smart-IDP embeds a Digital Twin Lite workflow that integrates cloud collaboration, role-play consultancy, sustainability dashboards, MOOCs, and automated assessment. This approach not only mirrors professional consultancy environments but also operationalises the principles of authentic assessment, directly addressing complex engineering problems. The innovation improves on traditional teaching by simultaneously engaging the cognitive, psychomotor, and affective domains, enabling students to acquire technical expertise, digital proficiency, teamwork, communication, and ethical reasoning in a single structured platform.

In terms of applicability, Smart-IDP is directly aligned with the New Academia Learning Innovation (NALI) model, the Engineering Accreditation Council's 2024 Standards, and Malaysia's Digital Education Policy (2023). It empowers digital education in curriculum and assessment, develops students' digital competency, and cultivates the integrated, creative, innovative, and ethical use of digital technology as outlined under DEP Thrust 1. Furthermore, Smart-IDP is adaptable across different contexts: it can be scaled within UiTM campuses and other higher education institutions, expanded to polytechnics and TVET programmes, and extended to interdisciplinary design studios beyond civil engineering. The integration of SDG frameworks—particularly SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), and SDG 11 (Sustainable Cities)—demonstrates its global relevance.

Pedagogy and Approach

The pedagogical foundation of **Smart-IDP** combines Problem-Based Learning (PBL) and Digital Experiential Learning (DEL) to create an immersive and authentic learning environment. Through PBL, students are engaged in authentic problem-solving tasks that require them to define, plan, design, iterate, and present solutions to complex engineering challenges. This process is reinforced with structured reflection and evaluation, ensuring that students not only complete design deliverables but also critically assess their decision-making and teamwork processes.

Digital experiential learning complements PBL by embedding students in a technology-rich ecosystem. The learning cycle begins with concrete digital experiences, such as simulations, drafting, project management, and sustainability calculations using MyCREST. Students then move to observation and data review, where outputs are compared against manual calculations and gaps are identified. This is followed by abstract conceptualisation, in which digital outputs are connected to theory, design codes, and sustainability metrics. The cycle culminates in active experimentation, where students refine and optimise their designs based on facilitator and industry feedback, ultimately producing digital deliverables such as simulation results and collaborative reports.

Smart-IDP operationalises these pedagogies through collaborative studio work in both physical and digital environments. Students work in teams to integrate structural, geotechnical, and infrastructural designs, comparing manual and software-based analyses while justifying decisions with sustainability data. The approach is directly mapped to Course and Programme Outcomes (COs, POs), Knowledge Profiles (WKs), Complex Engineering Problems (WPs), and the three learning domains (cognitive, psychomotor, affective).

Assessment is conducted through complex problem and SDG-linked rubrics (Figure 2), ensuring that student performance is measured not only in terms of technical accuracy but also in terms of sustainability, ethical reasoning, and societal impact. These rubrics are co-evaluated by academic staff and professional engineers from industry, providing students with authentic feedback aligned to real consultancy expectations. This pedagogy therefore ensures that **Smart-IDP** delivers true outcome attainment, cultivating graduates who are digitally fluent, sustainability-conscious, and industry-ready.

Appendix A: Performance Criteria Matrix for Capstone Project (Report) (40%) cont'

Criteria	Weight	WP, WK	Description of Performance Criteria				
			E, F 0-30%	D, D+, C- 40-49%	C, C+ 50-59%	B-, B, B+ 60-74%	A-, A, A+ 75-100%
1.0 Superstructure Design							
1.1 Structural Key Plan CO2-PO3 (C5) SDG11,12	5	**WP1:** Depth of Knowledge Required ***WK3**: Engineering Fundamental* ***WK4**: Specialist Knowledge* ***WK5** – Engineering Design* ***WK6** -Engineering Practices*	Ability to prepare structural key plans including items (i) practical positioning, (ii) practical sizing, (iii) naming & numbering of structural elements; (iv) clearly written notes & title block and (v) correct gridlines/dimensions				
			Prepare none of the structural key plans	Prepare few structural key plans with less framing by fulfilling 1/5 item	Prepare some structural key plans with satisfactory framing by fulfilling 2/5 items	Prepare most of the structural key plans with good framing by fulfilling 3/5 items	Prepare all the structural key plans with excellent framing and fulfilling ≥4/5 items
1.2 Structural Design *- Application of Engineering Knowledge in Calculation* CO1-PO1 (C4) SDG11,12	10	**WP3: Depth of analysis:** no obvious solution, abstract thinking, originality	Ability to identify rationale assumptions, and apply engineering & scientific principles to formulate solutions				
			Apply limited engineering & scientific principles with uncertain assumptions	Use assumptions and apply engineering & scientific principles with ≥ 30% errors	Demonstrate satisfactory assumptions and apply engineering & scientific principles with 20-30% errors	Demonstrate reasonable assumptions and apply engineering & scientific principles with 10-20% errors	Justify assumptions with complete rationale and apply engineering & scientific principles with ≤ 10% errors.
1.2 Structural Design (Cont) *- Design Process* CO2-PO3 (C6) SDG11,12	10	**WP2: Range of Conflicting requirements:** wide & conflicting technical, engr & other issues **WP5: Extent of applicable codes**	Ability to perform design processes with **considering element SDGs** and various design constraints/considerations (i) public health and safety, (ii) reuse resources, (iii) net zero carbon, (iv) cultural and societal (v) environmental and (vi) economic context, and referring to appropriate codes of practice.				
			Imitate design processes	Demonstrate design processes without clear design considerations. No information on the code of practice used.	Satisfactory design basis accordance with 1 code of practices. Clear suggestions/ justifications on SDG elements and 1-2 design considerations	Good design basis with 2 code of practices. Clear suggestions/ justifications on SDG elements and 3-4 design considerations	Excellent design basis with ≥ 2 code of practices. Outstanding suggestions/ justifications on SDG elements and ≥ 4 design considerations

Figure 2: Part of the rubrics that address complex engineering problems and SDGs.

Research Methodology

The innovation was evaluated using a quantitative research approach involving 384 civil engineering students from Universiti Teknologi MARA (UiTM) who were enrolled in ECC584 during the March–July 2025 semester. Data collection consisted of an entrance survey administered at the beginning of the semester, an exit survey conducted at the end, rubric-based evaluations by industry panels, and a student perception survey assessing the impacts of the project. The entrance–exit survey, administered through UiTM's Learning Management System (U-Future), assessed students' perceptions of learning outcomes before and after completing the course. Rubric-based evaluations, conducted during Week 13 Presentation Day by invited professional engineers from industry, measured attainment of course outcomes and graduate attributes. Comments were gathered through interviews with the industry panels and comments in a rubric form. Meanwhile, the student perception survey, distributed via Google Forms using a five-point Likert scale, provided deeper insights into students' experiences with digital experiential learning, the complexity of the problems addressed, particularly their perceptions of critical thinking ability, teamwork ability, and workplace preparedness. The students were also asked to rate the level of complexity of the capstone.

Findings and Discussion

The findings confirm that **Smart-IDP** significantly improved students' readiness and confidence in digital and sustainability competencies. The complexity of the project was acknowledged by students, with 64% rating it as very complex and 31% rating it as medium. This validates the project's alignment with the Engineering Accreditation Council's (EAC 2024) descriptors for complex engineering problems.

The entrance–exit survey was conducted to evaluate students' perceptions of their knowledge, skills, and competencies before and after completing the course. The entrance survey results (blue bars) consistently showed average ratings around 2.0, indicating that students initially perceived their mastery of reinforced concrete design, engineering mechanics, design standards, sustainability awareness, and professional skills as being at a basic or emerging level. This suggests that, prior to Smart-IDP, most students lacked confidence in applying engineering fundamentals and professional skills within an integrated design context. In contrast, the exit survey results (orange bars) displayed a marked increase across all items, with ratings approaching 4.5 out of 5. Students reported substantial improvement in both technical competencies (reinforced concrete design, engineering mechanics, use of design standards, and sustainability knowledge) and professional skills (communication, report writing, teamwork, leadership, and independent work). Notably, high gains reflect the strength of Smart-IDP in addressing transversal skills alongside technical content.

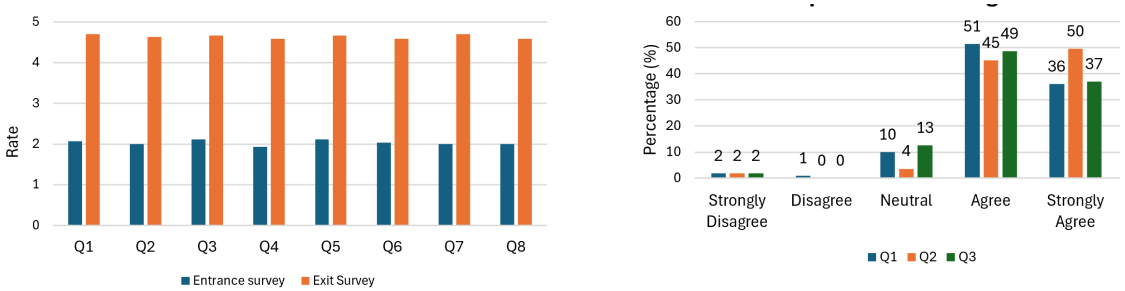


Figure 3. Survey Results (a) Entrance Exit Survey; (b) Student Perception survey

Left graph: Q1:I have acquired satisfactory knowledge on basic and fundamentals of reinforced concrete design Q2: have acquired satisfactory mastery of knowledge on engineering mechanics and civil engineering analysis Q3: I have acquired satisfactory knowledge in using design standards Q4: I have acquired satisfactory knowledge on sustainable issues related to engineering Q5: I am able to demonstrate effective communication skill through presentation Q6: I am able to demonstrate clear, concise and effective report writing Q7: I am able to lead a design project team Q8: I am able to work Q8: I am able to work independently.

Right graph: Q1 I feel more ready for professional/ industry workplace challenges; Q2 Count of My teamwork and communication skills improve; Q3 Count of I become more creative and enhanced critical thinking.

The student perception survey results indicate strong positive impacts of Smart-IDP on workplace readiness and professional skills. For Q1, more than 85% of students agreed or strongly agreed that they felt more prepared for professional and industry workplace challenges, showing the project's effectiveness in bridging academic learning with real-world expectations. Similarly, in Q2, over 80% reported improved teamwork and communication skills, highlighting the value of collaborative design tasks and role-play consultancy exercises. In Q3, approximately 86% agreed or strongly agreed that they became more creative and enhanced their critical thinking abilities, reflecting the benefits of problem-based learning and digital experiential approaches. Overall, the findings confirm that Smart-IDP cultivates not only technical knowledge but also transversal skills essential for employability, aligning with EAC 2024 graduate attributes and SDG-linked learning outcomes.

Commercialization Potential

Smart-IDP demonstrates strong potential for commercialisation as a scalable digital education solution that bridges academic learning with industry-relevant practice. Its Digital Twin Lite workflow, which integrates multi-software design, cloud collaboration, sustainability dashboards, and authentic assessment, can be packaged as a modular training platform for universities, polytechnics, and TVET institutions seeking cost-effective digital transformation without reliance on BIM infrastructure. The model can also be adapted into professional development programmes for engineers, surveyors, and project managers through micro-credential courses, MOOCs, or Continuing Professional Development (CPD) modules, generating revenue while enhancing workforce upskilling.

Beyond higher education, Smart-IDP can be commercialised through partnerships with industry bodies and local authorities, offering customised consultancy simulations, sustainability assessment tools, and digital project-based training for early-career engineers. Integration with existing platforms such as UiTM MOOC, U-Future, or regional e-learning systems creates opportunities for licensing, franchising, and cross-institutional adoption. With its alignment to the Digital Education Policy (DEP) and EAC 2024 Standards, Smart-IDP is well-positioned to expand as a national digital capstone framework, and potentially as an exportable Malaysian innovation in engineering education for international markets.

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Ministry of Education (2023). Digital Education Policy.

ID 113: DCN Peer Tutor Bot: An AI-Powered Personalized Learning Companion for Data Communication and Networks

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Highlights: The Data Communication and Networks (DCN) course poses significant challenges for students due to its abstract protocols, theoretical concepts, and diverse learning needs. To address this, the DCN Peer Tutor Bot was developed as an AI-powered personalized learning companion that integrates knowledge from core textbooks and validated examination materials with sound pedagogical frameworks. Designed to provide 24/7 tutoring support, the chatbot delivers topic-specific explanations, generates practice and exam-style questions, creates visual aids, tracks learning progress, and offers immediate feedback in a conversational manner that mirrors peer interaction. Implementation using the Pair–Compare–Confirm model demonstrated improved student engagement, deeper conceptual understanding, and enhanced higher-order thinking skills, positioning the DCN Peer Tutor Bot as a scalable and future-ready solution for personalized technical education.

Keywords: Artificial Intelligence; Personalized Learning; Peer Tutor Bot; Data Communication and Network

Introduction

The Data Communication and Networks (DCN) course is widely recognized as challenging, as it comprises roughly equal proportions of theoretical and calculation-based content. Students often struggle with the theoretical aspects, particularly abstract networking protocols that are difficult to visualize, which can lead to misconceptions and a superficial understanding. These challenges are compounded by the diverse backgrounds of students enrolled in the course, many of whom are from non-electrical engineering disciplines and require differentiated instruction that traditional teaching methods often fail to provide. Large class sizes further exacerbate the issue, as lecturers are unable to offer individualized support, allowing small knowledge gaps—such as weak comprehension of foundational topics like the OSI model—to develop into barriers for mastering advanced concepts. Although peer tutoring can be beneficial, human tutors are often limited by their availability, expertise, and scalability. In response to these challenges, Artificial Intelligence (AI) was utilized to design a peer tutor capable of delivering personalized learning experiences, providing immediate feedback, and monitoring progress both inside and outside the classroom (Holmes et al., 2019; Zawacki-Richter et al., 2019).

Objectives

i. To develop an AI Peer Tutor Bot that supports personalized learning in the Data Communication and Networks (DCN) course.
ii. To implement the DCN Peer Tutor Bot in and beyond classroom settings to deliver real-time support, feedback, and tracking of learning progress.
iii. To evaluate the effectiveness of the bot in enhancing students' higher-order thinking skills through analysis of Course Learning Outcomes (CLO) achievement and student reflections.

NALI Approach

In this project, the NALI approach is employed to promote active, student-centered learning by integrating AI-powered personalized tutoring. By leveraging conversational AI grounded in pedagogy, the DCN Peer Tutor Bot fosters creativity, innovation, and reflective learning while meeting the diverse needs of students. This aligns with the NALI philosophy by transforming traditional classroom teaching into an interactive and adaptive learning experience that is both impactful and future-oriented.

Novelty: The DCN Peer Tutor Bot is unique in combining both knowledge context (core textbooks and validated exam materials) and pedagogical context (How People Learn framework, Gibbs' Reflective Cycle, and OBE principles) into a single AI-powered learning tool. Unlike conventional chatbots, it is explicitly tailored to meet the needs of engineering students who struggle with abstract networking concepts. This dual integration ensures not only accuracy of content but also delivery that supports reflective, deep, and outcome-driven learning (Johnson et al., 2014).

Creativity: The design of the chatbot incorporates a Pair–Compare–Confirm model that blends AI support with peer learning, ensuring that technology complements human interaction rather than replacing it. By creating visual aids, generating exam-style questions, and tracking student progress in a conversational style, the bot mimics a peer tutor while maintaining academic rigor. The creative integration of metacognitive prompts encourages students to reflect on their learning process and build long-term understanding.

Innovativeness: The innovation lies in the pedagogically grounded AI design, where natural language processing is not only used for delivering answers but also for facilitating adaptive, reflective, and personalized learning. Unlike traditional e-learning tools, the DCN Peer Tutor Bot engages students in dialogue that mirrors peer interaction, creating a more engaging and supportive learning environment. Its scalable design allows lecturers from different engineering backgrounds to adopt the same structured process, even without building their own custom chatbot.

Applicability: This innovation is highly applicable across engineering courses that combine abstract theories with technical problem-solving. By providing 24/7 personalized tutoring, it bridges the gap between classroom teaching and individual student learning needs. The structured methodology ensures that it can be implemented in large classes, interdisciplinary settings, and even adapted for other technical subjects beyond DCN, making it a flexible solution for higher education.

Impact: Implementation of the chatbot demonstrated improvements in student engagement, concept mastery, and higher-order thinking skills, particularly in areas such as analysis, critical reflection, and problem-solving. It reduces knowledge gaps by offering immediate clarification, preventing misconceptions from hindering future learning. Beyond the DCN course, the bot establishes a scalable model for personalized technical education, addressing challenges of diversity, large-class teaching, and the demand for lifelong learning in the digital era.

Research Methodology

Development of the Chatbot: The DCN Peer Tutor Bot was developed based on three core textbooks in Data Communication and Networks (DCN) and validated using past examination papers. Its functions include providing topic-by-topic explanations, generating practice and exam-style questions, creating visual aids, recommending supplementary resources, and tracking student progress. To ensure pedagogical soundness, the chatbot was designed using the How People Learn framework, Constructive Alignment (Biggs & Tang, 2011), and Gibbs' Reflective Cycle, enabling it to communicate with students in ways that promote deep and reflective learning. Importantly, the design is flexible, allowing lecturers who don't create their own chatbots to still use the structured process by integrating existing AI chatbot tools into their courses. The innovation brings together two main contexts: the knowledge context and the pedagogical context. The knowledge context is derived from three widely used DCN textbooks and further enriched with validated examination materials to ensure academic rigor. The pedagogical context is guided by the How People Learn framework to align with principles of effective learning, embedded with Gibbs' Reflective Cycle to foster metacognition, and structured within the Outcome-Based Education (OBE) framework to ensure alignment with the Course Learning Outcomes (CLOs).

Implementation in the Classroom: The classroom application of the chatbot was carried out using a structured *Pair–Compare–Confirm* model. In the first phase, *Pair*, students explored and attempted questions individually with the support of the AI. This was followed by the *Compare* phase, where students shared and discussed their findings in pairs or small groups, refining their understanding through peer input and clarifications from the chatbot; in larger classes, groups of four to five were formed to ensure manageable interactions. Finally, in the *Confirm* phase, groups consolidated their answers with supporting evidence. They presented their conclusions, after which the lecturer synthesized the key points to validate and align the student discussions with the intended Course Learning Outcomes (CLOs).

Assessment and Data Collection: The effectiveness of the chatbot was evaluated based on the achievement of CLOs, with particular emphasis on higher-order thinking skills, including analysis, reflection, and problem-solving. Data collection involved quizzes, tests, and the final examination, which were mapped to CLOs. The attainment levels were then analyzed to determine the impact of the DCN Peer Tutor Bot in enhancing higher-order cognitive learning outcomes in higher education.

Findings and Discussion

The effectiveness of the DCN Peer Tutor Bot was evaluated through Course Learning Outcome (CLO) attainment and thematic analysis of student feedback. Among the five CLOs in the Data Communication and Networks course, CLO1 to CLO4 were selected for study, as these outcomes most directly measure the development of higher-order thinking skills (Table 1).

Table 1: CLO mapping to Bloom's Taxonomy

# CLO	Course Learning Outcomes	Bloom Taxonomy
CLO1	Explain the concept of data communication using a layered approach based on OSI & TCP/IP and their applications.	C2
CLO2	Identify various types of computer networks for LAN and WAN.	C2
CLO3	Decide the configuration network using classful and classless IP address configuration in the LAN.	C5
CLO4	Analyze the network performance scenario problem	C4

The comparison of CLO achievements across multiple semesters (2021–2024) highlights significant improvements following the introduction of the chatbot, as shown in Figure 1. Notably, CLO2 (identifying different types of computer networks) and CLO3 (deciding appropriate configurations using classful and classless addressing) showed the most substantial gains. In Semester 2, 2024/2025, average scores for these CLOs exceeded 0.75, compared to only 0.42–0.60 in earlier semesters. This reflects the chatbot's effectiveness in providing immediate clarification, adaptive questioning, and personalized guidance to support the application of technical knowledge and problem-solving. CLO4, which focuses on analyzing network performance scenarios, also showed marked improvement. Scores

increased from 0.39 in Semester 1, 2022/2023, to 0.71 in Semester 2, 2024/2025, demonstrating that the chatbot effectively supports higher-order cognitive processes such as analysis and critical reflection. CLO1 (explaining foundational concepts), while meeting the KPI, showed comparatively more minor gains. This can be attributed to students' initial hesitancy to fully engage with the chatbot during the first few weeks of class. Once students became more familiar with its use, the emphasis of instruction had already shifted toward outcomes aligned with CLOs 2 and 3.

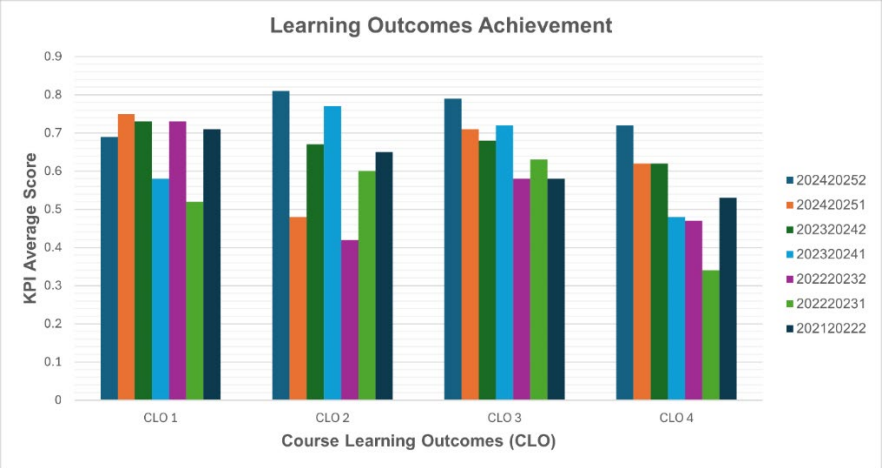


Figure 1: CLO Achievement Comparison

Overall, CLO3 and CLO4—mapped to Bloom's higher cognitive levels (C4–C5)—demonstrated the most substantial improvement, suggesting that the chatbot successfully enhanced students' ability to think critically, reflect on their learning, and make informed decisions. The integration of the chatbot with classroom activities created a supportive environment where students could first explore concepts individually, then validate and refine their understanding through peer and lecturer interaction. To further support these findings, weekly student feedback was analyzed thematically (Table 2). Three themes emerged: clarity of concept, effectiveness of learning activities, and engagement through peer interaction.

Table 2: Thematic Analysis of Student Feedback

Themes	Description	Students' Quote
Clarity of concept	Students gained clearer understanding of basic concepts	"I have learnt about the basic components of data communications, key elements of protocol, and the TCP/IP Model."
Effectiveness of teaching activities	Interactive methods were highlighted as most helpful.	"The quizzes helped keep attention and helped understand the topic better." "The 3-minute activities and mind-mapping helped me a lot." "The analogies and diagrams were very helpful. The questions Dr asked in class were also good to test our knowledge."
Engagement and peer learning	Opportunities to share opinions and collaborate made students feel more involved.	"The activities where all students need to give their opinions really make me feel involved in class." "Discussing questions from the previous week, even though asked by others, helped me learn together."

Students consistently reported that the chatbot enhanced their understanding of abstract concepts, such as networking protocols and the TCP/IP model, by providing explanations, analogies, and visual aids. Interactive activities, including quizzes, Cisco Packet Tracer simulations, and mind mapping, were enhanced by the chatbot's ability to provide immediate responses and personalized practice questions. Additionally, students valued opportunities for collaboration and discussion, with the chatbot serving as a reliable reference point that supported their learning both inside and outside the classroom.

Conclusion

Overall, the quantitative data on CLO achievement and the qualitative student feedback show that the DCN Peer Tutor Bot greatly improved learning results. By integrating academic rigor with pedagogically sound conversation design, the chatbot proved to be an effective and scalable tool for encouraging deeper understanding, engagement, and higher-order thinking in technical education.

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ID 114: Educating the Next Generation of Software Engineers: Agile, GitHub, and AI in Service Learning

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Highlights: In this study, the Application Development (AD) course which is part of the Software Engineering (SE) program has successfully integrated an Agile methodology, GitHub collaboration, and AI-powered tools into a unified, carefully structured workflow. Generally, students applied these three components concurrently while undertaking the real-world service-learning (SL) projects with schools and non-profit organizations and producing functional, high-quality technological solutions. Each of these components works together, with Agile practices guide project planning and iteration, GitHub facilitates transparent collaboration and version control, and AI tools enhance productivity, problem-solving, and creativity. This integration approach bridges theory and practice by assigning clear roles, defining milestones, and utilizing industry-relevant technologies that mirror professional development environments. In doing so, it not only builds technical proficiency but also achieves key learning outcomes in areas such as project management, collaborative software development, and ethical, user-centered design. Beyond academic goals, the course cultivates civic responsibility, teamwork, and readiness for complex, real-world challenges. Designed for scalability, it fosters innovation through reusable application templates, startup opportunities, and AI-enhanced educational resources, positioning it as a forward-thinking model for teaching software engineering with social impact.

Keywords: Agile; GitHub; AI Tools; Service Learning; Software Development Process

Introduction

The rapid evolution of digital technologies is reshaping how software is conceived, developed, and deployed, making it essential for future software engineers to master not only technical skills but also collaborative, adaptive, and socially conscious approaches to problem-solving. Traditional classroom instruction, while foundational, often falls short of replicating the complexity, pace, and interdisciplinary demands of real-world projects. To address this gap, innovative educational models are emerging that combine industry-relevant methodologies with community-oriented learning.

The initiative leverages Agile methodology, GitHub collaboration, and AI-powered development tools as a structured yet flexible framework for enhancing software engineering education (SEE). Similar to the eduScrum adaptation described by Neumann and Baumann (2021), which demonstrated that authentic agile projects can significantly increase student engagement and performance, our model immerses students in genuine, high-impact projects in partnership with schools and non-profits. By doing so, it bridges the divide between academic theory and practical application, enabling students to navigate the complete development lifecycle (from requirement gathering to deployment) while adopting defined or different roles, applying modern technologies, and following iterative development practices.

The approach also reflects the findings of Gonzalez-Huerta *et al*. (2020), who showed that integrating realistic software project experiences within coursework improves skill acquisition, knowledge transfer, and alignment with learning outcomes. Furthermore, AI tools such as ChatGPT and GitHub Copilot are embedded into the workflow, aligning with Salinas-Navarro *et al*. (2024), who highlighted the potential of generative AI to enrich experiential learning and authentic assessment, as well as Frankford *et al*. (2024), who demonstrated that AI tutors can offer timely feedback and scalable support for programming education. Beyond cultivating technical and project management abilities, the initiative seeks to foster civic responsibility, encourage ethical innovation, and prepare students for the challenges of a technology-driven society. Moreover, Its design allows for commercial scalability, paving the way for reusable application templates, early-stage startup ventures, and AI-enhanced educational tools. In this way, it serves not merely as a pedagogical framework but as a forward-looking blueprint for socially responsible, experiential technology education in the 21st century.

Objectives

The primary aim of this initiative is to create a learning environment where students can develop both technical expertise and social responsibility through real-world SE projects. By combining industry-relevant tools and methodologies with community engagement, the program ensures that learning outcomes extend beyond the classroom into meaningful societal contributions. In line with this vision, the objectives are as follows:

- To equip students with the ability to plan, design, and develop real software applications by guiding them through the complete software development lifecycle from requirements gathering to deployment and

ensuring they gain both theoretical understanding and practical competence.

- To encourage teamwork and experiential learning through the adoption of Agile methodologies and GitHub-based collaboration, enabling students to work in structured, iterative cycles that mirror industry best practices.
- To introduce and integrate AI-powered development tools, such as ChatGPT and GitHub Copilot, into the learning process, helping students enhance coding efficiency, improve software quality, and develop proficiency with emerging technologies that are shaping the future of software engineering.
- To strengthen problem-solving skills and ethical decision-making by engaging students in projects that address authentic, real-world issues, fostering a sense of accountability, empathy, and responsible technology use.
- To deliver impactful, user-friendly software solutions that directly benefit communities, particularly schools and non-profit organizations, ensuring the outcomes of student projects have tangible societal value beyond the classroom.

NALI Approach

This project offers a practical, industry-aligned approach to SEE by integrating Agile methodology, GitHub collaboration, and AI-powered tools into real community-based projects with clients such as schools and NGOs. Students work on authentic problems, applying Agile through iterative sprints while using GitHub as both a collaboration hub and a professional portfolio. AI assists in coding, documentation, design, and sprint planning which streamlining task generation, workload estimation, and goal alignment. The approach moves beyond classroom simulations, immersing students in real-world problem-solving while fostering critical thinking, creativity, and ethical AI use. AI serves as a mentor, providing feedback, alternative solutions, and idea generation to enhance project outcomes. This model is adaptable to other SE courses and welcomes multidisciplinary participation, ensuring broad applicability. Students graduate with tangible outcomes such as deployed applications, public portfolios, and hands-on experience in Agile planning, GitHub version control, and AI integration which equip them with both technical expertise and the professional readiness required to thrive in today's fast-paced, collaborative technology industry.

Research Methodology

The approach discussed in this paper is an enhancement of the initial model described in Hirol *et. al*, (2024) and Ghazali *et al*. (2024). Here, we discuss how the integration of the three components is being applied throughout the AD course while meeting the needs of the community. To achieve this, a comprehensive methodology, as shown in Figure 1, has been formulated and will be implemented through a structured, phased methodology that integrates theoretical instruction, experiential learning, and authentic community engagement.

The initiative will commence with a preparatory phase comprising targeted workshops on the Software Development Lifecycle (SDLC), Agile methodologies, GitHub-based collaboration, and the responsible use of AI-powered development tools, including ChatGPT and GitHub Copilot and project management tools such as Trello, Kanban and so on. This will ensure all participants possess a uniform foundation in technical skills, collaborative workflows, and ethical considerations. Some of the activities that have been conducted throughout the year to achieve this. In the requirements phase, students will engage directly with real stakeholders such as schools, faculty units, or research centers in UTM-MJIIT in order to identify genuine needs, conduct stakeholder interviews, and formalize findings into Software Requirement Specification (SRS) documents using design thinking principles. Figure 2 shows a few pictures taken when conducting the engagement with the stakeholders.

Next, the development phase will adopt an Agile Scrum framework, with students working in structured sprints, managing tasks through GitHub Projects, and implementing rigorous version control, code review, and peer collaboration practices. AI tools will be strategically integrated throughout the process to enhance productivity, support code generation, assist in documentation, and improve testing efficiency, with an emphasis on maintaining critical human oversight to ensure accuracy and quality. In the deployment and handover phase, students will conduct beta testing with end-users, gather feedback to refine the product, and deploy solutions via cloud platforms, accompanied by user training and documentation to ensure long-term sustainability. A showcase is conducted at the end of the semester to do the handover phase and shows each project that has been successfully developed by the students. Lastly, the final phase will involve structured reflection, with students producing post-project reports evaluating technical outcomes, AI integration, ethical decision-making, and the societal impact of their work. This methodology combines project-based and SL approaches with continuous formative assessment, enabling students to acquire advanced technical competencies, strengthen teamwork and problem-solving skills, and deliver impactful, user-centered software solutions that provide tangible benefits to the community.

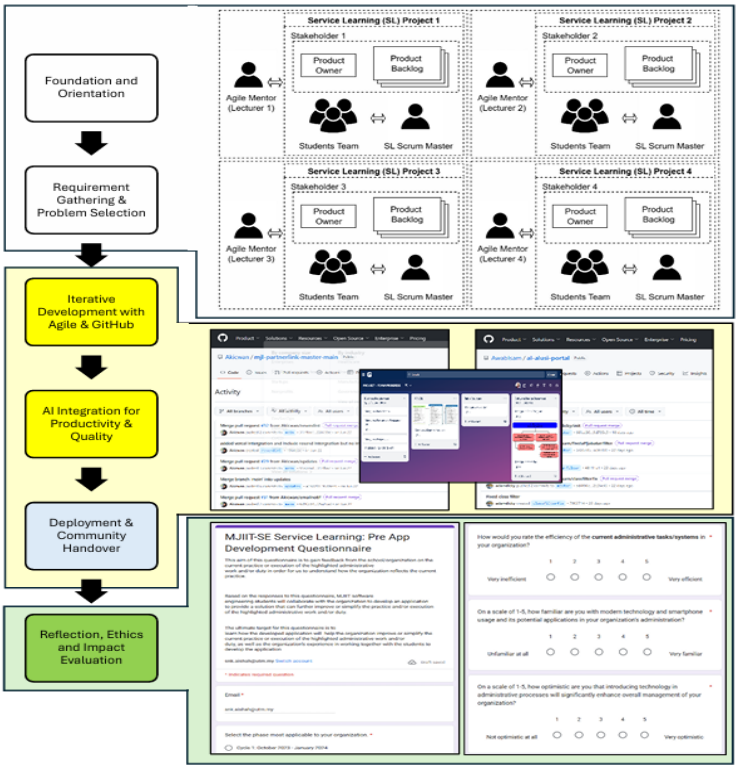


Figure 1: Comprehensive methodology for the AD course integrated with SL


Figure 2: Pictures taken when conducting the engagement with the stakeholders

Findings and Discussion

The service-learning project involved 55 students from two programmes namely Bachelor of Computer Science (REMS) and Bachelor of Computer Science (AD), where students worked collaboratively with a diverse range of stakeholders, including primary schools, secondary schools, religious schools, and university research units. They are also monitored by their Agile mentor (e.g. lecturer) during the session. These collaborations were facilitated through the involvement of designated stakeholder representatives and Project-in-Charge (PIC) members for service learning (shown in Table 1), ensuring that communication remained clear and project outcomes were aligned with real needs.

Table 1: Courses, Total number of students, the stakeholders and the Project-in-Charge (PIC) members involved

Course	Student (Year)	Total Students per Group	Stakeholder	Stakeholder PIC	PIC Service Learning
RESM (Requirements Engineering & Software Modelling-SEC15)	2	4	SK SENTUL 2	GB	DR SYARIFAH ZYURINA
		4	SK SAUJANA UTAMA	GB	DR AZURA
		5	SIRAJ AL ALUSI	GB	DR LIYANA ADILA
		5	SK TAMAN PUTRA PERDANA	GB	DR SUMIATY
		5	MJIIT: CAPSTONE PROJECT	DR LIEW PENG YEN	DR HATTA
		4	MJIIT: ACADEMIC CLASSROOM	PN SITI RAHMAH & EN AZROEL	DR FAIZ
		4	SK / SMK	GB	DR AMIR
		5	SK / SMK	GB	DR KAYISAH
AD (Application Development)	3	4	SK SAUJANA UTAMA	GB	DR AZURA
		4	SRI AL AMIN WP	GB	DR SITI RAHMAH
		4	SIRAJ AL ALUSI	GB	DR LIYANA ADILA
		4	MJIIT: RESEARCH UNIT	PN ARIFFI	DR AISHAH
		4	MJIIT: MUL	DR RUWAIDA	DR NEO CHIN CHEA

Students were organized into small groups of 4 to 5 members, enabling close engagement with each stakeholder and allowing for a more tailored development process. The project methodology followed an iterative development approach, with teams engaging in requirement gathering, prototyping, stakeholder feedback sessions, testing, and final refinement before deployment. This collaborative environment provided students with valuable exposure to real-world software engineering practices, including requirements elicitation, Agile development, and AI-assisted programming. Moreover, the project fostered soft skills such as teamwork, professional communication, time management, and ethical decision-making, while delivering tangible benefits to the community and institutional stakeholders. Based on survey given to the stakeholders, the findings of the project for each stakeholder are summarized in Figure 3, outlining the systems developed and the specific successes achieved by the student teams.

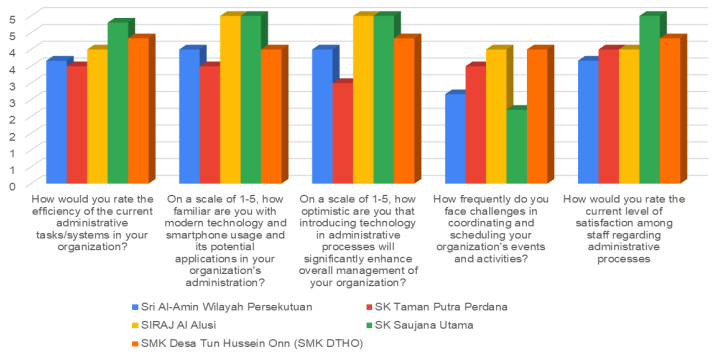


Figure 3: The findings of the project for each stakeholder

The findings indicate that administrative performance across the organizations is already robust, with high levels of efficiency, satisfaction, and technological familiarity, complemented by a generally positive attitude toward adopting innovative solutions. This environment is conducive to the strategic integration of Agile methodologies, GitHub-based collaboration, and artificial intelligence (AI) tools to address existing coordination and scheduling challenges. Agile provides a flexible, iterative framework that enables continuous improvement through regular feedback cycles, ensuring process enhancements are responsive to evolving needs. GitHub offers a centralized and transparent platform for version control and collaborative project management, facilitating seamless communication and resource sharing among administrative teams. AI technologies further enhance these capabilities by automating routine tasks, optimizing scheduling, predicting resource constraints, and delivering data-driven insights for informed decision-making. The combined application of these approaches not only addresses the most significant operational inefficiencies but also strengthens adaptability, collaboration, and intelligence in administrative processes. Such integration promises to transform current systems into a more agile, efficient, and strategically driven administrative ecosystem while safeguarding the high-performance levels already achieved. Overall, the results indicate that all student groups successfully met their stakeholder requirements, delivering functional and user-friendly systems with clear benefits to the intended users. The involvement of actual clients created a professional working environment that closely mirrored industry practice, reinforcing students' technical capabilities while instilling a sense of accountability and ownership. Notably, several stakeholders expressed interest in continuing to use and further develop the systems beyond the project period, indicating sustainable impact and long-term applicability.

Commercialization Potential

The outcomes of this initiative extend beyond the immediate delivery of community-focused applications, offering long-term value through scalable and transferable resources. Applications developed by students are designed with adaptability in mind, enabling them to be repurposed for broader contexts such as school management systems or donation tracking platforms. Some of these projects have the potential to evolve into startup ventures, as student teams refine their solutions for commercial viability. Additionally, the incorporation of AI throughout the development process opens opportunities for creating specialized AI-powered tools and plugins that can be shared within the developer community. The knowledge and methodologies gained can also be transformed into structured training kits, making it possible to conduct workshops and courses tailored for NGOs, small businesses, or educational institutions. Furthermore, Agile workflows optimized through platforms like Jira can be distilled into process automation templates, providing other institutions with ready-to-use frameworks for executing similar service-learning projects efficiently and effectively. This combination of adaptability, entrepreneurial potential, and knowledge sharing positions the initiative as a model that bridges education, community service, and sustainable innovation.

Awards Received

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ID 115: Tech Meets Touch: Enhancing Hands-On Learning of Sports Massage in Large Halls

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Highlights: Tech Meets Touch: Enhancing Hands-On Learning of Sports Massage in Large Halls highlights the innovative use of the Osmo Pocket Camera with Artificial Intelligence (AI) capabilities to transform practical teaching. By projecting real-time demonstrations onto big screens, every student gained clear visibility of massage techniques despite the large hall setting. While AI dynamic framing was not activated, the camera's stabilization and recognition features reveal strong potential for AI-driven community learning. This initiative bridges technology and tactile learning, creating scalable, engaging, and impactful community-based education.

Keywords: Sports Massage; Interactive Teaching and Learning; AI Technology-Assisted Approach

Introduction

Teaching hands-on skills such as sports massage presents unique challenges in higher education and community training contexts. Skill acquisition in this domain requires learners to integrate visual, auditory, and kinesthetic information, with direct observation of expert demonstrations playing a central role (Magill & Anderson, 2017). When conducted in small groups, students can gather closely to observe fine details such as hand positioning, rhythm, and pressure application. However, in large halls with high student numbers, visibility becomes a major barrier. Learners positioned far from the instructor may be unable to clearly follow the demonstration, which leads to disengagement, incomplete understanding, and errors in skill replication (Sigrist et al., 2013; O'Donoghue, 2014).

This issue is not unique to sports massage; similar challenges have been documented in sports coaching, medical education, and physical training programs. For example, research shows that visual demonstration quality directly influences motor learning, particularly in tasks that rely on precision and coordination (Wulf & Shea, 2002). In medical skills training, video-based and projection technologies have been used successfully to improve visibility and standardize instruction in large cohorts (Ziv et al., 2003; McGrath et al., 2018). Moreover, technology-assisted feedback systems, including AI-based movement recognition, have demonstrated significant improvements in student learning outcomes, engagement, and confidence (Xu et al., 2025).

The emergence of compact AI-integrated devices, such as the DJI Osmo Pocket Camera, provides new opportunities to address these challenges. Its features, including 3-axis stabilization, intelligent object tracking, and high-definition video projection, offer scalable solutions for teaching environments with large audiences (DJI, 2023). By projecting demonstrations in real time, every learner, regardless of seating position, can access clear and detailed visuals of massage techniques. While AI dynamic framing was not enabled in this project, the stabilization and recognition functions alone revealed strong potential for enhancing the quality and reach of hands-on learning. This innovation contributes to bridging the gap between technology and tactile community learning, ensuring effective skill transmission even in large-scale educational contexts.

Objectives

The aim of this innovation is to enhance the effectiveness of teaching and learning practical skills in large hall settings by addressing the visibility challenges that often diminish student engagement. In such environments, students positioned far from the instructor frequently struggle to observe critical details such as hand placement, pressure, and movement sequence, which leads to reduced focus and passive participation. By integrating AI-enabled technology, particularly the Osmo Pocket Camera, demonstrations can be projected in real time with improved clarity and accessibility for all learners. This approach ensures equal opportunities to observe and replicate techniques accurately while promoting active involvement, sustained attention, and confidence in applying the skills. As a result, the innovation directly strengthens student engagement and supports a more interactive and effective learning process.

NALI Approach

This innovation aligns with the New Academia Learning Innovation (NALI) 2025 framework across several dimensions, which are:

Novelty

- Introduces the use of an AI-equipped Osmo Pocket Camera to project live demonstrations of sports massage techniques in large-scale hall settings.
- Provides a new pedagogical solution to overcome the persistent challenge of limited visibility in practical instruction.

Creativity

- Combines technology with tactile learning, merging visual projection with hands-on practice.
- Enables students not only to see techniques more clearly but also to replicate them with greater accuracy and engagement.

Innovativeness

- Employs AI-driven features such as stabilization and object recognition to enhance real-time clarity of demonstrations.
- Demonstrates potential for further advancement through future application of AI dynamic framing and subject tracking.

Applicability

- Versatile for use in secondary schools, universities, vocational training centres, and community education programs.
- Provides a scalable model adaptable to any discipline requiring practical demonstrations, such as physiotherapy, first aid, or vocational skills.

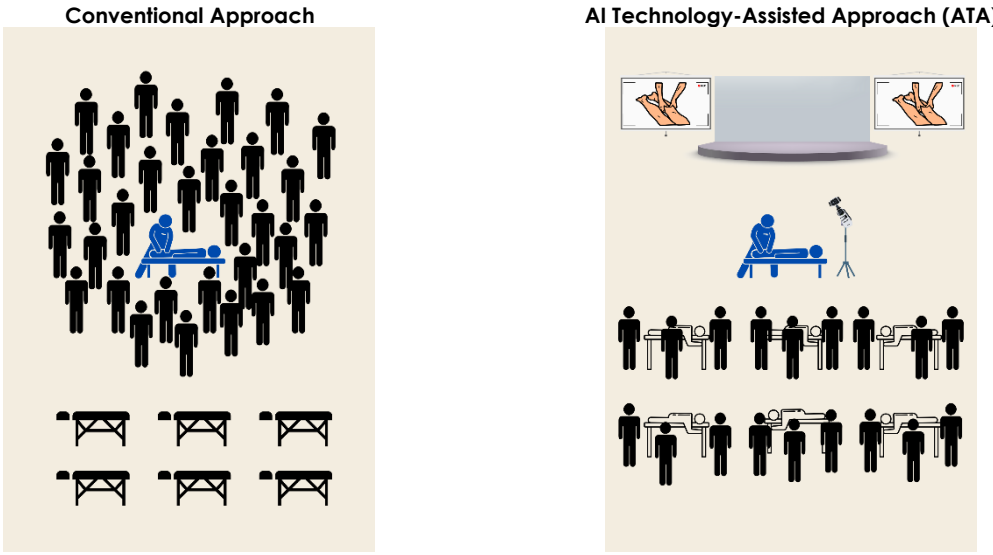


Figure 1: Comparison between Conventional Approach and AI Technology-Assisted Approach (ATA) in Teaching Practical Sports Massage Skills.

Research Methodology

This study used an observational and descriptive design to evaluate the effectiveness of integrating AI-enabled technology in teaching practical skills within a large hall setting. The session was conducted in a school hall and involved 30 secondary school students as participants, and 10 facilitators.

The teaching process was divided into two stages:

- Conventional approach – A 30-minute sports massage demonstration delivered directly by the instructor without technology assistance.
- AI Technology-Assisted Approach (ATA) – The same demonstration was then repeated using the Osmo Pocket Camera. The device captured the instructor's hand movements and projected them in real time onto large screens. Its AI features such as stabilization and object recognition ensured clear visuals for all students, regardless of their seating position. Although the AI dynamic framing function was not used, it was noted as a potential feature for future application.

After both approaches, students were given a questionnaire to evaluate their experience in terms of Visibility, Understanding, and Confidence. Facilitators also answered a questionnaire focusing on Facilitator Efficiency. In addition, facilitators observed student attentiveness and accuracy during practice sessions, and reflections were recorded to capture strengths and challenges of the ATA.

Data from questionnaires were analysed descriptively, while qualitative feedback from students and facilitators was thematically reviewed. This multi-source approach provided a comprehensive assessment of how ATA compared with the conventional method in improving clarity, engagement, and efficiency in large hall teaching.

Findings and Discussion

The use of the Osmo Pocket Camera for real-time projection successfully addressed visibility challenges in large halls. Students gained clearer access to demonstrations, while facilitators experienced more efficient teaching. The impacts can be summarized as follows:

Students

- Improved visibility of hand positioning and movement sequences.
- Better understanding of sports massage techniques.
- Increased confidence in practicing basic sports therapy.

University Facilitators

- Reduced need for repeated demonstrations.
- More time allocated for guided practice and individual feedback.
- Enhanced digital community learning skills using AI-enabled tools.

Overall, the combination of AI-enabled camera technology and hands-on learning created a more engaging and dynamic environment. Although the AI dynamic framing feature was not activated, the stabilization and recognition functions highlighted the potential of AI-driven community learning to scale practical skill training for wider educational and community applications.

Project Impact Data

Quantitative Impact:

- Number of participants: 30 secondary school students + 1 school teacher + 10 university facilitators.
- Visibility of demonstrations: 53% of students reported clearer visibility of hand positioning and movements through big screen projection.
- Understanding of techniques: 86% of students indicated a better understanding of sports massage techniques.
- Student confidence: 15% of students reported increased confidence in practicing basic sports massage.
- Facilitator efficiency: 71% reduction in repeated demonstrations, allowing more time for guided practice and feedback.

Table 1: Quantitative impacts of AI Technology-Assisted Approach (ATA)

Type of Approach	Visibility	Understanding	Student Confidence	Facilitator Efficiency
CONVENTIONAL	2.90	2.35	3.97	2.66
ATA	4.46	4.36	4.59	4.56
% DIFFERENCES	53.73	86.02	15.77	71.55

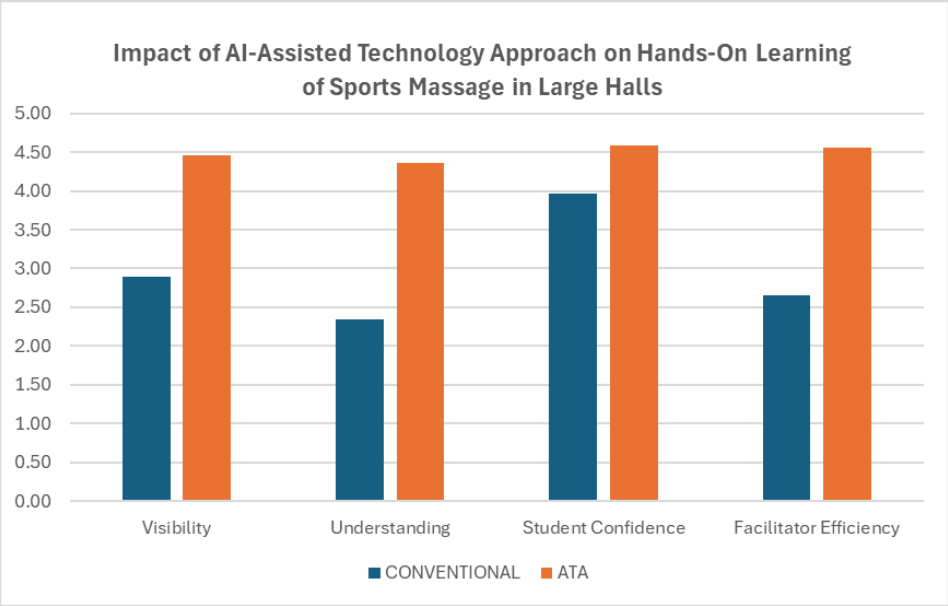


Figure 2: Impact of Conventional and AI Technology-Assisted Approaches (ATA) on Hands-On Learning of Sports Massage in Large Halls.

Qualitative Impact:

Students:

"I could see clearly even from the back, so I felt more confident to try it myself."

"The live video was more engaging than just listening to explanations, we can also do the techniques together with a facilitator."

University Facilitators:

"This technology saved us time, and we could focus on coaching students during practice."

"Using this AI camera enhanced our digital community learning skills."

Community:

"This activity showed us the importance of sports massage for daily health."

"The blend of technology and practical skills made learning more fun and relevant."

Conclusion

Tech Meets Touch: Enhancing Hands-On Learning of Sports Massage in Large Halls shows that using the AI-enabled Osmo Pocket Camera can effectively solve visibility and engagement challenges in large-scale teaching. Real-time projection improved students' understanding, confidence, and participation, while facilitators gained efficiency and the community benefited from greater health awareness. Despite not activating dynamic framing, the stabilization and recognition features proved effective, highlighting strong potential for future AI-driven teaching solutions. This innovation bridges technology and hands-on practice, creating a scalable and impactful model for education and community learning.

Acknowledgement

We gratefully acknowledge the support and sponsorship provided by Kolej Tun Razak, the UTM Centre for Community and Industry Network (CCIN), Maktab Rendah Sains Mara (MRSM) Batu Pahat and the 1 Kolej 1 Daerah (1K1D) 2025 Committee.

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ID 116: Empowering Students through Project-Based and Peer Teaching Approaches: An AI-Driven Integration Calculator with GUI for Effective Learning

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Highlights: This project introduces an innovative Graphical User Interface (GUI) Calculator for Numerical Integration that integrates Artificial Intelligence (AI) to enhance teaching and learning. The embedded AI verifies solutions, computes error values, and generates visualizations such as error tables and accuracy graphs, enabling students to assess the reliability of their answers. Grounded in Problem-Based Learning (PBL), the calculator encourages exploration of real-world problems while fostering critical thinking. Through Peer Teaching, the GUI also empowers students to guide classmates, making AI a collaborative teaching partner in mathematics education. Findings revealed that most students reported enhanced understanding, stronger problem-solving skills, and greater satisfaction with teaching delivery.

Keywords: integration calculator; Graphical User Interface (GUI); Numerical Integration; Problem-Based Learning (PBL); Peer Teaching

Introduction

Mathematics and computation are closely connected, especially in the study of numerical methods, which are essential for solving mathematical problems that do not have closed-form solutions. Numerical integration plays an important role in engineering applications such as structural analysis, fluid dynamics, and signal processing. According to Sauer (2018), mastery of numerical methods requires both theoretical knowledge and the ability to implement algorithms effectively in computational environments. Similarly, Mohd et al. (2021) emphasize that digital tools and programming applications enhance students' ability to apply mathematical concepts in practical problem-solving. In the context of modern education, project-based learning (PBL) and peer teaching have been recognized as powerful approaches to improve student engagement and understanding. As noted by Thomas (2020), PBL allows students to actively construct knowledge through real-world projects, while Topping (2019) highlights that peer teaching encourages deeper learning by positioning students as both learners and teachers. These approaches not only strengthen students' conceptual grasp but also improve communication, teamwork, and critical thinking skills.

For students in the Numerical Methods course at Universiti Teknologi Malaysia and other engineering institutions, understanding numerical integration techniques such as the Trapezoidal Rule, Simpson's Rule, and Gaussian integration is fundamental. However, many students struggle to apply the correct techniques and interpret results accurately. Research by Yusof and Zakaria (2022) indicates that numerical analysis is often perceived as difficult due to the abstractness of the concepts and the challenge of linking formulas to algorithmic solutions. To address these issues, this project introduces an AI-driven integration calculator with a graphical user interface (GUI). The calculator provides informative computational guidance with an AI-friendly interface, enabling students to experiment with different numerical methods in an interactive manner. Through the combination of PBL and peer teaching, students not only learn how to apply these techniques but also gain experience in designing, explaining, and testing solutions collaboratively.

Therefore, this project seeks to empower students by merging AI technology, PBL, and peer teaching into the learning of numerical integration. The integration calculator with GUI serves as both a practical computational tool and a collaborative learning platform, fostering mastery of numerical methods while enhancing creativity, confidence, and digital competence.

Objectives

i. To apply Problem-Based Learning (PBL) by challenging students to design an AI-assisted calculator tool that simplifies the learning of integration.
ii. To promote Peer Teaching using the AI tool as a medium for students to explain and guide their classmates.
iii. To enhance student engagement and motivation by integrating AI-driven to explain the accuracy of the final answer.

NALI Approach

A novel, systematically designed learning framework has been developed for Numerical Integration within the Numerical Methods SSCE2793 course, aimed at addressing the challenges faced by engineering students. This innovation combines project-based learning (PBL) and peer teaching with the use of an AI-driven integration

calculator equipped with an interactive GUI. Through this approach, students not only learn by solving real-world problems but also strengthen their understanding by explaining concepts and guiding their peers, fostering both independence and collaboration. As noted by Thomas (2020), PBL offers authentic learning opportunities, while peer teaching promotes deeper comprehension and teamwork (Topping, 2019).

The AI-driven calculator is designed with several advanced features that enhance students' learning experience. It integrates multiple numerical methods such as the Trapezoidal Rule, Simpson's Rule, Romberg Integration, and Gaussian Quadrature, allowing students to compare the performance of different approaches. Its interactive GUI design provides an intuitive platform for entering functions, intervals, and step sizes, reducing barriers that students often encounter when coding or performing lengthy manual calculations. In addition, the calculator incorporates an error analysis feature, offering both absolute and relative error values that guide students in evaluating the accuracy of their solutions. To further support critical analysis, comparative tables are generated to display results from various methods side by side, while graphical visualization illustrates the function curve and the approximated integral area, enabling students to clearly observe how numerical methods converge to the exact solution. The tool is also developed with flexibility in mind, as it can be reset and adjusted easily, encouraging iterative exploration and experimentation. Moreover, it is applicable to real-world engineering contexts such as load analysis, fluid flow estimation, and energy computations, thereby bridging the gap between theoretical knowledge and practical application.

To evaluate the effectiveness of this framework, students' performance will be assessed through peer teaching activities that measure their ability to apply numerical methods, analyze errors critically, and communicate results effectively. By embedding these targeted instructional strategies into the course, the project is expected to empower students to master numerical integration while enhancing their creativity, confidence, and digital competence, ultimately preparing them for the demands of professional engineering practice.

Research Methodology

The flowchart describes the process of developing and using an AI-enhanced Graphical User Interface (GUI) tool for numerical integration. It is divided into four main stages:

Stage 1: Research / Innovation
Students demonstrate innovation through a Problem-Based Learning (PBL) approach. Instead of merely applying formulas, they identify real-world integration problems, design a Graphical User Interface (GUI), and embed AI components for error detection and analysis. This innovation encourages students to think critically, test solutions, and compare manual versus AI-assisted methods. Furthermore, by sharing their GUI designs and solutions with peers, students engage in peer teaching, which reinforces their understanding while fostering collaboration and creativity.

Stage 2: Implementation
Students implement their innovative ideas by developing the GUI and testing it with both simple and real-world integration problems. At this stage, inputs are defined, numerical integration is executed, and AI components are embedded to verify answers and provide error analysis. This hands-on implementation allows students to bridge theoretical knowledge with practical application.

Stage 3: Evaluation
Students evaluate the effectiveness of the GUI and AI integration by analyzing the accuracy of results through error tables and graphical representations. This stage emphasizes reflective learning: students who want deeper insight into the final answers use the embedded AI to compute error values and visualize accuracy, while those satisfied with a basic check may verify their answers manually.

Stage 4: Training
In this stage, peer teaching is actively encouraged, as students from different classes collaborate to discuss and validate their findings, fostering deeper understanding and critical evaluation of numerical integration methods. The original student developers guide their peers, extending the benefits of the AI-assisted integration tool to a wider student community. Through guided practice, learners explore numerical integration techniques, visualize error analysis, and enhance their problem-solving skills. This collaborative process not only reinforces conceptual understanding but also cultivates a culture of knowledge sharing, active learning, and continuous improvement.

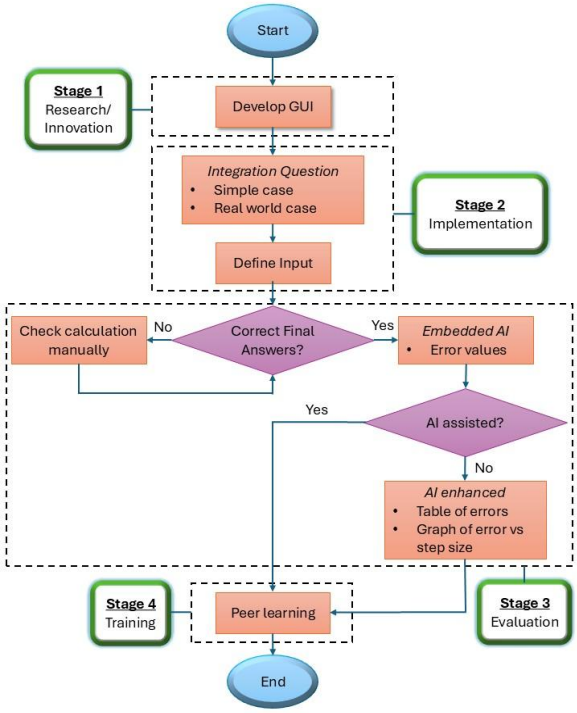


Figure 1: Flowchart of the learning process of users using integration calculator

Findings and Discussion

To evaluate the usability and impact of the developed AI-driven integration calculator with GUI on the teaching and learning experience, a set of questionnaires was administered to 27 students in the Numerical Methods course. The analysis focused on three key dimensions which are teaching delivery, student-centred learning, and the NALI framework, with questionnaire items adapted from established instruments by Ramsden (1991), Attard et al. (2010), and Salim et al. (2018). Table 1 presents the students' feedback on the use of the calculator across these dimensions.

Table 1 : Student's feedback

Student's Feedback	Strongly Agree	Agree	Disagree	Strongly Disagree
Teaching Delivery (Enhanced understanding)	22	5	0	0
Student-Centered Learning (Developed problem-solving skills through the tasks given)	17	9	1	0
NALI Framework (Enhanced learning experience)	20	6	1	0
Overall Satisfaction (Satisfied with teaching delivery using application)	21	6	0	0

As shown in Table 1, the students' feedback on the use of the AI-driven integration calculator with GUI indicates a highly positive reception across various dimensions of teaching and learning. Most students strongly agreed that the tool enhanced their understanding of teaching delivery, with 22 students selecting strongly agree and 5 selecting agree. It also promoted student-centered learning through the development of problem-solving skills, as reflected by 17 students who strongly agreed and 9 who agreed. Its alignment with the NALI framework was well acknowledged, with 20 students strongly agreeing and 6 agreeing that it enriched their learning experience. Overall satisfaction was similarly high, with 21 students strongly agreeing and 6 agreeing, while only minimal disagreement was recorded.

The feedback results reflect that the AI-driven integration calculator with GUI has had a highly positive impact on students' learning, particularly in enhancing understanding, promoting active participation, and strengthening problem-solving skills. The strong agreement in teaching delivery and overall satisfaction suggests that the tool not only supports effective knowledge transfer but also increases students' confidence in applying numerical methods. The positive response within the NALI framework further indicates that the application aligns well with innovative teaching strategies, fostering a more engaging and meaningful learning experience. The minimal disagreement shows

that while the tool is generally well accepted, there remains a small space for improvement, possibly in refining certain features or providing additional guidance to maximize its benefits for all learners.

Commercialization Potential

This AI-integration calculator with a GUI incorporates multiple numerical integration methods and presents results with corresponding error tables and error graphs. It has already been implemented in the Department of Mathematical Sciences, Universiti Teknologi Malaysia, through the Numerical Methods course. Students have responded positively, recognizing its value in verifying manual solutions, strengthening conceptual understanding, and enhancing their learning experience. Building on this success, the next phase is to extend its use to the Faculty of Engineering and the Faculty of Built Environment and Surveying, enabling a wider group of students to benefit from a reliable tool that supports and validates their problem-solving process. To ensure broader adoption and scalability, copyright registration is currently in progress, with the long-term aim of officially implementing the calculator not only within Universiti Teknologi Malaysia but also across other universities in Malaysia. Beyond academia, the calculator also demonstrates strong potential for industrial application, particularly in engineering fields where precise numerical solutions are essential. In line with this vision, software could be developed and commercialized as a practical tool for industry professionals.

Awards

The AI-integration calculator with GUI was awarded the Gold Medal in Johor International Innovation, Invention Competition and Symposium 2025 (JIIICaS 2025) and the Silver Medal in Semarak International Research Innovation Symposium V 2025 (SIRIS V 2025). This recognitions highlight its innovative contributions to education and its potential for industrial application.

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ID 117: Kembara Merdeka Scratch Berteraskan AI: Integrasi Nilai Kemerdekaan Dalam Pembelajaran Pengaturcaraan

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Sorotan: Kembara Merdeka Scratch Berteraskan AI merupakan pendekatan pembelajaran pengaturcaraan yang mengintegrasikan pengaturcaraan *Scratch* dengan teknologi kecerdasan buatan (AI) bagi menghasilkan projek bertema kemerdekaan. Melalui kaedah pembelajaran berasaskan projek, murid sekolah rendah didedahkan kepada asas pengaturcaraan sambil memupuk nilai patriotisme. Penggunaan AI membantu dalam penjanaan idea, reka bentuk grafik, dan animasi, sekali gus merangsang kreativiti serta memudahkan proses pembangunan projek. Inisiatif ini bukan sahaja meningkatkan kemahiran digital dan pemikiran kritis murid, tetapi juga memperkukuh literasi digital serta kesedaran terhadap nilai kemerdekaan.

Kata Kunci: kecerdasan buatan; pembelajaran berasaskan projek; patriotisme; literasi digital; pemikiran komputasional

Pengenalan

Perkembangan teknologi digital telah membawa perubahan besar dalam pendekatan pendidikan, terutamanya dalam pengenalan konsep pengaturcaraan di sekolah rendah. Scratch sebagai platform pengaturcaraan visual menyediakan medium yang mudah dan interaktif untuk memperkenalkan asas pemikiran komputasional. Namun, peluang untuk mengintegrasikan nilai kemerdekaan ke dalam modul pengaturcaraan masih kurang diterokai. Bengkel 'Merdeka Scratch Berteraskan AI' ini dirangka bagi menggabungkan elemen teknologi dan nilai kemerdekaan dalam satu aktiviti pembelajaran. Penggunaan AI seperti DALL·E, Canva AI, dan ChatGPT membantu pelajar dalam menghasilkan grafik, animasi, serta cadangan kod untuk projek bertema Merdeka. Pendekatan ini bukan sahaja meningkatkan kemahiran digital tetapi juga memupuk semangat patriotisme dalam konteks pembelajaran abad ke-21.

Objektif

- Memperkenalkan asas pengaturcaraan Scratch kepada pelajar sekolah rendah melalui tema kemerdekaan.
- Menggunakan teknologi AI untuk membantu proses reka bentuk projek digital kreatif.
- Meningkatkan kemahiran abad ke-21 seperti kreativiti, kolaborasi, komunikasi, dan pemikiran kritis.
- Menyemai nilai patriotisme dalam kalangan pelajar melalui projek digital.

Pendekatan NALI

- **Keunikan & Inovasi:** Pendekatan ini menggabungkan teknologi AI dengan tema kemerdekaan untuk mewujudkan pengalaman pembelajaran yang unik. Ia membolehkan pelajar meneroka teknologi moden sambil memahami sejarah dan nilai kebangsaan, menjadikannya relevan dalam konteks Malaysia.
- **Aplikasi & Hubungan Dengan NALI:** Projek ini selari dengan konsep NALI (New Academia Learning Innovation) yang menekankan inovasi dalam kaedah pembelajaran. Integrasi teknologi AI dalam pengaturcaraan Scratch membuktikan bahawa pendidikan STEM boleh dihubungkan dengan pembinaan jati diri bangsa.
- Impak Pembelajaran:
  - 90% pelajar menunjukkan peningkatan kefahaman terhadap konsep pengaturcaraan asas.
  - Semua kumpulan berjaya menyiapkan projek animasi atau permainan interaktif bertema Merdeka.
  - 85% pelajar melaporkan peningkatan kesedaran nilai kemerdekaan.
  - Guru melaporkan peningkatan minat pelajar terhadap bidang STEM.

Metodologi Kajian

Bengkel ini melibatkan 30 orang pelajar sekolah rendah berumur antara 10 hingga 12 tahun. Pendekatan pembelajaran berasaskan projek (Project-Based Learning, PBL) digunakan dengan integrasi AI untuk menyokong proses penghasilan projek. Penggunaan AI seperti DALL·E, Canva AI, dan ChatGPT membantu pelajar dalam menghasilkan grafik, animasi, serta cadangan kod untuk projek bertema Merdeka**.** Rajah1 menunjukan tahap-tahap Kembara Merdeka Scratch Berteraskan AI.

Langkah pelaksanaan adalah seperti berikut:

- **Tahap 1:** Bengkel latihan kepada nilai kemerdekaan dan asas pengaturcaraan Scratch oleh pensyarah.

- **Tahap 2:** Pengenalan kepada penggunaan AI bagi penjanaan idea projek, reka bentuk grafik, dan cadangan kod permulaan dalam sesi mentor-mentee, diikuti dengan tugasan pembangunan projek animasi atau permainan bertema Merdeka secara berkumpulan.
- **Tahap 3:** Pembentangan hasil projek oleh murid di dalam pertandingan Kembara Scratch Merdeka 2025.

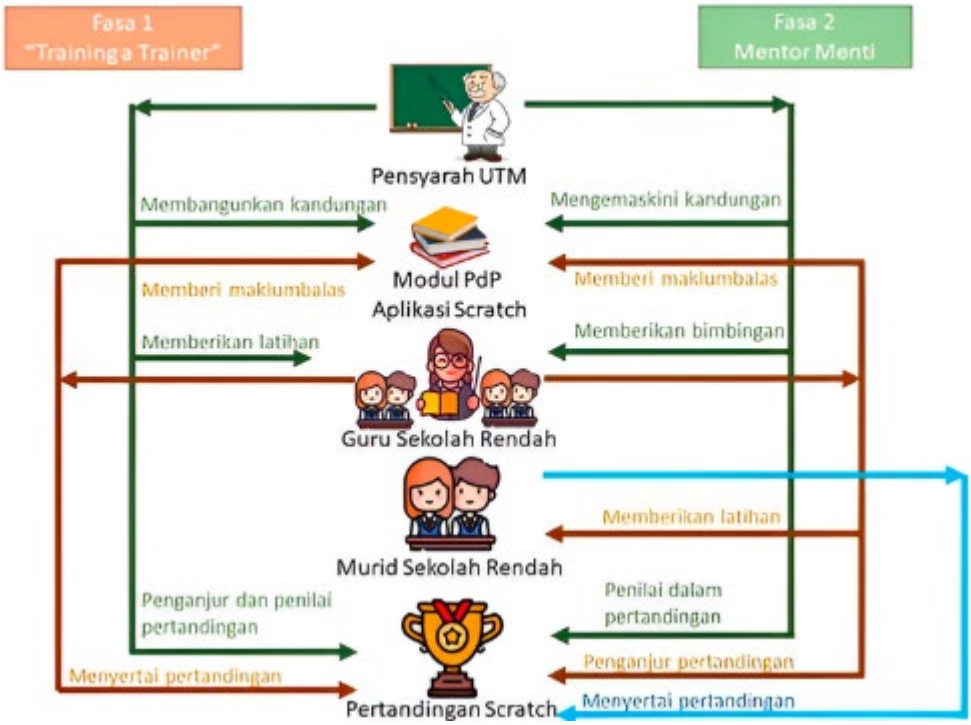


Figure 1: Tahap-tahap Kemabara Merdeka Scratch Berteraskan AI

Dapatan Kajian dan Perbincangan

Hasil pelaksanaan bengkel menunjukkan peningkatan minat pelajar terhadap pengaturcaraan serta pemahaman nilai kemerdekaan. Penggunaan AI memudahkan proses penghasilan projek, sekali gus meningkatkan kreativiti pelajar.

Potensi Pengkomersialan

Modul ini berpotensi dikomersialkan sebagai bahan pembelajaran digital bertema kemerdekaan untuk sekolah rendah di seluruh Malaysia. Ia boleh dijadikan modul latihan untuk guru serta penganjuran bengkel sempena sambutan Hari Kemerdekaan.

Kesimpulan

Bengkel Merdeka Scratch Berteraskan AI membuktikan bahawa integrasi teknologi moden dengan nilai kemerdekaan boleh menjadi pendekatan berkesan dalam pendidikan pengaturcaraan. Pendekatan ini sesuai untuk dikembangkan kepada lebih banyak sekolah demi memperkukuh kemahiran digital dan semangat patriotisme generasi muda.

Penghargaan

Penghargaan diberikan kepada semua pensyarah, fasilitator, mentor, guru pengiring, dan pelajar yang telah menjayakan bengkel ini.

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ID 118: Cultural Co-Creation: Bringing Yao Zhou Kiln Heritage into University Classrooms

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Highlights: This project integrates the intangible cultural heritage of the Yao Zhou Kiln into higher education through curriculum design, digital innovation, and community collaboration. It addresses challenges in cultural sustainability by combining theory and practice, enhancing student engagement with heritage, and fostering long-term collaboration among universities, museums, and industries.

Keywords: Yao Zhou Kiln; Intangible Cultural Heritage; Higher Education; Teaching Innovation; Digital Integration

Introduction

Yao Zhou Kiln where located in Tongchuan, Shaanxi, is renowned as the pinnacle of northern celadon. Listed as national intangible cultural heritage in 2006, Yaozhou Kiln faces various challenges including aging inheritors, declining dissemination, and limited innovation. Integrating Yaozhou Kiln into higher education, this project aims to provide a novel approach to revitalize heritage; furthermore, enhance student cultural engagement, and strengthen universities' role in regional cultural sustainability.

Objectives

i. To develop interdisciplinary content such as art, material science, and cultural management related to Yaozhou Kiln in mobile platform.
ii. To create immersive ICH teaching models by integrating classroom learning and field study by using mobile platform.
iii. To modernize the heritage via student-led digital storytelling and product innovation.
iv. To establish a university–museum–industry collaborative mechanism.

NALI Approach

The Yao Zhou Celadon Mini-Classroom is a mobile platform designed for university students, educators, and the general publics. It provides lightweight and interactive access to Yaozhou Kiln heritage, enable users explore to the history, craftsmanship, and cultural significance of Yao Zhou celadon in anywhere, anytime. Core features in mobile platform:

Heritage Knowledge Cards
It provides structured content on the historical evolution of Yaozhou Kiln, its ceramic types, glaze categories, and carving techniques, enabling users to build a solid foundation of cultural understanding.

Micro-Lesson Videos
By co-creating with inheritors, deliver short and accessible teaching modules. Micro-lesson videos enrich with interactive functions such as comments and progress tracking, fostering two-way communication and sustained learning.

Virtual Artifact Display
With this display in the platform, users can explore representative artifacts in 3D with zoom and rotation functions, bringing traditional craftsmanship to life in digital space.

Carving Mini-Game
The game engages learners by simulating traditional carving techniques through touchscreen interaction, allowing users to experience the artistry in a playful yet educational manner.

Student Works Cloud Gallery
The cloud gallery serves as a digital exhibition space for student creations, where peers and the public can respond with likes, comments, and knowledge tags, thereby creating a participatory cultural ecosystem.

- Novelty: This project introduces a fresh approach to intangible cultural heritage (ICH) education by combining mobile technology with heritage preservation. This platform offers *anytime, anywhere* access to Yaozhou Kiln knowledge by integrating the knowledge cards, micro-lesson videos co-created with inheritors, and interactive 3D artifact displays distinguishes it from existing heritage-learning applications, which often focus on static information delivery.
- Creativity: The project demonstrates creativity in how it transforms traditional cultural expressions into interactive digital experiences. For instance, the Carving Mini-Game provides a playful yet educational

means for learners to simulate craftsmanship techniques through touch interaction, bridging the gap between historical artistry and modern digital engagement; the Student Works Cloud Gallery adds another creative dimension by allowing learners to become cultural creators themselves, contributing digital artifacts and stories that expand the heritage narrative.

- Innovativeness: Innovation lies in the project's interdisciplinary design and collaborative ecosystem. By combining art, material science, digital media, and cultural management, the platform transcends traditional heritage education frameworks. Furthermore, the co-creation of micro-lesson videos with inheritors ensures authenticity while also leveraging modern pedagogical tools such as interactive feedback and progress tracking. The integration of a university–museum–industry collaborative mechanism also represents a new model for sustaining ICH transmission through digital transformation.
- Applicability: The platform is highly applicable in both formal and informal learning environments. In universities, it can serve as a supplementary teaching tool that enhances classroom lessons with immersive digital content. For museums, it provides an extended outreach mechanism that engages audiences beyond physical visits. For the general public, it offers cultural enrichment in a mobile, lightweight format, making heritage accessible to a wider audience.
- Impact: The anticipated impact of the Mini-Classroom is multifaceted. Educationally, it enhances students' interdisciplinary learning and fosters deeper appreciation of Yaozhou Kiln heritage. Socially, it democratizes access to cultural knowledge, enabling broader participation in heritage appreciation and safeguarding. Culturally, it revitalizes traditional craftsmanship through digital storytelling and participatory engagement, ensuring the continuity of intangible heritage in the digital age. Economically, by fostering collaboration among universities, museums, and industries, it creates opportunities for cultural product innovation, heritage tourism promotion, and creative industry development.

Research Methodology

Rapid Application Development (RAD): Yao Zhou Celadon Mini-Classroom is developed using the Rapid Application Development (RAD) methodology. RAD is an accelerated development approach that produces a high-quality system with relatively low investment. The method prioritizes quick prototyping, iterative testing, and user involvement, placing greater emphasis on feedback and software functionality rather than rigid planning and documentation. Its primary strength lies in its fast project delivery, making it particularly suitable for dynamic environments such as software development. By minimizing time spent on initial planning and focusing on iterative prototypes, RAD allows project managers and stakeholders to monitor progress more effectively and address emerging issues or changes in real time. This leads to improved efficiency, faster development cycles, and clearer communication.

In practice, the RAD process is structured into four main stages: planning, user design, construction, and switchover. The user design and construction phases are repeated in cycles until the users confirm that the system fully meets the specified requirements.

Findings and Discussion

This project positions Yaozhou Kiln as more than a preserved legacy—it becomes a living classroom, cultural bridge, and innovation platform. By expanding its integration into higher education curricula, developing cross-disciplinary collaborations, and leveraging digital platforms, the model can be scaled to other forms of intangible heritage in China and beyond. In doing so, it demonstrates how universities can play a pivotal role in sustaining cultural heritage, fostering student creativity, and contributing to regional revitalization. Ultimately, the project aspires to ensure that Yaozhou Kiln, while rooted in its thousand-year-old tradition, continues to inspire new generations and thrive in contemporary society.

Acknowledgement

We sincerely thank to the company **薪火星耀** for their strong support and partnership in this project, which has been instrumental in advancing the revitalization of Yaozhou Kiln and fostering innovative cultural education.

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ID 120: Defeat as Innovation: Rethinking Pricing Education with AI and Intergenerational Learning

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Highlights: This innovation re-engineers a repeatedly failing apple-selling activity that revealed students' buyer mindset, cost neglect, and weak pricing discipline. Evidence from three cohorts showed over-reliance on round numbers, parity pricing, and poor targeting. The planned redesign introduces a structured kit of cost sheets, pitch scripts, .99 pricing templates, competitor-free mapping, and reflection logs to convert breakdowns into structured learning. By embedding authentic micro-experiments and AI-supported analysis, the framework builds cost discipline, pricing agility, and persuasive storytelling. Sustainable and low-cost, it aligns with OBE standards and Malaysia's entrepreneurship agenda, while scalable from universities to schools and transferable globally.

Keywords: Authentic assessment; Authentic learning; Buyer–seller mindset; Entrepreneurship learning; OBE alignment

Introduction

Pricing is decisive yet widely misunderstood. Globally, 85% of executives report that pricing needs improvement, signaling that many failures are pricing, not product problems (Bain & Company, 2023). At Universiti Teknologi Malaysia, SBSF2133 (Pricing Decision) has been taught by a single lecturer for five years, with Programme Learning Outcome 1 (PLO1) usually meeting the 65% KPI (with one shortfall) but typically sitting around 70–75%, making it weaker than peer subjects. Students also call it a "killer course." The core gap is application where many students still think like buyers seeking "cheap/free" (despite being told from Day 1 to adopt a seller mindset), default to parity (equal to competitor) and round numbers (not .99 just-below number pricing), and struggle to surface hidden costs and justify Value-to-Customer (VTC). Despite explicit teaching of cost-, competitor-, and value-based pricing, classroom knowledge is not transferring to real decisions. This persistent pattern is a clear teaching–learning gap that this project addresses.

This project tackles the gap through a real-setting pricing simulation with Year-2 students and an observation-led, AI-supported analysis (Ortega and Tabares, 2023) of handouts, brief media, and short self-ratings. The learning logic is experience → reflection → analysis → conceptualisation → re-action, and repeated shortcomings are treated as evidence for redesign, not isolated failures (Kolb, 2014; Bryk et al., 2015). The contribution is twofold: (i) a transparent, data-backed way to diagnose why pricing breaks down at the point of action, and (ii) a replicable model aligned with Course Learning Outcome 1 (CLO1) on applied pricing key concept. A small intergenerational micro-probe with Gen Alpha tests message clarity and informs transfer to school-level entrepreneurship.

Objectives

This project sets five focused objectives aligned with CLO1 and the course context.

i. Evaluate students' application of CLO1 pricing strategies (cost-, competitor-, and value-based) in an authentic selling task.
ii. Assess how students execute key pricing moves (segmentation, hidden-cost treatment, .99 just-below number pricing endings, and VTC storytelling) at the point of sale.
iii. Quantify the pricing behavior and their immediate selling outcomes to reveal patterns that block effective application.
iv. Specify pedagogical gaps by redesigning activities based on coded evidence and lecturer observations.
v. Probe whether a concise value narrative increases perceived value among Gen Alpha (vs a neutral message) to judge transferability to school-level entrepreneurship.

NALI Approach

We depart from success-case reporting by holding the task constant across three cohorts and deliberately treating recurring, stable failure patterns as evidence for redesign. Using the same apple-pricing activity for three years (with only minor refinements: a standardised handout and explicit hidden-cost cues so students could choose whether to turn them into a value story at the point of sale), the task repeatedly produced parity pricing, round numbers, weak VTC reasoning, and .99 just-below number pricing usage, contrary to the syllabus. Positioning frames were not spoon-fed so students had to infer healthy/clean/ready-to-eat versus price-led angles, which made learning gaps visible. Channels were not prescribed; students could sell face-to-face, and online selling was not prohibited (deliberately not highlighted to encourage initiative). We document this baseline through an observation-first, AI-supported reading of student data, with human judgment final. Our stance follows improvement in science by studying the system that produces the results, then changing the design. We therefore treat defeat as innovation (Bryk et al., 2015). Such

openness about failure is unusual yet valuable; organisations often claim to learn from errors, but effective learning from failure is rare (Edmondson, 2011).

The design makes pricing choices visible at the point of sale by turning ideas into observable behaviours. A single SKU which is an everyday product (apples), kept attention on price, not product differences. We deliberately ran the activity in low-footfall windows (08:30 and 16:30) under real constraints of off-peak campus traffic, limited walk-by demand, and the preceding Monday being a public holiday, which further reduced targeting opportunities. Boundary rules (no selling to the lecturer or classmates; no cross-section sharing) raised the persuasive challenge and kept communication observable. A mid-task permission to revise price were triggered only if the item was still unsold, invited purposeful agility rather than "set-and-forget" pricing. Together, these affordances taught ideas of price segmentation, hidden costs, VTC logic, and psychological .99 just-below number pricing endings into visible, reflectable actions (Kolb, 2014).

In the 2025 cycle, we formalised key elements to lift evidence quality and internal validity. Hidden-cost cues where the apple was salt-washed, covered and handled with gloves; the transport effort from the night market to the faculty; and packaging were made explicit in a standardised handout so students could decide whether to use them in pricing and storytelling. We used an AI-supported coding pipeline with human judgement to ensure consistent interpretation of the data. Before running the analytic cycle, we pre-declared success markers which is reduced reliance on parity pricing, increased VTC framing, greater use .99 just-below number pricing, and higher perceived value with explicit costing (including staff time, transport, and other inputs) as taught in class. Together, these changes shift reflection from anecdote to analysable patterns and provide a stable platform for iterative improvement across cohorts (Ifenthaler et al., 2021).

We propose a low-cost, portable kit, one Stock Keeping Unit (SKU), a two-page handout with cost cues as a simple material plus a coding rubric that fits standard class periods with minimal setup and can slot into pricing, entrepreneurship, or persuasive-communication courses. Outcomes are coded in straightforward categories (method, positioning, price endings, tactics, mindset) that any instructor can tabulate in a spreadsheet, even specialised software is unnecessary. The analysis pipeline remains flexible as observation-led and fully replicable with manual coding, with optional AI support when resources permit. A small, perception probe (rating only) enables safe extension to school-level entrepreneurship activities, keeping participation ethical for younger learners while retaining diagnostic value. This makes the approach easy to adopt, scale, and sustain across contexts (Trujillo-Torres et al., 2023).

We identify the core barrier as a default buyer mindset. From this we set clear redesigned priorities which are building costing habits, strengthening positioning literacy, teaching simple VTC storytelling, using .99 just-below number pricing endings with discipline, and practice targeted agility. The approach gives transparent diagnostics that tighten alignment to CLO1 and guide programme decisions on teaching, assessment, and support. For the next cycle, our targets are lower parity use, stronger VTC framing, wider .99 just-below number pricing adoption, and higher perceived value. Together these steps create a credible path from reflection to measurable gains in pricing competence (Tremblay et al., 2024).

Research Methodology

The flowchart in Figure 1 maps five stages of this project. Planning and Setup defines the mixed-methods design, participants/context, and materials. Implementation runs the selling task and captures evidence. Data Collection and Coding start with lecturer observation, then AI-supported coding, variables/codes, and operative definitions. The Analysis Phase produces descriptive statistics, checks reliability, and generates output. Ethics and reporting de-identify data and document findings. A return arrow from outputs to data shows the act–reflect–analyse–conceptualise–re-act improvement loop (Kolb, 2014; Bryk et al., 2015).

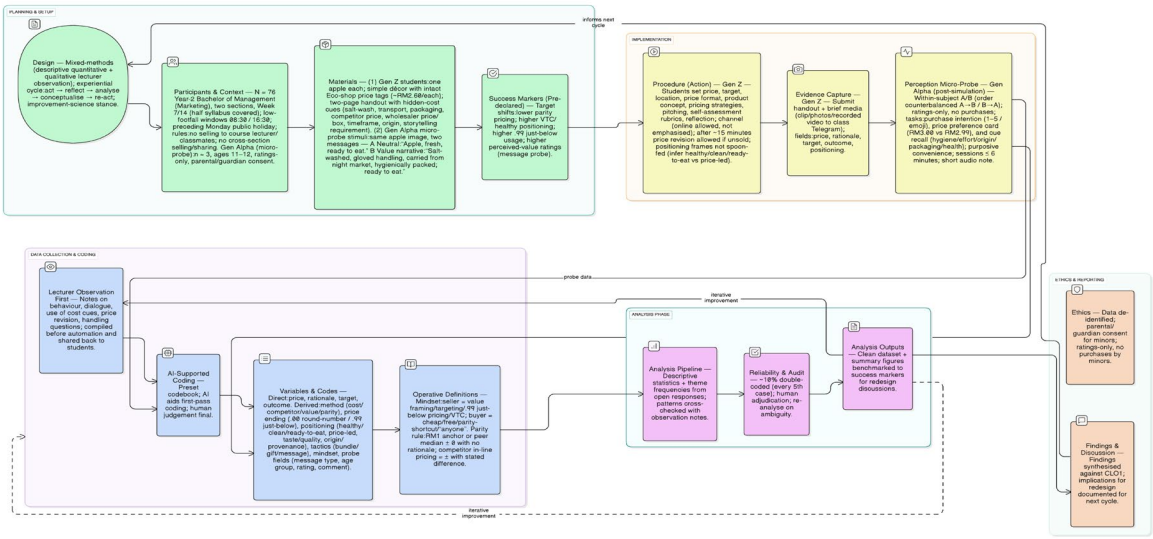


Figure 1: Research Methodology Flowchart

Findings and Discussion

Across three cohorts we saw a clear buyer mindset where students rushed to "finish the task" instead of planning like sellers who create and defend value. Although online selling (social media/other platforms) was allowed and 08:30/16:30 low-footfall windows were set to force targeting, all sales stayed face-to-face; few tried remote channels, waiting for written instructions which are not seller behaviour.

No one used the keystone rule of markup thumb for retail (100% markup, double cost). Hidden-cost cues (5-min salt wash; dry & pack in covered container; gloves; overnight night-market trip; transport/effort; packaging with intact Eco-shop tags ~RM2.60) were ignored; most did not compute unit and effort costs (staff time, overtime, distance). Many anchored to night-market RM10 for 10 apples (~RM1) price without differentiation. .99 just-below number pricing psychological pricing was rare despite QR ease with round numbers dominating.

Message discipline and product knowledge were weak as such "healthy" claims come with plastic decoration; gloves unused while selling "washed & ready" apple although provided and worst wrong guessed type of the apple origin despite box cues. Some go with over-selected unnecessary decoration and untidy materials which indicated limited ownership most probably, signs of limited ownership as it is free that fit a buyer mindset.

Targeting and agility were also limited where student tend to pitch to "anyone", clustered in faculty corridors, with only few in hostels or food courts or niche low-competition spots. A few tried to sell to classmates (against rules). After ~15 minutes, few revised prices but some could not even start a conversation. Isolated sales dominated with bundles and free gifts as well as selling in pairs. Two students even rode back to college to sell. Another clear cost-neglect case is where RM0.70 pricing below unit cost (RM120/165pcs – 1box ≈ RM0.73 as indicated in the handout). These behaviours reinforced buyer-like habits, seeking shortcuts, convenience, relying on benchmarks, and avoiding ownership, rather than seller discipline.

Table 1 summarises results from the handout, combining pricing practices, positioning cues, customer interactions, and outcomes across the activity.

Table 1: Summary Result

Pricing Key Concepts	Summary
Selling Price	Mean RM 3.20; median RM3.00; min RM0.70; max RM15.00
Price Format	Round Number 84%; Other 13%; Just-below pricing (.99 just-below number) 3%
Pricing Strategies	Parity 72%; Cost-based 19%; Value-based 5%; Competitor (± vs benchmark) 4%
Positioning (multi-select)	Price-led 63%; Ready-to-eat 29%; Healthy/Wellbeing 23%; Quality 13%; Origin 8%
Selling Channel	Face-to-face 90%; Online/remote 10%
Selling Location	Faculty area 89%; College/Hostel 3%; Food court/Other 8%
Target Customer	Students 60%; Lecturers/Academics 22%; Staff/Visitors 18%
Decoration	Sticker/Label/Tag 50%; Bag/Wrapper 42%; Ribbon 27%; Card 16%; Box 10%
Tactics	Bundling 11%; Free gift 7%
Outcome	Sold 93%; Not Sold 3%
Mindset	Buyer mindset 79%; Seller mindset 21%
Self-ratings (mean/5)	Pricing strategy 3.1; Creativity 3.4; Customer engagement 3.05; Adaptability 3.25
Activity Challenges (themes)(multi-select)	Low footfall/time window 58%; Confidence in pitching 42%; Hidden cost/pricing confusion 39%; Handling questions 29%
If redo the activity… (themes)(multi-select)	Start earlier / try online 45%; Use value story (hygiene/effort/origin) 42%; Target lecturers/staff 33%; Try .99 just-below number pricing (just-below pricing) 10%
Why buyers bought	Convenience 35%; Support student 29%; Quality 26%; Hygiene/ready-to-eat 16%
Customer questions	Price/discount 55%; Origin/type 33%; Hygiene/washing 19%; Size/weight 19%
Gen Alpha micro-probe	Value narrative > neutral (perceived value); Purchase Interest increased (mean 2.7→3.7; median 3→4); .99 just-below number pricing preference 66.7% (2/3); top recall: healthy

Our planned redesign of structured kit will shift students from a buyer to a seller mindset through live micro-experiments that generate authentic buyer data. Each group will be given a cost worksheet covering staff time, transport, packaging, energy, overhead, and opportunity cost, which they must complete and defend. Positioning will be strengthened with a short pitch script integrating hygiene, effort, health, or sustainability cues, while a pricing template will highlight round-number reliance and train disciplined use of .99 just-below number pricing endings and keystone markup rules.

The redesign will require students to apply clear segmentation by selecting a target profile in advance and then plan their selling approach accordingly. Any props used must be justified and paid for, while online readiness will be practised by uploading a QR code or short post. To train location strategy, a faculty map will be provided by the instructor, and each group will be required to mark their chosen spot with a pin. This ensures competitor-free zones, prevents clustering in corridors, and encourages students to think critically about footfall, visibility, and segment targeting when deciding where to sell.

Learning will be consolidated with reflection logs (three mistakes, one strategy), peer feedback, demo pitches, and a mini rubric applied to cost sheets, scripts, and checkpoints. These measures will make the activity reflective, measurable, and explicitly mapped to CLO1 pricing strategies: cost-based pricing (cost sheets), value storytelling (scripts), and .99 just-below number pricing templates. AI tools and spreadsheets will support coding and markup accuracy, while sustainability cues (eco-cost, biodegradable packaging) will add relevance. Embedding real-world

constraints such as stall fees and online transaction costs will make the simulation realistic, scalable to other courses, and adaptable for school learners.

Assessment evidence will be captured through rubric scores and reflection logs to demonstrate CLO1 attainment. The redesign will be inclusive, using visual scales and bilingual prompts, and future iterations will add simple dashboards to visualise price-volume trade-offs. Pilot testing with cohorts will be conducted to confirm weaknesses and improvements, generating traceable learner data (willingness to pay, questions, reflections) for research in pricing pedagogy.

Overall, this project reimagines failure not as a setback but as the foundation for innovation. By converting repeated classroom breakdowns into structured redesign, it delivers a replicable, low-cost, and evidence-driven model for teaching pricing competence. The framework equips students with entrepreneurial skills in cost discipline, pricing agility, and persuasive storytelling, while embedding authentic assessment that aligns with Outcome-Based Education (OBE) standards and Malaysia's entrepreneurship agenda. Adaptable from universities to schools and transferable globally, it contributes to the scholarship of teaching and learning by showing how authentic assessment, supported by AI and intergenerational learning, can turn persistent weaknesses into lasting entrepreneurial competence, a model ready to be scaled nationally and internationally.

Commercialization Potential

This innovation has strong potential for scaling and commercialization as a low-cost, portable teaching kit. Using one SKU, simple worksheets, and reusable templates, it can be applied in universities, polytechnics, and schools with minimal resources, and integrated into curriculum modules or teacher training programs in line with Malaysia's entrepreneurship and education agendas. Its adaptability to global classrooms also opens opportunities for publishing, consultancy, and collaboration with education providers or entrepreneurship programs. At the same time, the worksheets, handouts, pitch scripts, pricing templates, rubrics, and scenario drills can be copyrighted and packaged as a facilitator's kit, enabling IP registration, and use in training programs.

Acknowledgement

We would like to thank the Faculty of Management, Universiti Teknologi Malaysia, for their continuous support in this project. Our appreciation also goes to the students who participated in the experiments and pilot probes, whose involvement provided valuable insights for this innovation.

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ID 121: AI-Powered Escape Room for Interactive Learning Tools

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Highlights: This study introduces an innovative application of Canva's generative AI as co-designer in the rapid development of an educational escape room for teaching mathematics. The approach significantly reduced the time and expertise typically required to design immersive, gamified resources. Analysis of pre- and post- survey data indicated statistically significant improvements in students' self-efficacy in solving problem, alongside enhanced motivation and engagement. The findings suggest that integrating accessible AI tools into pedagogical design offers a scalable and efficient for advancing both conceptual understanding and student-centred engagement in mathematics education.

Keywords: gamification; mathematics; artificial intelligence

Introduction

The rapid advancement of artificial intelligence (AI) in education presents new opportunities for reimagining teaching and learning practices. In higher education, particularly in mathematics, students often face difficulties engaging with abstract concepts (Saha et al, 2024). Traditional instructional approaches such as lectures, tutorials, and worksheets are effective for transmitting content but often fall short to sustain motivation or to accommodate diverse learning preferences. This persistent challenge highlights the need for pedagogical models that are not only innovative but also scalable and responsive to the demands of twenty-first century learners.

Gamification has emerged as a promising pedagogical tool to increase motivation (Kassenkhan et al, 2025), its implementation is often hindered by the significant time, technical expertise, and resources required to develop high-quality, immersive experiences (Kok et al, 2025). To address this barrier to innovation, this project introduces an AI-powered escaped room game as a novel pedagogical innovation. This escape room game uses the generative power of accessible AI to radically accelerate the design and production of a complex gamified learning activity to demonstrate a new and practical model for integrating AI into the educator's toolkit to foster resilience, engagement, and deep learning (Ryan and Deci, 2020).

Recent empirical studies in STEM education demonstrate gamified interventions improve not only affective responses such as enjoyment and engagement but also measurable learning outcomes, particularly when active problem solving and immediate feedback are embedded in the design (Tiria & Nama, 2025; Nacimiento-Garcia et al., 2024). Despite its positive outcome, the adoption of gamification has been constrained by the significant expertise, resources, and time required to develop immersive and pedagogically coherent learning environments (Sambo et al, 2025).

To address this barrier, the present project introduces an AI-powered escape room as an innovative educational game. Unlike traditional gamification efforts that demand extensive programming and design capacity, this intervention leverage generative AI tools to accelerate the production of complex, visually immersive, and thematically coherent gamified learning experiences. The escape room format was selected because it combines narrative, and problem-based learning, which align with active and experiential learning.

By embedding generative AI within the instructional design process, this project seeks not only to entertain but to advance a critical model of how AI can function as a catalyst for scalable and high-impact educational innovation. The innovation aims to demonstrate how AI can reduce design barriers while enhancing resilience, engagement and conceptual understanding. Crucially, the approach recognizes AI as an enabler within the educator's toolkit rather than a substitute for pedagogy. This positions the escape room as both a testbed for integrating AI into classroom practice and a contribution to the broader discourse on gamification, motivation, and deep learning in mathematics education.

Objectives

The objective of this project is to design and develop a fully-realized, narrative-driven educational escape room targeting a specific topic within intermediate mathematics. The second objective is to integrate this AI-generated escape room activity into teaching for mathematics course and measure its effects on student engagement and conceptual understanding of the target mathematical topic. The final objective is to establish a scalable framework to lower the traditional barriers of time and technical expertise required for such innovations that make high-impact pedagogical design accessible to a broader academic audience.

NALI Approach

- **Novelty**: The novelty of this project lies not in the isolated use of gamification or AI, but in their synthesis. It introduces the concept of using generative AI as a rapid prototyping and production tool for complex,

narrative based pedagogical simulations.

- **Creativity**: The creativity of this project is demonstrated through the narrative construction, puzzle design, and the strategic use of AI prompt engineering. The educator's creative role is redefined as the design of detailed textual prompts which guide the AI to generate unique, and thematically consistent visual assets. This approach encourage originality while maintaining coherence across the learning experience.
- **Innovativeness**: The project addresses a major obstacle to pedagogical creativity which is resource constraints by compressing a traditionally time-intensive design process into a significantly shorter timeframe. Tasks that would normally require several days of graphic design can now be completed within hours. This efficiency reflects a paradigm shift in how educators conceptualize and produce immersive learning activities.
- **Applicability**: By employing Canva AI platform, the approach ensures low barriers to adoption and transferability across disciplines. The model can be adapted to diverse subject areas, ranging from mathematics and physics to history and language learning, wherever problem-solving and applied knowledge are central.
- **Impact on student learning:** The impact extends across both cognitive and affective domains. Preliminary data suggest notable increases in student engagement that attribute to immersion in narrative and game-based elements. Beyond engagement, the activity empowers learners by promoting collaboration, critical thinking under constraints, and resilience through a failure-positive environment. These outcomes contribute directly to the development of confident, adaptable, and future-ready graduates.

The escape room interface is shown in Figure 1.

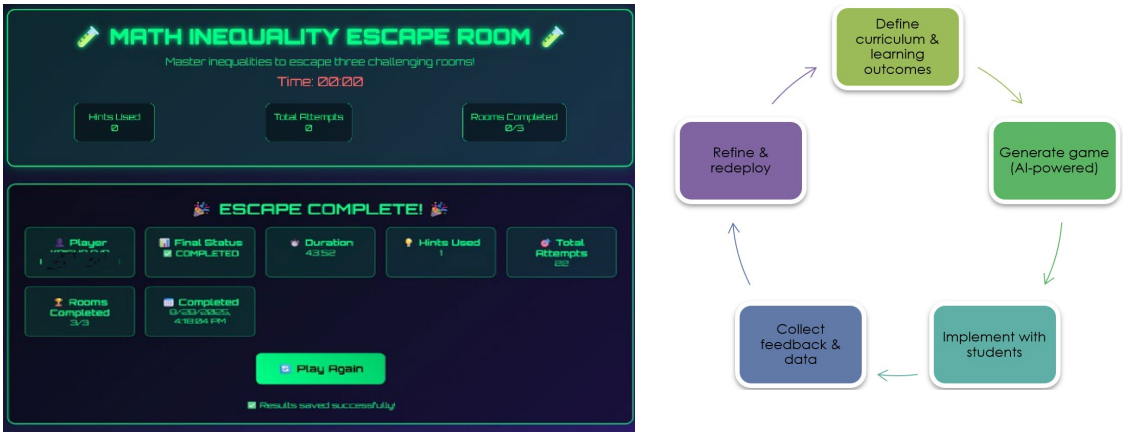


Figure 1 Escape room interface generated by AI and its framework

Research Methodology

A mixed-methods research design was employed to evaluate the cognitive and affective impact of an AI-generated escape room on students' learning of mathematics topic. This design was selected to enable triangulation of quantitative and qualitative evaluation, thereby strengthening the validity of findings beyond a single data source. This project involved 25 students enrolled in mathematics course. The intervention consisted of a digital escape room created using Canva AI. Puzzles were sequenced to align with the curriculum, which require students to solve problem to unlock successive stages, AI was employed not as pedagogical substitute but as a design accelerant, which enable rapid development of contextually relevant environments that supported puzzle-based learning objectives. Surveys are conducted before and after the intervention in the same cohort. Both surveys used 5-point Likert scale items to assess students' conceptual understanding and attitudes towards mathematics and game-based learning. Paired sample t-tests compared pre- and post- survey responses. This approach was selected for its suitability in detecting significant within-subject change. The qualitative were used to contextualize quantitative outcomes.

Findings and Discussion

Preliminary analysis has shown the suitability of parametric testing since Shapiro-Wilk tests indicated no significant deviations from normality across all difference scores ($p > 0.05$). This justified the use of paired sample t-tests to evaluate the intervention's impact. The results demonstrated statistically significant gains ($p < 0.05$) in students' self-efficacy and conceptual understanding on the topic with a pre-mean of ~3.5 to a post-mean of ~4.3.

The affective outcomes such as engagement and motivation are consistently scored above 4.0, underscoring the capacity of the game to transform mathematics learning into an immersive and motivating experience. Qualitative feedback describes the activity as "fun", "refreshing", and "interactive" highlights how the narrative and puzzle created "safe-to-fail" environment that encouraged persistence.

Nevertheless, the findings also exposed persistent and technical challenges. Frustration with the answer submission system and residual confusion in combining solutions on number lines and solving rational inequalities point to the need for both technical refinement and pedagogical scaffolding. These limitations underscore that while the innovation was effective, its impact depends on seamless integration of content, design and user experience.

The findings suggest that AI-assisted design enabled the rapid development of high impact game that improved the students' engagement while also surfacing area for instructional refinement. The tool is best positioned not as a standalone replacement for traditional teaching but as a complementary strategy for formative assessment and applied practice. Its success highlights the promise of AI to accelerate the production of immersive, conceptually meaningful learning environments, by providing technical execution that matches pedagogical intent.

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ID 123: GeoCollab+: AI-Enhanced Collaboration for Transforming Engineering Geology Education and Sustainability

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Highlights: GeoCollab+ is an AI-enhanced collaborative educational breakthrough that transforms Engineering Geology education by incorporating artificial intelligence, geographic visualisation, and interactive digital platforms to establish a dynamic, sustainability-oriented learning environment. GeoCollab+, an enhancement of the original GeoCollab framework, mitigates the shortcomings of conventional lecture-based methods by promoting active, interdisciplinary collaboration among academics, industry, and communities. The platform personalises education through AI-driven adaptive learning pathways by providing real-time feedback, predictive analytics, and tailored content delivery to enhance student performance. Integrated geospatial technologies, including immersive 3D modelling and real-time field data processing, allow students to visualise subsurface conditions and make data-driven decisions, thereby connecting theory with practice. GeoCollab+ is closely aligned with the Sustainable Development Goals (SDGs), namely SDG 4 (Quality Education), SDG 9 (Industry, Innovation & Infrastructure), SDG 11 (Sustainable Cities & Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land). Students engage with industry partners and communities on practical projects that tackle real-world issues, including slope failures, geological hazard mapping, and the design of climate-resilient infrastructure. Essential characteristics encompass transdisciplinary co-teaching, AI-driven adaptive learning, and a scalable modular design, facilitating flexibility for in-person, hybrid, or entirely virtual learning settings. The framework improves industry preparedness by offering access to genuine datasets and professional workflows, while also empowering communities through hazard awareness and resilience planning. GeoCollab+ has enormous commercialisation potential, offering specific training modules, consultation services, and digital tools for worldwide education and professional sectors. GeoCollab+ integrates AI and sustainability concepts to prepare engineers for the future, enabling them to provide safe, innovative, and climate-resilient infrastructure solutions.

Keywords: AI in Education, Engineering Geology, Collaborative Learning, Sustainability, Geospatial Innovation, Adaptive Learning, Digital Engineering Tools.

Introduction

GeoCollab+ is a collaborative teaching and learning innovation powered by artificial intelligence (AI), geographic visualisation tools, and interactive digital platforms that aims to transform Engineering Geology education. Traditional engineering education frequently relies on lecture-based, passive learning approaches that do not provide students with the skills required to address complex, real-world infrastructure challenges, particularly in the age of climate change and sustainable development. GeoCollab+ fills this gap by providing an immersive, technologically advanced, and interdisciplinary learning environment. Using realistic case studies and field data, the system allows for real-time interaction, adaptive learning pathways, and applied problem solving. It significantly aligns with the Sustainable Development Goals (SDGs), which are:

- SDG 4: Quality Education
- SDG 9: Industry, Innovation & Infrastructure
- SDG 11: Sustainable Cities & Communities
- SDG 13: Climate Action
- SDG 15: Life on Land

This innovation was designed to provide future-ready graduates with the technical competencies, collaborative skills, and sustainability mindset needed to design climate-resilient infrastructure, while also addressing community needs through field-based projects and geohazard risk awareness programs.

Objectives

The main objectives of GeoCollab+ are to:

- Integrate Artificial Intelligence into Engineering Education by using AI-driven analytics and adaptive systems to tailor student learning and deliver real-time feedback.
- Combine theory and practice by using real-time field data processing, 3D geospatial modelling, and digital geological mapping technologies to address authentic challenges.
- Encourage multidisciplinary collaboration by connecting students with industry experts, government

agencies, and community stakeholders, ensuring that learning is relevant to national and societal requirements.
- Promote Sustainability in Engineering by aligning all teaching and learning activities with relevant SDGs, with a special emphasis on sustainable urban development and disaster risk reduction.
- Improve Graduate Employability by giving students industry-ready technical skills, soft skills, and problem-solving talents so they may thrive in global engineering markets.

NALI Approach

Novelty (New Ideas)

- GeoCollab+ incorporates innovative elements that distinguish it from typical teaching approaches:
- AI-Powered Adaptive Learning: Personalises material distribution and learning paths for each student based on progress tracking and predictive analytics.
- Integration of Emerging Digital Tools: StereoNet, petrographic analysis tools, XRF/XRD testing, and 3D geospatial visualisation platforms are used to provide complete geology education.
- Real-Time Data Processing and Visualisation: Students work with real geological datasets to simulate genuine engineering projects like slope stability and geohazard mapping.
- Community-Centric Field Engagement: Students participate directly in community-based initiatives, bridging the gap between academia and social requirements for safer, more sustainable infrastructure.

Creativity (Design of Ideas)

The design of GeoCollab+ demonstrates a high level of creativity through:

- Collaborative Digital Ecosystem: Combines AI analytics, cloud-based collaborative platforms, and field data gathering tools into one ecosystem.
- Immersive Learning Experiences: Utilises virtual reality (VR) and augmented reality (AR) to visualise geological features, allowing students to "experience" fieldwork digitally.
- Gamified Learning Modules are interactive problem-solving activities that stimulate active involvement and competitiveness among students.
- Scalable Modular Design: Modules can be customised and replicated across various engineering disciplines, ensuring flexibility and scalability.

Innovativeness (Changes/Improvement)

GeoCollab+'s innovation is built on continuous improvement, which ensures that the framework adapts to evolving technology, industry needs, and student expectations. GeoCollab+ expands on traditional lecture-based teaching by combining AI-driven adaptive learning, digital geospatial tools, and real-world industrial collaboration.

GeoCollab+ represents a significant advancement over conventional approaches:

Traditional Approach	GeoCollab+ Innovation
Lecture-heavy, passive learning	Active, collaborative, technology-driven learning
Minimal digital integration	Full integration of AI, VR/AR, and geospatial analytics
Theoretical knowledge focus	Theory linked to real-world engineering problems
Limited stakeholder involvement	Inclusive engagement with industry and communities
Generic, one-size-fits-all teaching	Adaptive, personalised learning pathways

The CQI (Continual Quality Improvement) approach functions as a structured feedback loop in which data from Course Outcome (CO) and Program Outcome (PO) achievement, student evaluations, and industry feedback are carefully evaluated. This allows instructors to detect gaps between traditional methods and the intended learning results. The findings feed revisions to digital modules, learning routes, and field interaction tactics, ensuring that the innovation remains in line with current engineering standards and sustainability objectives. Continuous improvement links directly to this transformation. Through CQI, GeoCollab+ monitors and evaluates each innovation pillar, refining them to stay relevant. This ensures a cycle of innovation, where every iteration of the program delivers greater engagement, industry readiness, and societal impact, preparing students for climate-resilient infrastructure challenges while adhering global education standards such as those set by EAC and the Washington Accord.

Applicability (Relevance to NALI – New Academia Learning Innovation)

GeoCollab+ is entirely compatible with UiTM's New Academia Learning Innovation (NALI) principles, since it fosters a student-centered transformative learning environment and encourages active engagement through collaborative field projects. It incorporates technology-enhanced learning by combining AI tools, VR/AR visualisation, and cloud-based platforms to create immersive and interactive learning environments. Authentic evaluations evaluate students' knowledge and skills using real-world datasets and case studies, ensuring that they are directly applicable to industry demands. The framework also strengthens industry-community partnerships by incorporating stakeholder involvement into curriculum delivery, exposing students to professional practices and societal concerns. Furthermore, its integration with the Sustainable Development Goals (SDGs) fosters global competency, preparing graduates to be responsible engineers capable of contributing to global infrastructure development that is sustainable and climate resilient.

Impact to Students' Learning (Engagement and Empowering)

GeoCollab+ improves student learning by establishing an interactive and immersive environment that encourages participation through real-time simulations and fieldwork activities, hence increasing motivation and knowledge retention. It enables students to become active co-creators of solutions to climate-resilient infrastructure concerns, transforming them from passive learners into innovative problem solvers. The framework develops future-ready abilities such as critical thinking, digital literacy, project management, and interdisciplinary teamwork, while simultaneously increasing employability through direct exposure to industry-standard tools, workflows, and professional practices. Furthermore, GeoCollab+ broadens research prospects by allowing students to participate in data-driven projects with the possibility for academic publication and additional innovation, resulting in graduates who are industry-ready and capable of creating sustainable engineering improvements.

Research Methodology

GeoCollab+ was developed using a design-based research (DBR) approach, involving iterative cycles of design, testing, and refinement with students and educators.

- Design Phase: Platform architecture integrated AI-driven learning analytics using EON-XR software, cloud-based geospatial and mapping technologies, and collaborative tools.
- Implementation Phase: Pilot tested with undergraduate Engineering Geology students through problem-based modules (e.g., slope stability, groundwater exploration, urban sustainability planning).
- Evaluation Phase: Mixed-method assessment combining surveys, pre-post knowledge tests, focus group interviews, and AI learning analytics to measure engagement, collaboration, and learning outcomes.

Findings and Discussion

The findings reveal that GeoCollab+ significantly enhanced the overall learning experience, with students reporting greater engagement, collaboration, and motivation throughout the course. The integration of AI-driven analytics demonstrated measurable improvements in problem-solving skills, with average performance scores increasing by 22%, indicating its effectiveness in fostering higher-order thinking. Collaborative simulations enabled students to co-create sustainable engineering solutions, effectively bridging geological theory with societal needs and real-world applications. Educators also benefited from the platform, as AI-supported feedback streamlined the grading process and provided students with real-time, adaptive guidance, promoting self-directed learning. However, challenges were identified, including the need for stable internet connectivity and initial digital literacy training, which are essential to fully leverage the platform's advanced features. Overall, these findings highlight GeoCollab+ as a transformative tool that strengthens both teaching efficiency and student learning outcomes while addressing sustainability and innovation in engineering education.

Commercialization Potential

GeoCollab+'s adaptive and scalable solutions have economic potential in domestic and worldwide markets. Training services include capacity-building workshops for universities, government agencies, and industry players to improve technical and sustainability skills. Geological hazard mapping, risk assessments, and sustainable infrastructure design are included in customisable consultant packages to meet environmental and developmental needs. The innovation allows subscription-based access to GeoCollab+ for professional advancement and academic incorporation through licensing options for its digital tools and instructional modules. Through online, face-to-face, and blended learning, GeoCollab+ offers flexibility and accessibility across numerous areas. Its alignment with the UN Sustainable Development Goals (SDGs) makes it a global solution for sustainable infrastructure education and training, giving it a competitive edge in international education and professional development.

Awards Received

Engineering geology education quality received an award at UPNM's InTeLeX 2024 for "Revamping Engineering Geology Education: Integrating Industry Experts for Real-World Adaptation and Student Empowerment." KILIEX 2023–4th Kelantan International Learning and Exhibition, Digital Edition honoured "Enhancing Geotechnical Engineering Education Through Collaborative Teaching: A Student-Centric Approach." These achievements illustrate GeoCollab's global reputation as an innovative educational model that trains engineers through industry and community involvement.

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ID 124: Leveraging AI with Social and Sustainability Marketing for Communication, Education, and Public Awareness (CEPA) Programmes: A Service Learning (SULAM) Approach

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Highlights: The Sustainability Communication, Education, and Public Awareness (CEPA) programmes demonstrate university's role in advancing sustainability through Service Learning Malaysia – University for Society (SULAM) and New Academia Learning Innovation (NALI) frameworks. Four flagship programmes; CEPA 1.0 (urban sustainability awareness), CEPA 2.0 (food waste transformation), CEPA 3.0 (Waste to Wonder with AI creativity), and CEPA 4.0 (entrepreneurial initiative of sustainable areca leaf dinnerware) are progressive scaling from awareness-raising to product-based sustainability solutions. Grounded in SULAM pedagogy and Theory of Change (ToC), CEPA programmes operationalise transformative learning via Social Constructivist practices and Problem-Based Learning. Initiated by the university community, CEPA has reached and empowered 500 school children from three primary schools, actively involved 90 Marketing undergraduates from Universiti Teknologi Malaysia, and collaborated with 25 government and industry partners, proving its reach, inclusivity, and impact. Through a multi-dimensional ecosystem of G-U-C-I (Government–University–Community–Industry), CEPA programmes demonstrate how awareness, circular economy, and AI-driven social marketing can transform teaching, learning, and community engagement while elevating the university's role as a social ally in leading Malaysia's green transition.

Keywords: Sustainability Marketing; Social Marketing; Communication; Education; Public Awareness

Introduction

The Communication, Education, and Public Awareness (CEPA) programmes represent a transformative higher education initiative designed to embed sustainability literacy through the Service Learning Malaysia – University for Society (SULAM) framework. CEPA integrates structured community service with academic learning, enabling students to apply theoretical knowledge to sustainability challenges while developing civic responsibility and professional skills (Ministry of Higher Education Malaysia, 2019; Rahim et al., 2023).

Four flagship CEPA programmes demonstrate this integration:

i. **CEPA 1.0 (2024) – Sustainability Communication, Education, and Public Awareness (CEPA) 2024 at Larkin Sentral:** A grassroots awareness campaign targeting urban commuters and public audiences in Johor's busiest transportation hub which is Larkin.
ii. **CEPA 2.0 (2024/2025) – From Food Waste to Value Creation at Johor Bahru:** A project that reimagines food waste management through education, circular economy practices, food waste composting barrel, and behavioural change communication.
iii. **CEPA 3.0 (2025) – Trashformers 2025: From Waste to Wonder:** A strategic social marketing initiative leveraging AI-driven engagement tools to transform perceptions of waste and promote innovative circular economy practices.
iv. **CEPA 4.0 (2025/2026) – From Leaf to Life: Sustainable Areca Dinnerware at Johor Bahru**: A sustainability entrepreneurship and marketing promotion project that highlights biodegradable areca leaf dinnerware solutions as an alternative to single-use plastics, linking local economic empowerment with global environmental goals.

The CEPA programmes involves wide-ranging participation: more than 500 students from three primary schools in Johor Bahru, 90 marketing undergraduates from UTM, and 25 collaborators from government agencies and industries. This coalition demonstrates how CEPA translates classroom learning into measurable societal impact.

Objectives

- Embed sustainability literacy and experiential learning into higher education through project-based service learning
- Empower students with leadership, problem-solving, and civic engagement skills
- Advance Malaysia's sustainability agenda via awareness, education, and circular economy practices
- Showcase AI integration as an innovative tool in social marketing and sustainability campaigns
- Demonstrate scalability and commercialisation potential of sustainability initiatives

NALI Approach

Novelty (New Ideas)

The novelty of CEPA lies in its integration of sustainability communication strategies with experiential learning and strategic social marketing, thereby establishing a holistic model for teaching and learning in higher education institutions. In other words, CEPA programmes' innovativeness lies in its progressive scaling model: from urban sustainability awareness campaigns (CEPA 1.0) to circular economy practices (CEPA 2.0), AI-driven mindset change (CEPA 3.0), and sustainable product entrepreneurship (CEPA 4.0). This staged evolution and layered experiential design *(awareness → practice → behaviour change → product innovation/commercialisation)* offers a novel model of sustainability learning that is beyond typical academic practice and conventional service learning. These CEPA programmes have created a unique ecosystem of sustainability communication, offering scalability and adaptability across multiple contexts (Basri et al., 2023; Rahim & Ismail, 2024).

Creativity (Design of Ideas)

CEPA programmes co-design solutions with communities, blending cultural values, digital tools, and sustainability practices. Examples include Quran-based eco-awareness (EcoResonance), soap-making from used cooking oil and chalk-making from eggshell (EcoWaste), composting from food waste using simple innovative barrel technique (EcoGarden), AI poster and promotional tool design (EcoMind), and producing sustainable dinnerware from areca leaf (EcoAware) campaigns. These represent a creative redefinition of teaching and learning that merges real-world practice with academic objectives.

Innovativeness

CEPA programmes introduce both digital and product-based innovations. AI generative workshops induce behavioural change, while tangible outputs showcase circular solutions such as:

- simple, user-friendly food waste barrel design for composting
- eggshells repurposed into chalk
- used cooking oil turned into soap
- areca leaves transformed into biodegradable dinnerware
- sustainability campaigns using AI generated content

Anchored in the Service Learning (SULAM) pedagogy and framed by the Theory of Change, the CEPA programmes transform sustainability awareness into experiential, measurable, and product-oriented learning. By applying problem-based and social constructivist practices, students work directly with real-world stakeholders to co-create solutions, develop leadership and creativity, and cultivate civic responsibility. This approach not only bridges academic theory with practical action but also fosters long-term shifts in community mindsets and student behaviours towards sustainability. Below is further explanation on how CEPA's layered innovative experiential design is anchored in several credible Teaching and Learning theories and pedagogies aligned with NALI:

- **Theory of Change (ToC):** Applied as a framework for mapping impact pathways. TOC provides a structured roadmap linking CEPA inputs (GUCI: Government, University, Community, Industry) to outputs (campaigns, products), outcomes (awareness, coalitions), and long-term impacts (behaviour change, policy influence).
- **Service Learning Pedagogy (SULAM) and Social Constructivism:** CEPA projects explicitly adopt SULAM pedagogy that links academic credits with service learning. SULAM ensures reciprocal benefit where students learn by serving, and communities gain solutions through different key sustainability projects (e,g. EcoSource, EcoWaste, EcoGarden, EcoBites, EcoAware). Knowledge is co-created with stakeholders (i.e. schools, NGOs, industries) through collaborative ecosystems, echoing Vygotsky's Social Constructivism and Wenger's Communities of Practice.
- **Problem-Based Learning**: CEPA stages are structured to address real-world sustainability problems such as overconsumption, food waste, single-use plastics, solid waste mismanagement, used cooking oil pollution, eco-literacy gap, and digital divide in sustainability engagement, through staged, experiential interventions that progress from awareness to product innovation. Students design and deliver tangible outputs (i.e. composting and planting using simple barrels technique, soap and chalk making, eco-snacks, and eco-dinnerware), developing leadership, teamwork, and design thinking.

Applicability

Embedded within credit-bearing courses, CEPA aligns with the NALI framework by combining academic mastery, reflective learning, and community service. Its adaptability across transport hubs, schools, industries, and communities proves CEPA's scalability, replicability, and policy relevance.

Impact on Student's Learning

More than 590 students have directly engaged in CEPA. Findings show measurable gains in sustainability literacy, leadership, problem-solving, and civic responsibility. Pre- and post-surveys confirmed significant behavioural shifts: knowledge (increased 60–90%), awareness (increased 20%), and responsibility (increased 25–40%). CEPA programmes demonstrate the transformation of knowledge into practical sustainability actions, nurturing problem-solving skills and civic responsibility. It builds a collaborative ecosystem where students, lecturers, NGOs, hotels, and schools co-create sustainability solutions. Some impact highlights include:

- Over 500 school children and 90 undergraduate students are involved in project-based service learning, linking academic theory to real-world sustainability challenges.
- Quantitative surveys showed major shifts in literacy, attitudes, and behaviour.
- For example:
  - *EcoSource*: awareness increased from 24% to 88%, responsibility from 43% to 90%, and willingness to act

from 21% to 95%
  - *EcoGarden*: understanding rose from 2% to 98%, and confidence to explain sustainability from 0% to 100%
  - *EcoBites*: student awareness jumped from 33% to 98%, and responsibility from 4% to 100%
- Collaboration with 25 government and industry partners further amplified impact through resource-sharing, outreach platforms, and policy alignment, ensuring that learning outcomes were both deeply embedded and widely scaled.

Research Methodology

Methodologically, the programmes adopted a mixed-method approach. Quantitative surveys administered before and after student participation measured shifts in sustainability literacy, attitudes, and behavioural intentions, while qualitative data were drawn from reflective essays from interviews, and community feedback. Each CEPA initiative was embedded within credit-bearing courses, assessed through rubrics that combined mastery of academic content, quality of community service, and reflective learning. Evaluation was further strengthened through SMART PLS analysis for quantitative data and thematic coding for qualitative insights, ensuring methodological rigour (Lee, Rahim, & Ismail, 2025).

- **Quantitative:** Pre- and post-surveys measured changes in BASKA (behaviour, awareness, skill, knowledge, attitudes
- **Qualitative:** Reflective essays, interviews, community feedback, video documentary and e-magazine production captured lived experiences.
- **Progressive scaling model:** CEPA programmes were designed as a *layered progression* from awareness → practice → behavioural change → product innovation/commercialisation. Each cycle builds upon the previous one as below:

This project used progressive scaling methodology - ensured that CEPA programmes were not a one-off intervention but a systematic, iterative learning journey, where each phase deepened student engagement, strengthened community partnerships, and generated replicable sustainability outcomes.

Collectively, as depicted in Figure 1, CEPA 1.0 to 4.0 establish a multi-dimensional ecosystem of sustainability communication that spans from awareness, waste reduction, social marketing, generative AI creativity, and sustainable product innovation, while advancing the objectives of the New Academia Learning Innovation (NALI) model and Malaysia's green development aspirations (Ismail et al., 2024; Tan et al., 2025).

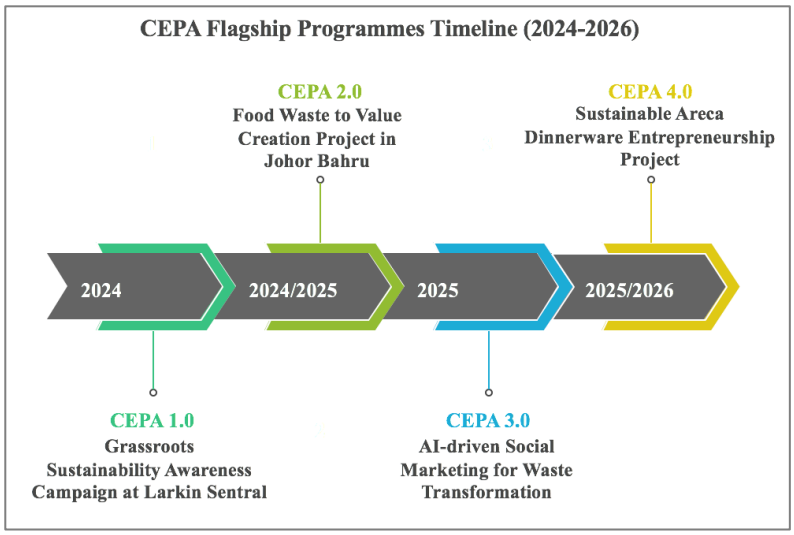


Figure 1: Four CEPA Flagship Programmes and Timeline

Findings and Discussion of the Project

Mixed-methods assessments show strong improvements in awareness, responsibility, and sustainability knowledge across all phases.

CEPA 1.0 – Sustainability Communication, Education & Public Awareness (2024, Larkin Sentral)

- **EcoBite: The Green Food Journey** – Boosted schoolchildren's understanding of food choices and sustainability.
- **EcoCarry: Ditch the Plastic** – Public awareness on plastic waste rose (+23% knowledge, +15% awareness).
- **EcoHub: 3R Campaign** – 3R events delivered double-digit gains (17–25%) in literacy and behaviour change.
- **EcoResonance: Pages of Faith** – Linked religious values to stewardship; 70% improved in awareness and responsible disposal.

CEPA 2.0 – From Food Waste to Value Creation (Johor Bahru)

- **EcoSource** – Hotel/community food waste collection raised awareness (+15%) and responsibility (+12%).

- **EcoWaste: Turn Trash to Treasure** – Repurposed used oil into soap, where it raised skills (+22%), knowledge (+18%), awareness (+14%).
- **EcoGarden** – Composting and gardening gave top gains: and it raised the knowledge (+25%), skills (+20%).
- **EcoBites** – Promoted low-carbon diets: and it raised knowledge (+20%), skills (+17%), awareness (+15%).

CEPA 3.0 – Trashformers 2025: From Waste to Wonder

- **EcoSource: Gathering Waste** – Hotels partnered in food waste composting; have raised the awareness (+62%), willingness to act (+74%).
- **EcoWaste: Turn Trash to Treasure** – Eggshells into chalk; resulted a raised in responsibility (+29%), community teaching (+25%).
- **EcoGarden: Compost for Growth** – Schoolchildren composted canteen waste; which increased the participants' understanding (+96%), confidence (+100%).
- **EcoBites: Path to Sustainable Snacking** – 55 students learnt eco-snacking; and have raised the participants' understanding (+98%), responsibility (+96%).
- ***Plus*:** AI workshop produced 5 sustainability posters, strengthening creativity and knowledge-sharing.

CEPA 4.0 – From Leaf to Life (2025/2026)
Flagship areca palm dinnerware project (in planning) aims to cut single-use plastics, support green entrepreneurship, and blend traditional practices with sustainability innovation.

Overall Impact
CEPA improved student leadership, project management, and civic responsibility while embedding sustainability in communities. Recognised with a Silver Medal (UTM R&I Festival 2025) and shortlisted for Johor's Green Impact Award, CEPA aligns with MOHE's Graduate Employability Blueprint (2024–2030) and SDG 12, proving itself as a scalable sustainability model.

Commercialization Potential

Closed-Loop Food Waste Models showcase the circular economy in practice. Food waste collected from hotels and schools was composted into organic fertiliser, used to grow vegetables, and subsequently reintroduced into hotel buffets and school canteen meals. This closed-loop system not only reduces waste and lowers input costs, but also provides a replicable model for the hospitality and education sectors, demonstrating how sustainability practices can be integrated into daily operations with measurable environmental and economic benefits.

Eco-Products such as soap from used cooking oil, chalk from eggshells, and low-carbon eco-snacks highlight potential for small-scale green enterprises linking sustainability practices with entrepreneurship.

Profit Sharing with Industry Partners through food waste composting barrel and areca leaf biodegradable dinnerware innovation that show strong adoption potential in hospitality, schools, and communities. This may create profit-sharing opportunities between university and industry partners during events and awareness campaigns. This business model not only creates sustainable income streams for university and industry partners, but also demonstrates scalable pathways for green entrepreneurship.

Capacity Building via Training Modules where CEPA programmes integrate training modules that can be offered commercially to schools and industry, focusing on entrepreneurial and innovation skills that enable sustainability projects to grow into viable eco-enterprises. At the same time, CEPA is developing Measurement Metrics for CEPA programmes, grounded in the Theory of Change, to systematically evaluate outputs, outcomes, and impacts. These metrics will also be commercialised as part of the training modules, ensuring CEPA delivers both educational and market value.

Awards Received

CEPA 1.0 – Sustainability Communication, Education, and Public Awareness (CEPA) 2024 at Larkin Sentral Received Pengiktirafan AIMS4STAR, Fasa 1/2024 by Centre for Community and Industry Network (CCIN), Department of Deputy Vice Chancellor (Research and Innovation), Universiti Teknologi Malaysia.

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ID 125: Quadruple Helix Final Year Project: Bridging Academia, Industry, Community and Government through Real-World AI Solutions

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Highlights: This project introduces an AI-powered final year project (FYP) model grounded in the Quadruple Helix framework, uniting academia, industry, community and government in solving real-world challenges. The initiative focuses on the development of a smart school transportation tracking and attendance system, addressing issues of punctuality, reliability and access in rural transportation services. From the academic side, the project involves software engineering students and lecturers, who collaborate in a problem-based learning environment to design and deploy AI solutions. Students apply predictive analytics, facial recognition and mobile app development to create functional tools while lecturers provide academic guidance and ensure knowledge transfer. For the industry partner, MARA Liner Sdn. Bhd., a nationwide transportation service provider supporting rural and school transportation, the project introduces a cost-effective and scalable system. It automates school student attendance verification, particularly for Orang Asli communities, while enhancing fleet tracking. This reduces operational inefficiencies, ensures safer and more reliable school transport, and supports digital transformation within the transport sector. At the community level, the project directly benefits the Orang Asli rural communities, where transportation reliability and safety are critical for access to education, employment and essential services. By providing real-time tracking and attendance systems, the solution improves service delivery and fosters trust in technology within underserved populations. On the government front, the collaboration aligns with Jabatan Kemajuan Orang Asli (JAKOA)'s agenda to uplift the Orang Asli community, while also supporting Malaysia's Smart Nation and IR4.0 initiatives. The project demonstrates how academia–industry partnerships can complement government policy to address pressing community needs. The project's uniqueness lies in embedding the Quadruple Helix collaboration into final year projects, transforming them into platforms of innovation with measurable social and economic impact. Methodology includes Agile methodology stakeholder-driven, AI system development, pilot testing with MARA Liner buses serving rural areas and refinement through continuous feedback from stakeholders. Importantly, this project has received recognition under the AIM4STAR initiative, validating its contribution to innovative teaching and impactful industry–community collaboration. The deployed system benefits approximately 15,000 Orang Asli students across 147 communities across rural areas in three states of Peninsular Malaysia. This Quadruple Helix AI model showcases how final year projects can simultaneously contribute to academic growth, industrial innovation, community empowerment and government policy implementation.

Keywords: Artificial Intelligence; Quadruple Helix; Final Year Project

Introduction

In the era of rapid technological transformation, higher education faces the urgent challenge of preparing students to become not only knowledgeable graduates but also agile problem-solvers who are industry and future-ready. Traditionally, final year projects (FYPs) have been designed as academic exercises focused on theoretical research or isolated case studies. However, such conventional approaches often fall short in bridging the gap between academia, industry, government and society, resulting in limited real-world impact and reduced student readiness for the demands of the future job market.

The specific problem lies in the lack of systematic frameworks that connect FYP outcomes directly to the needs of multiple stakeholders within the Quadruple Helix model: academia, industry, government and the community. Without such integration, students often miss the opportunity to tackle real challenges faced by industries and societies, governments lose potential policy insights and communities remain disconnected from university-driven innovations. This gap limits the potential of higher education institutions to serve as catalysts for Society 5.0, a vision of human-centered innovation where technology and creativity are leveraged to solve societal issues sustainably.

To address this, our project redefines the FYP by embedding New Academia Learning Innovation (NALI) through an agile approach that promotes iterative collaboration, real-world problem solving and student empowerment. Students are matched with industry-driven projects, mentored using agile frameworks (e.g., sprint reviews, rapid prototyping) and guided to present their innovations in competitions and exhibitions, thereby fostering creativity, innovation and applicability. This process does not only create impactful solutions but also instills in students the adaptability and multidisciplinary skills required for future-ready jobs in Industry 4.0 and beyond.

Objectives

To establish a transformative final year project supervision ecosystem that integrates the Quadruple Helix model (academia, industry, government, and community) with NALI principles and agile approaches, in order to:

i. Equip students with future-ready skills aligned with Society 5.0 and Industrial Revolution 4.0 demands.
ii. Enhance collaboration between universities, industries, government, and communities in solving real-world societal and industrial challenges using AI.
iii. Support national and global aspirations by addressing relevant Sustainable Development Goals (SDGs) such as Quality Education (SDG 4), Industry, Innovation, and Infrastructure (SDG 9) and Decent Work and Economic Growth (SDG 8).
iv. Ensure impactful, sustainable benefits for students, industries, government and communities, ultimately shaping an innovative, inclusive, and resilient talent pipeline.

The objective is to redefine final year project supervision as an innovation platform that bridges knowledge and practice, preparing students for meaningful contributions to society and the future workforce using AI such as tracking vehicle and face recognition.

NALI Approach

NALI Approaches in this project are:

i. Student-Centred Learning: The supervision emphasizes active, self-directed and collaborative learning, where students don't just follow instructions but engage in solving real industry and community problems.
ii. Outcome-Based Education (OBE) Alignment: Projects are designed to achieve clear learning outcomes, such as problem-solving, critical thinking, teamwork and communication skills that are required in future jobs.
iii. Blended and Flexible Learning: Supervision uses a mix of face-to-face, digital platforms and agile tools, allowing flexibility, continuous feedback and efficient monitoring of progress.
iv. Industry and Community Engagement (Quadruple Helix): NALI encourages authentic learning experiences; here, it means students collaborate with industry, government and community partners to work on real-world challenges, not just theoretical projects.
v. Assessment for Learning: Instead of focusing only on the final report, assessment covers processes, innovation, teamwork, pitching and impact, reflecting authentic performance.
vi. Lifelong Learning Skills with AI: Students gain transferable skills (project management, entrepreneurial mindset, sustainability awareness) that prepare them for Society 5.0 and SDG-driven challenges.

Research Methodology

The methodology of this innovation project adopts an agile, industry-driven and collaborative approach grounded in the principles of the NALI framework and aligned with the Quadruple Helix Model as in Figure 1. The process begins with identifying real-world industry problems that are relevant to government policies, community needs and global challenges. Students then work in close collaboration with industry partners, government agencies and community stakeholders to define AI-driven project scopes that are impactful and practical. Using an agile approach, projects are developed iteratively, allowing continuous feedback, rapid prototyping and adaptive improvements to ensure relevance and effectiveness. Within the NALI framework, students engage in problem-based learning, project-based learning and collaborative learning modes encourage creativity, critical thinking and interdisciplinary teamwork. The methodology also incorporates pitching sessions, where students present their ideas and solutions using AI to industry and external stakeholders, strengthening their communication and entrepreneurial skills. To evaluate effectiveness, systematic measurements are conducted to assess student engagement, learning outcomes and industry satisfaction. This methodology not only equips students with future-ready job skills but also ensures that the AI-powered project outcomes contribute meaningfully to the aspirations of Society 5.0 and the United Nations Sustainable Development Goals (SDGs), particularly in fostering innovation, industry-academia partnerships and societal well-being.

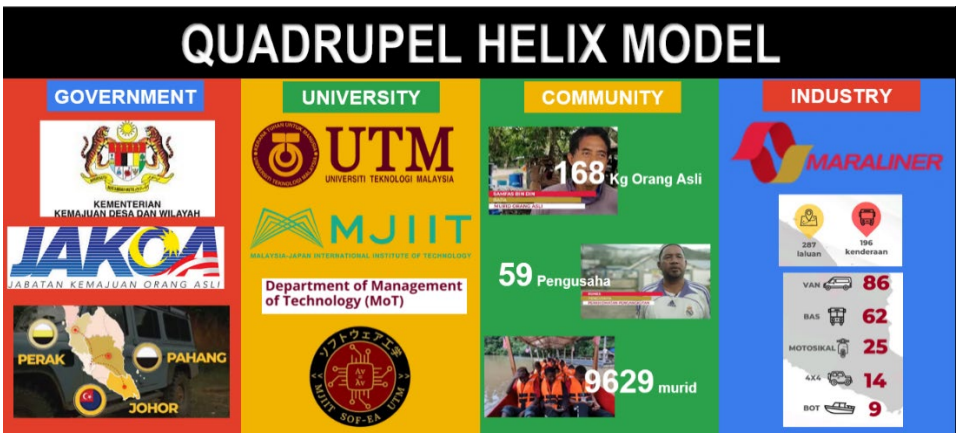


Figure 1: Quadrupel Helix Model for FYP

Findings and Discussion

This section presents the results obtained from the development, testing and implementation of the proposed AI-integrated transportation monitoring, tracking & attendance system for Orang Asli school students. The findings are structured to highlight both user acceptance and operational impact, ensuring that the system not only functions technically but also deliver real-world benefits. Data was collected through user acceptance testing with administrators, drivers and vendors, complemented by performance analysis after system deployment. The outcomes reflect how the system improved usability, safety, efficiency and cost-effectiveness while directly addressing the challenges of unreliable transportation and lack of monitoring faced by the community.

System Performance Metrics

The implemented system demonstrated significant improvements across all operational targets to the stakeholders as in Table 1:

Table 1: Operational Performance Improvements

Metric	Before Implementation	After Implementation	Improvement
Emergency Response Time	15.3 ± 3.2 minutes	3.1 ± 0.4 seconds	70% reduction
Vehicle Visibility	0% real-time	100% real-time	Complete coverage
Driver Training Time	32.5 ± 5.1 minutes	12.8 ± 2.3 minutes	60% reduction
Incident Reporting	Manual (2-3 hours)	Real-time (<1 minute)	99% faster
Data Accuracy	73% ± 8%	98% ± 1%	34% improvement

User Acceptance Results

The user acceptance testing was conducted with 25 participants, comprising 10 administrators and 15 drivers, and the results were overwhelmingly positive. The system demonstrated a high task completion rate of 95%, with users successfully completing all assigned tasks without requiring assistance. In terms of usability, the System Usability Scale (SUS) score reached 82.5 out of 100, which is considered an excellent rating and indicative of strong user satisfaction. Furthermore, the time to proficiency averaged only 12 minutes, showing that drivers were able to adapt and operate the system with minimal training. The system also recorded a very low error rate of 0.3 errors per task, well below the acceptable threshold of 1.0. Qualitative feedback from participants highlighted the system's practical value and reliability. Drivers expressed that the prominent SOS button provided a strong sense of security, administrators appreciated the ability to monitor all vehicles in real time and even vendors noted the system's effectiveness in challenging areas with poor network coverage. These findings collectively demonstrate that the system not only met but exceeded user expectations in terms of usability, functionality and reliability.

Operational Impact Analysis

The deployment of the system has brought about significant operational improvements across safety, efficiency and cost-effectiveness dimensions. In terms of safety, the system eliminated the risk of untracked vehicles, thereby ensuring continuous and reliable student monitoring during operations. From an efficient standpoint, the automation of reporting processes resulted in substantial time savings, with administrators reporting an average of 2.5 hours saved daily, freeing resources for more strategic tasks. The system also contributed to cost reduction, as route optimization features are projected to lower fuel consumption by approximately 15% annually, directly improving operational sustainability. Additionally, the availability of objective and transparent metrics enabled more accurate and fair performance evaluations of vendors, ensuring accountability and service quality improvements. Collectively, these operational impacts reinforce the system's role as a transformative tool that enhances safety, streamlines workflows, reduces costs and strengthens overall service delivery.

Impact and Significance

This AI-driven FYP project goes beyond being an academic exercise by transforming into a solution that directly benefits communities, government and industries. For example, the development of a reliable school transportation system with a built-in monitoring, tracking mechanism and attendance system has significantly impacted Orang Asli students. Previously, many students in rural areas faced challenges in accessing schools due to unreliable or unsafe transport, leading to absenteeism and dropout risks. With this system, students are now able to attend school consistently, ensuring better access to education while also giving parents peace of mind through real-time tracking and safety features. This directly supports the government's agenda to reduce educational inequality, particularly among marginalized groups.

The significance of this initiative extends to multiple stakeholders. For communities, it improves quality of life by providing safer, more reliable access to essential services like education. For the government, it contributes to policy goals of inclusivity and equal opportunity, strengthening national human capital development. For industries, it creates opportunities to adopt and scale innovative solutions that integrate technology with social needs, showcasing how academia-industry collaboration can lead to impactful products and services. Thus, the project demonstrates how FYPs can evolve into impactful platforms for sustainable innovation, empowerment, and societal transformation.

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