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Applying the Project-work AI Integration Framework (PAIIF): Early insights from multi-institutional implementation

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The Project-work Artificial Intelligence Integration Framework (PAIIF) was developed to guide educators in embedding AI tools into project-based learning in engineering education. Grounded in the CDIO model, PAIIF extends the traditional four project stages (Conceive, Design, Implement, Operate) by incorporating four additional sub-stages that emphasise evaluation, communication, and reflection. This paper presents the early application of the PAIIF across six undergraduate and one postgraduate engineering course at five Australian universities during 2024. To evaluate the framework's effectiveness, a two-phase survey was deployed to capture students' understanding and usage of GenAI tools before and after the integration. The implementation was tailored to each institution's policies and curricular context, with instructors selecting relevant stages of the framework based on course learning objectives. This paper offers a snapshot of how GenAI tools were introduced to support ideation, documentation, and evaluation tasks within project work. While full survey results are still being analysed, early observations suggest that PAIIF provided a valuable scaffold for ethical and pedagogically aligned GenAI use. This work contributes initial practical insights for educators seeking to apply structured AI integration in engineering education and lays the foundation for future large-scale evaluations.

Keywords: GenAI, Project-based learning, Engineering Education, Evaluative Judgment

Introduction

The release of generative artificial intelligence (GenAI) tools such as ChatGPT, Copilot, and Gemini has catalysed significant shifts in higher education. These tools have demonstrated remarkable capabilities in tasks ranging from content generation to coding and data analysis, raising both pedagogical opportunities and academic integrity concerns (Nikolic et al., 2023; Kizilcec et al., 2024; Quince et al., 2025). While much early attention focused on risks to assessment validity, a growing body of research emphasises the transformative potential of GenAI as a co-intelligence tool, supporting, rather than supplanting, human creativity and problem-solving (Mollick, 2024; Bearman et al., 2024).

Project-based learning (PBL), especially in engineering education, offers an ideal context for meaningful GenAI integration. PBL emphasises real-world relevance, critical thinking, teamwork, and iterative development, making it inherently adaptable to GenAI-supported workflows (Mills & Treagust, 2003; Guo et al., 2020). Yet, despite the proliferation of GenAI tools, educators face a lack of clear guidance on how to systematically and ethically integrate GenAI into project work (Baig & Yadegaridehkordi, 2024; Nikolic et al., 2025a). To address this gap, a multi-institutional team of Australian engineering educators developed the Project-work Artificial Intelligence Integration Framework (PAIIF) (Nikolic et al., 2025a). Grounded in the CDIO model (Crawley et. al, 2014), PAIIF provides a structured yet flexible framework that aligns GenAI integration with project stages, learning objectives, and ethical considerations. The framework includes both core stages and reflective sub-stages, enabling educators to scaffold AI use while promoting evaluative judgment and responsible innovation. Policy-wise, this aligns with accreditation calls for program-wide, multi-layered integrity, published GenAI policy and benchmarking, risk-calibrated mixes of supervised/unsupervised assessment, and gatekeeper checkpoints, to assure graduate competence (Nikolic et al., 2025b).

This paper presents a case study of the application of PAIIF within an undergraduate and postgraduate engineering subjects. By detailing the selection, adaptation, and implementation of specific framework elements, we explore how PAIIF can enhance student engagement, digital literacy, and critical thinking. Through reflection on observed outcomes and student behaviours, we aim to provide actionable insights for educators seeking to embed GenAI in a pedagogically sound and ethically aware manner.

The PAIIF Framework

The PAIIF was developed to address the lack of structured guidance for integrating GenAI in engineering project work. While CDIO provided a robust starting point, the development team recognised the need to extend the framework to better support critical and reflective aspects of project-based learning. As a result, PAIIF includes four additional sub-stages: Presentation and Documentation, Testing and Evaluation, Review and Revision, and Post-project Analysis. These sub-stages draw from the engineering method and reflect essential practices such as communicating findings, assessing compliance, refining solutions, and capturing lessons learned. Figure 1 documents the PAIIF.

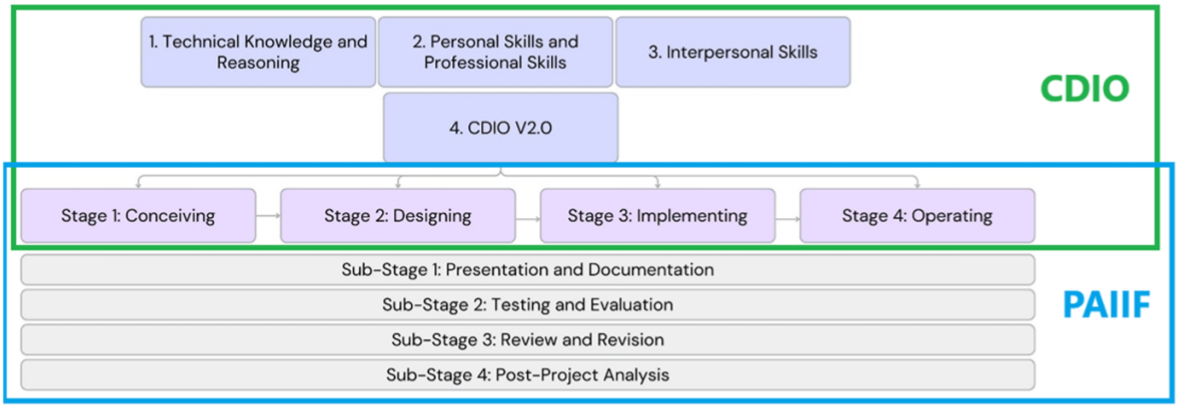

Figure 1. PAIIF structure (Nikolic et al. 2025a).

Each stage and sub-stage are associated with student activities and GenAI integration opportunities. For example, in the Conceive stage, GenAI can support research, brainstorming, and requirement gathering; during Implementation, it may assist with content generation, simulation, and automation. This structure allows educators to align specific PAIIF elements with their subject's learning objectives, class size, and level of technical complexity; selecting only the relevant components. The framework is intentionally non-prescriptive, enabling flexible use across disciplines and contexts. For example, the conceiving stage contains elements associated with any modern project; modify the use to the context.

Methodology: Applying the PAIIF Framework in Practice

The PAIIF framework was integrated into six undergraduate engineering subjects, and one masters course across four Australian universities during 2024. Table 1 summarises the details of each implementation, including teaching landscape, year level, course duration and GenAI model used. As the framework can be applied to any project-based learning courses, the sampling rationale was to have a mix of discipline-specific courses (C2, C4, C6, C7) as well as general courses offered to all engineering disciplines (C1, C3, C5).

Table 1
University and courses for initial implementation

Code	University	Level	Discipline	Runtime	Models
C1	UOW	Masters	General	July - Oct 24	Free to access models

C2	USYD	Bachelors	Civil	July - Oct 24	Cogniti and GPT 4
C3	UNSW	Bachelors	General	Sep - Nov 24	Azure Open AI/Free to access models
C4	UNSW	Bachelors	Chemical	Sep - Nov 24	Microsoft CoPilot
C5	UniSQ	Bachelors	General	Aug - Nov 24	Microsoft CoPilot
C6	UTS	Bachelors	Mechanical	Aug - Nov 24	Free to access models
C7	UNSW	Bachelors	Chemical	Sep - Nov 24	Microsoft CoPilot

To evaluate the framework's effectiveness and gather insights into student engagement with GenAI, a two-step survey methodology was employed. The first survey was administered at the beginning of the course and captured students' baseline understanding, attitudes, and current usage patterns of GenAI tools. The second survey, conducted after course completion, aimed to assess shifts in awareness, critical thinking, and the application of GenAI throughout the project lifecycle. With these key factors in mind, the survey was designed into the following five areas: Demographics (teaching landscape); student experience with digital technology specifically GenAI; student awareness and ethics; students' perception of GenAI specifically for education; GenAI use specifically for PBL (PAIIF stage/s implementation).

Given the diversity of institutional policies and ethical guidelines surrounding the use of GenAI in coursework, the integration of PAIIF elements was scaffolded differently across sites. Educators selected specific stages and sub-stages based on alignment with their local teaching contexts and assessment structures. Table 2 provides an overview of the PAIIF integration per course, mapping the specific student activities and associated AI tools used at each site. Table 2 also shows (via the 'O's) how the framework supported coordinator thinking to expand integration opportunities beyond those initially planned.

Table 2
Implementation of PAIIF Across Institutions

	Conceiving							Designing							Implementing				Operating				
Institution	Problem Analysis with AI:	Brainstorming with AI:	Enhanced Research:	Customer Feedback Analysis:	Requirement Documentation:	Planning	Competitor & Trend Analysis:	Project Outlining:	Resource Allocation:	Safety and Risk Analysis:	Design Alignment:	Evaluate Design Options	Design Optimisation:	Design Validation:	Content Creation:	Simulation and Modelling:	Automation & Efficiency:	Implementation Guidance:	Lifecycle Planning:	Real-time Adjustments:	User Feedback Analysis:	Predictive Maintenance:	Performance Monitoring:
C1	X	X	X		O	X	X	O	X	X		O											
C2	X			X	X	X	X							X						X	X	X	X
C3	X	X	X	X	X	X	X	X		X	X		X	X							X		
C4	X	X	X		X	X						X							X				
C5	X	X	X	X											X								
C6	X	X	X		X	X		X	X	X	X	O	O	O	X			X					
C7	X	X	X		X	X					X												

	Presentation and Documentation					Testing and Evaluating				Review and Revision				Post-Project Analysis			
Institution	Automated Reporting:	Report Generation:	Visualisations:	Documentation:	Data Summarisation:	Testing & Compliance:	Test Feedback:	Environmental Impact Assessment:	Evaluation Analytics:	Performance Review:	Iterative Improvement:	Scenario Analysis:	Historical Data Analysis:	Data Synthesis:	Lessons Learned:	Post-Project Reports:	Future Project Recommendations:
C1																	
C2						X	X										
C3		X								X	X				X		
C4																	
C5																	
C6		X	X	X	O	X	X	X	X	O	X				X	X	
C7		X	X	X		X	X	X	X		X				X	X	

Where the 'X' represents the activity was part of the initial planning, 'O' represents it was added in flight.

As the implementation is ongoing, the full analysis of the pre and post-course survey data is still in progress. This paper therefore presents an initial snapshot of the integration process, offering early reflections on the framework's utility and adaptability across varied engineering education contexts. All institutions approved ethics based on the initial approval from UNSW's human research committee (iRECS:5789).

Results and Discussion

These early findings provide valuable preliminary insights into the impact of the framework and the broader shifts in student behaviours and attitudes towards GenAI-supported learning in engineering contexts. Table 3 highlights student response to GenAI usage in their studies, professional or personal lives before (n=141) and after (n=50) PAIIF was introduced. The majority of students consistently reported occasional use of these tools, maintaining a stable proportion of around 60 percent across both survey points. This suggests that while PAIIF may not have significantly altered how often students used GenAI. There was a slight increase in those students who were aware of GenAI but chose not to use it. Most notably, the proportion of students who were neither aware of nor had used any GenAI tools dropped to zero.

Table 3
Frequency of Use of GenAI Before and After PAIIF Integration

Use	Before	After	Use	Before	After
Yes, occasionally	60.99%	60.00%	No, but I am aware of them	13.48%	20.00%
Yes, frequently	20.57%	20.00%	No, and I am not aware of them	4.96%	0.00%

Table 4 examines the specific GenAI tools used by students. GPT-based tools such as ChatGPT remained the most commonly used, although their share declined slightly after PAIIF implementation, as several institutions were required to utilise Copilot. Grammarly AI did not retain its position as the second most popular tool, indicating students were utilising Microsoft Copilot as this saw a considerable increase.

Table 4
Type of GenAI tools used by students before and after implementation.

Tool	Before	After	Change	Tool	Before	After	Change	Tool	Before	After	Change
GPT (OpenAI)	51.74%	44.23%	-7.51%	Other	3.47%	5.77%	+2.30%	No use	0.77%	1.92%	+1.15%
Grammarly AI	19.69%	11.54%	-8.15%	DALL-E	3.09%	3.85%	+0.76%	Codex	0.39%	0.96%	+0.57%
Google's AI	8.88%	7.69%	-1.19%	Brainly	2.32%	2.88%	+0.56%				
Bing AI/Copilot	8.11%	21.15%	+13.04%	DeepAI	1.54%	0.00%	-1.54%				

Figure 2 presents student confidence in using GenAI tools across the eight stages of the PAIIF framework prior to its implementation. Responses were measured on a five-point Likert scale (5: Strongly Agree, 4: Agree, 3: Neutral, 2: Disagree, and 1: Strongly Disagree. These results reflect that most respondents indicated at least a moderate level of confidence in applying GenAI to their project work. Confidence levels were slightly higher for reflective sub-stages such as Testing and Evaluation, Review and Revision and Post-Project Analysis. This suggests that students felt more capable using GenAI tools to assess, critique, and refine their work compared to earlier project phases, like implementing and operating.

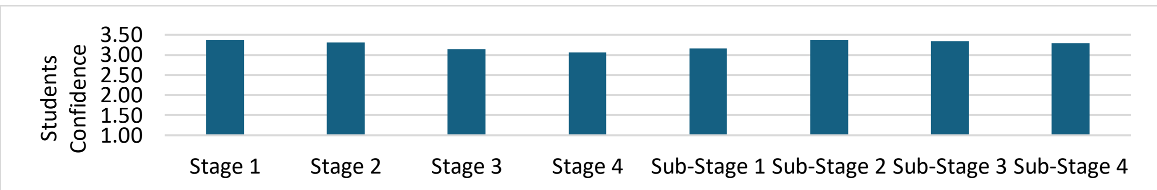

Figure 2: Student confidence in using GenAI for the 4 stages and sub-stages before implementation.

The early results from PAIIF's application suggest that the framework does not change the usage of GenAI of students. This in itself is an important factor to note that students are engaging when and how they want to, regardless of directions for learning. By linking GenAI use directly to project stages and learning outcomes, PAIIF provides a practical approach that helps demystify the role of GenAI for both students and educators. It frames GenAI as a collaborative partner in learning, rather than a shortcut or threat, which is essential for fostering ethical, critical and creative engagement. The diversification in tool use following implementation is particularly promising. It indicates that students are making informed choices about which tools to use and when based on institutional advice.

The study's main limitation is the involvement of multiple institutions, courses, and educators, with PAIIF applied differently across each setting. Despite this, the authors believe such diversity offers valuable insights for educators seeking to implement PAIIF more systematically. The results will monitor changes in students' confidence and perceptions regarding GenAI tools, helping educators assess the impact of institutional strategies on digital literacy and engagement. Over time, these findings will enable refinement of the framework to better support students' ethical and effective collaboration with AI in various learning environments.

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