

REDESIGNING ASSESSMENT FOR AI-SUPPORTED PROJECT-BASED LEARNING: EVIDENCE FROM ENGINEERING EDUCATION

Mohamad H Farhat, Mohammed Abdul-Niby, Hamzeh Aljarajreh

Electrical and Electronics Engineering Department, College of Engineering, Australian University

ABSTRACT

The integration of Artificial Intelligence (AI) tools into engineering education is reshaping how students learn, collaborate, and complete project-based tasks. In Project-Based Learning (PBL) environments, where students design, build, and justify complete engineering solutions, AI offers powerful advantages, including enhanced productivity, improved conceptual understanding, and support for ideation and debugging. However, increasing reliance on AI also presents significant challenges for assessment fairness, authenticity, and the evaluation of individual student contribution. This study investigates how engineering students use AI within a PBL course, examines their perceptions of its benefits and risks, and analyzes the implications for traditional assessment structures. Survey results from 38 students reveal that AI is extensively used across all stages of the PBL workflow, yet students acknowledge that fair assessment requires mechanisms ensuring they can explain, justify, and validate AI-assisted work. Based on these exploratory findings, this paper proposes an AI-aware PBL assessment framework grounded in four principles: transparency of AI use, prioritization of understanding over output quality, incorporation of multiple evidence sources for individual contribution, and proportional weighting of tasks susceptible to automation. The framework introduces practical mechanisms such as AI-use declarations, micro-vivas, process-oriented artefacts, and rebalanced rubrics, all of which can be integrated into existing assessment structures. This work contributes a practical CDIO-aligned approach for incorporating AI into engineering education without compromising academic integrity or learning outcomes. By emphasizing accountability, understanding, and responsible AI use, the proposed framework supports the evolving needs of modern engineering programs while maintaining fairness and rigor in PBL assessment.

KEYWORDS

Artificial Intelligence (AI); Project-Based Learning (PBL); Engineering Education; Academic Integrity; Standards 5, 6, 7, 8, 11.

INTRODUCTION

Within the Conceive-Design-Implement-Operate (CDIO) framework, engineering education aims to develop graduates capable of conceiving, designing, implementing, and operating complex systems while demonstrating professional and ethical competence.

Project-Based Learning (PBL) is widely adopted in engineering education due to its effectiveness in integrating technical knowledge with transversal skills such as teamwork, communication, problem-solving, and self-directed learning (Boud & Feletti, 1997; Boud, 1985; Barrows & Tamblyn, 1980; Crespí et al., 2022; Chen et al., 2021). By engaging students in real-world engineering challenges, PBL supports deep learning and professional readiness, aligning closely with active and integrated learning principles.

In parallel, accreditation frameworks and policy documents, including the Accreditation Board for Engineering and Technology (ABET) criteria (ABET, 2025–2026) and the European Key Competences for Lifelong Learning (Council of the European Union, 2018), emphasize the importance of professional competencies such as communication, collaboration, critical thinking, and ethical responsibility alongside technical expertise.

Despite its strengths, assessment within PBL remains challenging, particularly when evaluating individual contributions in team-based projects (Farhat et al., 2021; Devlin et al., 2016). These challenges have intensified with the rapid emergence of Artificial Intelligence (AI) tools capable of generating code, designs, and technical documentation. While AI can enhance learning efficiency and student confidence, it complicates instructors' ability to verify authorship, understanding, and individual contribution.

Recent studies on generative AI in higher education similarly highlight both opportunities and risks for learning and assessment. AI tools can support idea generation, feedback, coding, writing, and self-directed learning; however, they also raise concerns related to academic integrity, authorship, over-reliance, accuracy of generated outputs, and the validity of traditional assessment methods (Kasneci et al., 2023; Cotton et al., 2024; Perkins, 2023; Farrelly & Baker, 2023; Xia et al., 2024). These concerns are particularly relevant in PBL environments, where students are assessed not only on final outputs but also on process, reasoning, teamwork, and individual contribution.

From a CDIO perspective, this challenge directly affects the implementation of Standard 7 (Integrated Learning Experiences), Standard 8 (Active Learning), and Standard 11 (Learning Assessment). As AI becomes embedded in PBL workflows, assessment practices must be adapted to ensure that learning outcomes, professional competence, and fairness are preserved.

This study therefore investigates how engineering students use AI within PBL environments and examines the implications for assessment practices. Building on prior work in PBL assessment, technology-enhanced learning, and generative AI in higher education, the paper proposes an AI-aware assessment framework that supports responsible AI use while maintaining alignment with CDIO learning objectives.

AIM OF THE STUDY

The aim of this study is to investigate how engineering students use AI tools within PBL environments and to examine the implications for assessment fairness, authenticity, and individual accountability. The study analyzes student perceptions of AI-supported learning and

uses these insights to propose strategies for redesigning PBL assessment practices in AI-rich educational settings. Given its exploratory nature, this paper is positioned as a CDIO implementation and design-based contribution rather than a fully validated intervention study. It proposes an AI-aware PBL assessment framework informed by student perceptions, instructor reflection, and existing CDIO-aligned assessment practices. Future work will focus on implementing and validating the framework across additional cohorts and PBL contexts.

Research Questions

1. How do engineering students use AI tools during different stages of a PBL course, including planning, coding, documentation, design, and reporting?
2. What are students' perceptions of the benefits, limitations, and risks of using AI in PBL activities?
3. What assessment strategies can support fairness, authenticity, transparency, and individual accountability in AI-supported PBL environments?

METHODOLOGY

PBL Course Context

The study was conducted within an undergraduate PBL course offered in the Electrical Engineering program for students in Year 3–4 at the Australian University-Kuwait. PBL is a core pedagogical component of the curriculum, with students completing five PBL courses across their degree. In this course, students work in teams to apply CDIO framework (Conceive, Design, Implement, Operate) and document a complete engineering solution over a full academic semester. A project brief is provided at the start of the semester, after which students are divided into groups and are required to develop their solution collaboratively.

During weekly sessions, students engage in structured teamwork and receive formative feedback from the instructor, who serves as a facilitator rather than a traditional lecturer. Students are expected to work independently, troubleshoot problems autonomously, and consult external experts or industry professionals when needed. All consultations must be documented through meeting minutes, while external work completed by practitioners is strictly prohibited and results in loss of marks. Students maintain reflective workbooks, record team meetings, and progressively build project documentation over the semester.

Permitted Use of AI Tools

In this iteration of the course, students were explicitly allowed to use AI tools to support their project work. This included AI tools for coding, documentation, debugging, design, and simulation support. However, students were clearly informed that while AI may assist their work, they remain entirely responsible for the accuracy, validity, and reliability of all project outcomes. Students must be able to validate, justify, and demonstrate full understanding of any AI-assisted component during presentations, evaluations, or technical questioning. No restrictions were placed on specific AI platforms; students could freely use tools such as ChatGPT, GitHub Copilot, or other AI generative systems as long as they maintained complete ownership and comprehension of their submitted work.

Assessment Structure

The course assessment is distributed across five components spanning the semester as shown in table 1:

Table 1. Course assessment elements

Assessment	Type	Description	Week	Weight
Assessment 1 – Deliverables	Individual / Group	Individual report (10%) and project plan (5%)	Week 4	15%
Assessment 2 – Presentation	Individual / Group	Interim presentation	Weeks 7–8	15%
Assessment 3 – Comprehensive Evaluation	Individual / Group	Final presentation (15%) and final report (15%)	Weeks 3–14	30%
Assessment 4 – Portfolio	Individual / Group	Technical evaluation (20%) and final code/simulation/prototype (10%)	Weeks 13–14	30%
Assessment 5 – Participation	Individual	Attendance and class engagement	Weeks 1–14	10%

Survey Design and Purpose

A structured survey was designed to examine students' use of AI tools within the PBL process and to capture their perceptions of learning impact, teamwork dynamics, and assessment fairness. The survey supports the study's research questions by providing empirical evidence on how AI is integrated into PBL activities and how students believe assessment practices should adapt in response.

The instrument included Likert-scale items addressing AI usage frequency, perceived benefits and challenges, and impact on teamwork, as well as open-ended questions to gather qualitative insights and recommendations. The survey was reviewed for clarity and alignment with the research objectives and was administered anonymously during the final weeks of the semester via Microsoft Teams after completion of major PBL milestones. Participation was voluntary and had no impact on course grades, with a total of 38 student responses.

Quantitative data were analyzed using descriptive statistics, while open-ended responses were examined through thematic analysis to identify recurring themes related to AI integration, learning processes, and assessment fairness.

RESULTS AND DISCUSSION

Thirty-eight upper-level electrical engineering students participated in the survey, the majority with prior PBL experience. About 88% reported using AI tools during the course, primarily ChatGPT, across most PBL stages including coding, report writing, brainstorming, and design development.

Overall, students viewed AI as beneficial, reporting improved understanding of project tasks and greater confidence when presenting AI-assisted work. Learning outcomes were perceived as comparable to or better than those in previous non-AI courses, suggesting that students did not perceive AI use as reducing their engagement with engineering concepts.

However, concerns about assessment fairness were prominent. Students emphasized that AI-assisted work should be assessed equally only when accompanied by clear explanations and demonstrated conceptual understanding. Suggested strategies included oral assessments, AI-use declarations, reflective explanations, and peer evaluation.

While students acknowledged risks such as over-reliance on AI and reduced critical thinking, they noted that responsible use and independent validation could mitigate these issues. Overall, the findings highlight the need for transparent, explanation-based assessment approaches to ensure fairness and academic integrity in AI-supported PBL.

Table 2. Summary of Student Survey Results on AI Use in PBL (N = 38)

Category	Variable	Summary of Findings
Participant Profile	Major	100% Electrical Engineering students
	Year of Study	Majority Year 3–4 (upper-level students)
AI Usage	Used AI in PBL	~88% Yes, ~12% No
	Frequency of AI Use	Mostly Occasionally → Frequently → Almost Always
AI Tools Used	Tools	ChatGPT dominant; some DeepSeek
AI-Related Tasks	Tasks	Coding, report writing, brainstorming, flowcharts, formatting
Impact on Learning	Understanding	Majority reported improved understanding (Yes/Partial)
	Confidence	Majority felt more confident presenting AI-assisted work
	Learning Level	Most said About the same or Learned more
Fairness of Assessment	Equal assessment	Majority: Only fair if explanation of AI use is provided
	Preferred Strategies	Oral discussions (viva), AI-use declarations, reflections, peer evaluation
	Declaration Requirement	Majority Yes or Only for major tasks
Perceived Risks of AI Use	Risks	Over-dependence, wrong answers, reduced writing/critical thinking, shallow understanding
Student Suggestions	Recommendations	Oral questioning, testing understanding, AI-use declaration, ensuring comprehension

The survey findings directly informed the proposed framework. Students' emphasis on explanation and oral questioning supports the inclusion of micro-vivas; their support for AI-use disclosure informed the AI declaration requirement; and their concerns about over-reliance, incorrect AI outputs, and shallow understanding informed the focus on validation, reflection, and individual accountability. The framework presented in the following section is therefore interpreted as a proposed assessment design rather than a fully validated intervention. It is grounded in the exploratory survey findings, the existing PBL assessment structure, and reflective instructor experience in managing AI-supported project work.

PROPOSED AI-AWARE PBL ASSESSMENT FRAMEWORK

Building on the survey findings, the existing PBL assessment structure, and reflective discussions among instructors teaching PBL courses, this section proposes an AI-aware assessment framework designed to preserve fairness, authenticity, and alignment with learning outcomes while recognizing AI as a legitimate and increasingly unavoidable tool in engineering education.

Rather than restricting AI use, the framework rebalances assessment priorities, shifting emphasis away from polished outputs, such as well-written reports, formatted documentation, generated code, or visually refined presentations, toward understanding, validation, and individual contribution. The central premise is that meaningful learning in AI-supported PBL environments can be ensured when assessment focuses on *how* students use AI and *what* they understand, rather than *what* AI produces.

The proposed framework is structured around four guiding principles, each supported by concrete assessment mechanisms that can be integrated into existing PBL courses with minimal structural change.

Principle 1 – Transparency of AI Use

To ensure assessment fairness and accountability, students must explicitly declare how and where AI tools are used throughout the project lifecycle. Transparency reduces ambiguity regarding authorship, clarifies individual contribution, and enables instructors to make informed assessment decisions.

Operational Mechanism: AI-Use Declaration and Documentation
Each major deliverable includes a short *AI Use* section in which students specify:

- Which AI tools were used (e.g., ChatGPT, DeepSeek, Copilot),
- For which tasks (e.g., brainstorming, debugging, drafting report sections),
- How AI-generated outputs were reviewed, modified, or validated.

In addition, individual reflective workbooks are extended with prompts such as: “Describe one instance where an AI-generated response was incorrect, incomplete, or unsuitable, and explain how you identified and corrected it.” This requirement reinforces critical engagement with AI rather than passive acceptance.

Principle 2 – Assessment of Understanding Rather Than Output

Since AI tools can generate technically correct code, designs, and documentation, assessment must prioritize students’ ability to explain, justify, and adapt AI-assisted outputs. Understanding, not output quality alone, becomes the primary indicator of learning.

Operational Mechanism: Embedded Individual Oral Checks (Micro-Vivas)
At key project milestones such as interim presentations, final presentations, and technical evaluations each student participates in brief, targeted oral questioning focusing on:

- Specific components of the design or code for which they claim responsibility,
- The rationale behind design decisions, parameter choices, or control strategies,
- The role AI played and how its outputs were verified or refined.

These *micro-vivas* are assessed using a simple rubric emphasizing conceptual clarity, technical reasoning, and responsiveness to follow-up questions, ensuring that learning remains demonstrable even when AI is used.

Principle 3 – Multiple Sources of Evidence for Individual Contribution

Fair assessment in team-based PBL requires triangulation across multiple evidence sources rather than reliance on a single group deliverable. This principle is particularly important in AI-supported environments, where outputs may not reliably reflect individual effort.

Operational Mechanism: Process-Oriented Artefacts and Logs Students continue to submit meeting minutes and reflective workbooks, but with explicit prompts to document:

- Major project decisions and the individuals involved,
- How AI contributed to brainstorming, analysis, or problem-solving,
- The evolution of drafts, highlighting where AI-generated content was adapted or replaced.

Where feasible, instructors may also consider artefact histories such as version control logs or annotated drafts to further support contribution tracking.

Principle 4 – Proportional Weighting of AI-Prone Tasks

Assessment weightings should reflect the degree to which tasks can be automated by AI. Activities that require judgment, validation, adaptation, and real-time reasoning should carry greater weight than tasks that AI can perform with minimal student input.

Operational Mechanism: Rebalanced Rubrics and Weighting Rubrics for reports, presentations, and technical evaluations are revised to:

- Increase emphasis on explanation, justification, and validation of results,
- Reduce emphasis on surface-level features that AI can readily generate (e.g., basic formatting or boilerplate code),
- Allocate a small but explicit portion of marks to responsible and transparent AI use, rewarding critical and ethical engagement with AI tools.

Application to the Existing PBL Assessment Structure

The proposed framework can be integrated into the current assessment plan without changing the overall weights, but by modifying what is assessed within each component.

Assessment	Proposed AI-Aware PBL Assessment
Assessment 1 – Deliverables	<ul style="list-style-type: none"> • Mandatory “AI Use” subsection in the individual report. • Reflective questions on independent vs. AI-assisted work. • Emphasis on logic, calculations, and validation rather than writing fluency.
Assessment 2 – Presentation	<ul style="list-style-type: none"> • Each student presents a defined section. • 1–2 targeted questions per student verifying understanding of AI-supported content. • Marks emphasize real-time explanation.
Assessment 3 – Comprehensive Evaluation	<ul style="list-style-type: none"> • AI declaration table in the final report. • Structured micro-viva with randomized technical questions.

	<ul style="list-style-type: none"> • Reduced weight on polished report; increased weight on demonstrated reasoning.
Assessment 4 – Portfolio	<ul style="list-style-type: none"> • Focus on interpreting results, diagnosing issues, and adapting designs. • Live modifications during evaluation to test understanding. • AI assistance allowed in preparation, but marks awarded for independent technical reasoning.
Assessment 5 – Participation	<ul style="list-style-type: none"> • Includes brief in-class tasks performed without AI. • Provides a baseline of individual understanding.

The proposed framework aligns closely with student perspectives captured in the survey. Students overwhelmingly supported:

- The usefulness of AI for learning, productivity, and confidence.
- The need for oral questioning and explanation to ensure fairness.
- Transparent disclosure of AI use.

By integrating declarations, micro-vivas, process documentation, and rebalanced rubrics, the framework directly addresses the central challenge identified in this study: AI can support learning in PBL without compromising the integrity, fairness, or validity of assessment provided that assessment is redesigned to reward understanding and accountability rather than AI-generated output.

CONCLUSION

This study examined how engineering students use AI tools within a PBL course and considered the implications for assessment design in CDIO-based engineering education. The findings show that AI was used across several stages of the PBL workflow, including coding, report writing, brainstorming, formatting, flowchart development, and design support. Students generally perceived AI as beneficial for productivity, understanding, and confidence. However, they also identified risks such as over-reliance, incorrect AI-generated outputs, reduced critical thinking, and shallow understanding. These findings suggest that AI can support PBL learning, but students must remain responsible for checking, explaining, and validating AI-assisted work. In response, this paper proposed an AI-aware PBL assessment framework based on transparency of AI use, assessment of understanding, multiple evidence sources for individual contribution, and proportional weighting of AI-prone tasks. The main takeaway is that AI use in CDIO-based PBL does not need to be prohibited; instead, assessment should be redesigned to reward reasoning, validation, accountability, and responsible AI use. Since this study is exploratory and based on one cohort, future work should implement and evaluate the framework across additional PBL offerings.

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AI Usage Declaration

During the final editing phase, the authors used generative AI (ChatGPT) solely for English language editing and clarity. The tool did not influence the study design, analysis, or conclusions.

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BIOGRAPHICAL INFORMATION

Mohamad Farhat received his B.Eng. and Ph.D. degrees in Electronics and Communication Engineering from London Metropolitan University, and an M.Sc. in Mobile and Personal Communications from King's College London. He is currently an Associate Professor and Head of the Electrical and Electronic Engineering Department at the College of Engineering, Australian University of Kuwait. His research interests include reconfigurable microwave devices, techniques for suppressing spurious responses in filters for electromagnetic compatibility (EMC) systems, active learning methodologies in engineering education, renewable energy systems, structural health monitoring, and fiber optic sensing technologies.

Mohammed Abdul-Niby is the Dean of the College of Engineering and an Associate Professor of Electrical Engineering at the Australian University in Kuwait. He earned his PhD in Microelectronics from the University of Surrey (1998) and is a Chartered Member of Engineers Australia. He was formerly affiliated with the Centre for Osmosis Research and Applications at Surrey. As Dean, he leads with a vision of academic excellence, driving curriculum innovation, accreditation standards, and industry-aligned engineering education to ensure competitive programs and transformative student learning experiences.

Hamzeh Aljarajreh received a B.Eng. degree in Electrical (Electronics) engineering from the University of Mu'tah, Alkarak, Jordan, in 2010. He received M.Eng. degree in Microelectronics from Universiti Kebangsaan Malaysia (UKM), Bangi Selangor, Malaysia, in 2012. He completed a PhD degree in Electrical (Power Electronics) engineering at the University of Technology Sydney (UTS), Australia, in 2022. From 2015 to 2016, He was a Senior Electronic Engineer at Demand Manager Pty Ltd. From 2016 to 2022, he was a Casual Academic at UTS for various power electronics subjects. Then, He worked as a subject coordinator at UTS from 2022 to 2023 for various power electronics subjects. Currently, he is working as Assistant Professor in the Department of Electrical and Electronics Engineering at the Australian University in Kuwait. His current research interests include designing efficient multiple-input multiple-output DC/DC converters for renewable energy sources, energy storage systems, and microgrids. He is currently a reviewer for several IEEE Transaction journals.

Corresponding author

Mohamad Farhat
Australian University-Kuwait
P.O. Box 1411
Safat 13015 Kuwait
m.farhat@au.edu.



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