

# INTEGRATING AI INTO ENGINEERING EDUCATION: LEVERAGING CDIO FOR ENHANCED ASSESSMENT STRATEGIES

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## ABSTRACT

The recent advancements of generation artificial intelligence (Gen AI) and large language model (LLM AI) in content creation and manipulation have brought significant challenges to teaching and learning in various disciplines. These challenges have called for a transformative change in traditional teaching and assessment strategies to accommodate the latest technological advancements, without compromising the integrity of assessments and evaluations. Many higher education institutions (HEIs) have employed critical thinking tasks within their evaluation methods to stimulate a thought process that would be difficult to simulate by AI-assisted technologies. However, it has been repeatedly observed that even analytical topics such as mathematics and core engineering modules were susceptible to the corruptive use of AI-assisted technologies in their assessments, which fundamentally demeans the educational qualifications' quality across the HEIs. Equally well researched and developed machine learning AI (ML AI) can assist in data processing, pattern recognition and analysis.

Having witnessed the advantages of CDIO (conceive, design, implement, operate)-based curricula in fostering innovation, critical thinking, and analytical skills across engineering, technology and design courses, this paper designs a modern strategy that harnesses the novelties of AI technologies within a CDIO-based pedagogy. This is as Gen AI has the potential to assist students in evaluating their conceived ideas at "C" stage, feedback on "D" and machine learning AI (ML AI) analysis of "O" stages, shortening the project lifecycle. Using the existing case-studies on CDIO-based teaching and learning, the intersection of CDIO principles and AI technologies have been mapped to identify opportunities and interferences. The findings demonstrated the empowerment of each CDIO stage, conceive, design, implement and operation, through the effective and optimum use of technology, both in teaching methods and in assessments. Therefore, this paper presents a modern approach to teaching and learning, acknowledging the opportunities and risks of AI within the engineering curriculum. It demonstrates the potential benefits of AI in CDIO pedagogy, to not only reduce the risks but also harness the potential benefits as a stimulating tool rather than a replicating technology. The output of this work offers rich insights to HEIs who seek to embrace the positive aspects of AI technologies while preserving the resilience and integrity of their practices in this era of technology.

## KEYWORDS

## **INTRODUCTION**

The CDIO Initiative is a framework that aims to revolutionise engineering education by aligning it with the technological needs of today's world. The acronym CDIO represents the life cycle of any engineered product or system which includes conception, design, implementation and operation (Graham, 2020). This approach places an emphasis on project-based and problem-based learning with the goal of nurturing engineers who are equipped to make contributions, to both technology and society (MIT CDIO Initiative, 2020).

In the field of engineering education, there has been a long-standing emphasis on learning which focuses heavily on mathematics and fundamental sciences. However, there is a growing recognition of the CDIO Initiative as a progression that bridges the gap between theory and real-world application. This initiative aims to align education with the skills and knowledge required for engineers to excel in technology-driven environments (Crawley et al., 2007 & 2014). With the inclusion of AI and digital technologies, the importance of CDIO becomes more pronounced. It ensures that graduates are not only proficient in utilising these tools but also have a deep understanding of their ethical implications. Moreover, CDIO equips engineers with the flexibility to adapt to advancements in this evolving field (Shoham et al., 2020). As AI continues to revolutionise industries it becomes increasingly crucial for engineers to possess skills provided by the CDIO framework. This framework enables them not only to master AI, but also to comprehend its impact and incorporate ethical considerations into their work, while remaining flexible in response to future developments (Wibawa et al., 2023).

## **CHALLENGES POSED BY AI IN EDUCATION**

The incorporation of AI into the field of engineering education offers advantages. Through experimentation with Large Language Model AI (LLM AI), the authors have observed that it offers the opportunities to personalise the student learning, personal feedback, effective assessment methods, the ability to replicate problem scenarios, aid for problem identification, and results analysis. However, obstacles, including potential challenges that can impact the learning experience, promote dishonesty, and potentially compromise the quality of engineering qualifications, need to be considered. This section will delve into these challenges within the context of engineering education, with a focus on assessments and the broader learning environment.

*Undermining Deep Learning:* AI-powered solutions that offer responses or solutions to problems can encourage students to overly depend on technology for answers, disregarding the need for deep conceptual comprehension in engineering (Oakley et al., 2021). This reliance may result in an understanding of subjects where the emphasis shifts from comprehension to finishing tasks, impeding the cultivation of crucial critical thinking and problem-solving abilities that are vital in engineering.

*Academic Dishonesty:* academic dishonesty has become a concern due to the accessibility of Gen AI and LLM AI tools that can tackle problems, write reports, and even generate code. It is possible for students to rely on these tools to finish their assignments or exams without engaging with the content or honing their comprehension and abilities (Selwyn, 2021). This

not only undermines the credibility of assessments, but also hampers students' learning experiences and devalues their qualifications.

*Quality and Rigor of Assessments:* the quality and rigor of assessments pose a challenge when incorporating AI into the process. There is a concern that assessments may not accurately measure students' true understanding and abilities or distinguish between work assisted by AI and work generated by students (Floridi & Cowls 2021). It is essential to prioritise the integrity and fairness of assessments in order to uphold the standard of engineering qualifications.

*Equity and Access:* the unequal distribution of AI tools among students can create disparities in opportunities. Students with access to resources may have an edge over their peers, raising concerns about fairness. Additionally, the paced evolution of AI necessitates educators to constantly adapt their approaches and materials, which can pose challenges, especially in institutions with limited resources (Foltynek et al., 2023).

*Unintended Consequences and Ethics:* as AI advancements continue to progress, they frequently give rise to outcomes that encompass concerns regarding privacy, data security and the ethical employment of technology. In the realm of engineering education, where students acquire knowledge of designing systems and solutions that may incorporate AI capabilities, it is vital to instil a comprehension of these considerations (Gujjula & Sanghera, 2023). Furthermore, fostering discussions about the implications of AI in education is imperative in order to provide guidance for both students and educators in the responsible utilisation of this technology.

## **CDIO AS A SOLUTION TO AI CHALLENGES**

The CDIO framework, which focuses on hands-on learning, offers an approach to address the difficulties presented by the integration of artificial intelligence (AI) into engineering education. By promoting a grasp of engineering principles and their application to real-world problems, CDIO can safeguard the integrity of the process and ensure the excellence of engineering qualifications in the age of AI. Saputra et al. (2023) discusses the integration of LLM AI tools like ChatGPT in engineering education, highlighting how project-based learning can leverage AI to enhance problem-solving skills while mitigating potential misuse. The following points provide insight into how the CDIO framework can tackle the challenges posed by AI.

*Emphasis on Conceptual Understanding and Innovation:* the conceive phase of CDIO places importance on grasping the underlying concepts and fostering innovation. It highlights the significance of understanding the problem or requirement before delving into solutions. This approach ensures that students develop an appreciation for the subtle aspects of engineering challenges. By promoting creative thinking from the start, CDIO makes it challenging for AI to substitute the profound and innovative thought process necessary for conceiving novel engineering solutions. However, LLM AI could be useful sounding board to assist in the evaluation and feedback on their concepts, potentially shortening idea generation and evaluation process.

*Design with Human-centric Approach:* in the design phase students are tasked with combining their expertise with creativity and a focus on human-centered perspectives. This phase pushes students to think beyond solutions and take into account effects, user

requirements, and ethical considerations. The intricate nature of this process, along with the need for thinking, makes it difficult for AI to imitate or substitute the nuanced judgments and inventive solutions that students come up with. However, LLM AI potentially can provide constructive feedback to students on their design ideas and challenge students thinking and wider consideration factors.

*Hands-on Implementation:* during the implementation phase designs are transformed into products or systems. This hands-on experience plays a role in comprehending the real-world aspects of engineering: such as materials, manufacturing, testing and quality assurance. By engaging with the engineering solutions students acquire practical skills and problem-solving capabilities that surpass what AI can simulate. This hands-on approach guarantees that students acquire experience that is challenging to replicate with AI, ultimately strengthening their comprehension and proficiency.

*Real-world Operation and Feedback:* in the operate phase students gain knowledge about how engineered systems function in real-world scenarios. This includes learning about sustainability, maintenance and life-cycle analysis aspects. By comprehending the context in which engineered solutions exist students become better prepared to tackle practical problems that arise in reality. LLM AI has the potential to assist in the feedback process potentially challenge the students to derive improvements, as in reality the improvement process embedded within the operate phase is challenging for AI to mimic accurately. This ensures that students develop an understanding of engineering systems, through hands-on experience.

*Project-based and Problem-based Assessments:* the CDIO approach to learning and assessment involves project-based and problem-based tasks that demand comprehension, creativity and critical thinking. These assessments are designed in a way that challenges AI to assist or solve them, ensuring the evaluation process remains rigorous. Students' performance is evaluated not only on their solution, but also on their approach, decision-making skills and capacity for innovation and collaboration. These are areas where AI currently falls short in comparison. However, LLM AI can assist in feedback to students to challenge students to address issues and improve the resulting system from the CDIO project.

*Cultivating Ethical and Responsible Engineers:* by incorporating LLM AI and Gen AI concepts and ethical considerations into the CDIO framework educators can equip students to not only excel as engineers, but also to become responsible users and innovators of Gen AI and LLM AI. This entails comprehending the constraints, societal repercussions and ethical dimensions associated with AI. Through the CDIO framework educators can guide students in evaluating the application of Gen AI, LLM AI and ML AI in their professional endeavours, enabling them to cultivate a thoughtful approach as ethical engineers capable of navigating the intricacies of modern technology.

## **CASE STUDY: ENGINEERING PRODUCT LIFE CYCLE AT CANTERBURY CHRIST CHURCH UNIVERSITY**

The Engineering Product Life Cycle module offered at Canterbury Christ Church University is a demonstration of how the CDIO-based teaching approach is incorporated into engineering courses. This module is included in engineering programs such as Mechanical Engineering, Biomedical Engineering and Product Design Engineering. Its main objective is to cover all

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stages of a product's life cycle, from conception to considering its end-of-life aspects. In this discussion, we will explore how the module's structure and evaluation methods effectively address the misuse of AI in assessments, while promoting education in engineering.

*Module Structure and Approach:* The module is divided into two semesters and requires 400 hours of study. It consists of both on-campus lectures and practical classes, as significant time is dedicated to group projects and independent study. The module's foundation lies in the CDIO framework, focusing on hands-on learning, active engagement and real-life application. Its goal is to equip students with a comprehension of products' life cycles within wider social, environmental and business settings.

*Assessments' Overview:* The module employs a variety of assessments designed to evaluate different facets of the engineering process and student learning:

1. Outreach Portfolio + Reflection (20%): for this evaluation students will be tasked with developing an inclusive CDIO engineering STEM outreach activity. The main goal is to evaluate their skills in applying design methodology and engineering analysis and their ability to effectively manage an engineering project from start to finish. This assessment focuses on the "Conceive" and "Operate" aspects of the CDIO approach.
2. Group Presentation (20%): for this assignment students will need to deliver a research proposal about a product, with a special emphasis on its design and manufacturing processes, as well as strategies for improvement. This assessment is designed to align with the "Design" and "Implement" stages, promoting teamwork and encouraging students to analyse, develop, and effectively communicate engineering concepts.
3. Set Exercises (25%) and Group Report (35%): these assessments focus on conducting life-cycle assessments and performing engineering computations. Students are expected to create ISO life-cycle assessments using computer software tools. The assessments cover aspects of the CDIO framework including conceptualising a product solution, designing it, rapidly prototyping it, and evaluating its operation.

### ***Mitigating AI Misuse***

- *Diverse and Integrated Assessment Methods:* the module incorporates a range of assessment methods such as portfolios, group presentations and comprehensive reports. This approach ensures that students are actively involved in the subject matter as these tasks demand comprehension, creativity and analytical thinking.
- *Hands-on and Collaborative Learning:* the assessments focus on hands-on activities and group work promoting collaboration and problem-solving skills. These tasks require students to apply their knowledge in real-world situations, where relying on AI as a shortcut is less practical and not advantageous.
- *Focus on Professional Skills:* the module places an emphasis on the cultivation of professional engineering skills, such as ethical considerations, effective communication and critical self-reflection. These skills are integral to the assessments, requiring a level of professional involvement that surpasses what can be replicated by AI technology.

- *Continuous and Active Learning*: the module is designed to encourage learning and active participation in lectures, practical assignments and group work. This approach ensures that students remain engaged throughout their learning journey, minimising the likelihood of them misusing AI tools for assessments.

In an article, Li et al. (2024) show how the Gen AI-assisted approaches have led to observable improvements in student outcomes or reductions in academic dishonesty.

The Engineering Product Life Cycle module at Canterbury Christ Church University is an example of how CDIO-based teaching methods can be incorporated into engineering education to tackle the challenges presented by AI. By adopting a practical approach to instruction, the module ensures that students not only achieve the intended learning outcomes, but also develop the necessary skills and ethical mindset required in the engineering field. By emphasising the product’s life cycle and integrating ethical considerations throughout the curriculum, this module produces graduates who are well prepared to ethically and innovatively utilise AI in their future careers. This case study serves as a model for educational institutions seeking to enhance their engineering programs in this age of AI.

## INTEGRATING AI INTO CDIO

AI poses both challenges and opportunities in the field of engineering education. It has the potential to greatly enhance and innovate within the CDIO framework. Integrating AI into CDIO allows educators to harness its capabilities in order to enrich the learning process, improve engineering project design and implementation, and offer personalised learning experiences. In this section the advantages of incorporating AI into CDIO are explored and its application is showcased in CCCU’s Engineering Product Life Cycle module as illustrated in Figure 1.

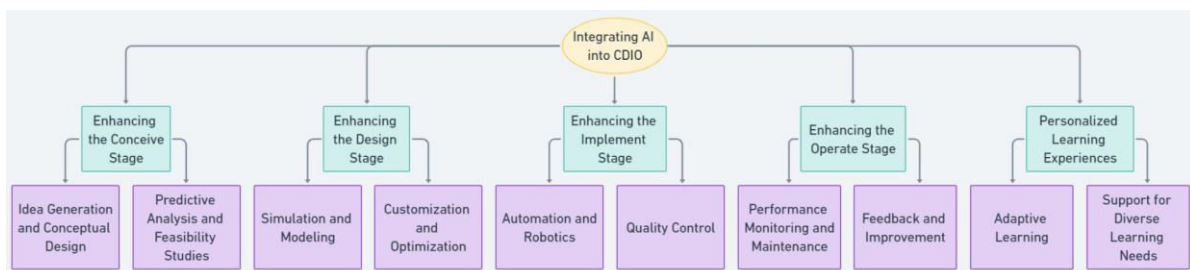


Figure 1. How AI can be integrated beneficially into the CDIO framework (Diagram made with Whimsical)

### **Enhancing the Conceive Stage**

- *Idea Generation and Conceptual Design*: Gen AI has the potential to aid in the beginning phases of engineering projects by offering tools for idea generation and design. For instance, design software driven by Gen AI and LLM AI can provide feedback on concepts, challenge areas of consideration, propose enhancements and alternative options that students may not have thought of, thereby expanding the possibilities and assisting them in conceiving groundbreaking solutions. Also, can

support students to identify the problem and break the problem down into smaller manageable parts.

- *Predictive Analysis and Feasibility Studies:* AI algorithms have the ability to analyse volumes of data and provide predictions, which can assist students in conducting feasibility studies and can impact assessments. By incorporating this technology into their work students can make informed decisions at the stage of the design process, guaranteeing the success and long-term viability of their projects.

### ***Enhancing the Design Stage***

- *Simulation and Modelling:* artificial intelligence has the potential to greatly improve the design phase by providing students with simulation tools. These tools enable students to test and refine their designs quickly. For instance, simulation software powered by ML AI can accurately predict how a product will perform under certain conditions, enabling students to enhance their designs efficiently. Importantly assist in compressing time duration of the design stage, overall aid in shortening a CDIO project lifecycle.
- *Customisation and Optimisation:* AI has the capability to customise designs based on requirements or fine tune them to achieve objectives. For instance, it can assist in minimising the use of materials, identification of more sustainable or ethically sourced materials or reducing energy consumption. This feature is especially advantageous in engineering education as it enables students to learn how to juggle design criteria and limitations, that is satisfy TQM+ paradigm; time, cost, quality, sustainability, health and safety, (Imam et al., 2023)

### ***Enhancing the Implement Stage***

- *Automation and Robotics:* during the implementation phase ML AI can oversee the automation and robotics involved in constructing engineering projects. This integration provides students with exposure to manufacturing methods while also allowing them to concentrate on the intricate aspects of the engineering process.
- *Quality Control:* AI can play a role in improving the implementation phase by offering real-time quality control and problem-solving tools. For instance, machine learning algorithms can identify irregularities or flaws in materials or processes, assisting students in upholding standards of quality and safety throughout their projects.

### ***Enhancing the Operate Stage***

- *Performance Monitoring and Maintenance:* after a project is up and running, ML AI can still be beneficial by keeping track of its performance and anticipating maintenance requirements. This application assists students in comprehending the significance of managing the lifespan of a system and the ongoing obligations associated with operating a system.
- *Feedback and Improvement:* ML AI, but so has more recent Gen AI have the capability to analyse data and offer suggestions for improvements or optimisations. This feedback can be extremely useful for students to incorporate into their projects. The ongoing learning process is a part of the CDIO approach, highlighting the aspects of engineering. Gen AI is particularly useful providing feedback sandwich areas meeting the assessment criteria and areas for improvement. Therefore, particularly useful to provide formative feedback on student's reflective practice.

### ***Personalised Learning Experiences***

- *Adaptive Learning:* AI has the ability to customise the learning experience according to each student's needs. It can adapt the difficulty of tasks and offer resources



whenever required. This individualised approach guarantees that all students, regardless of their level, can make the most out of the CDIO framework.

- **Support for Diverse Learning Needs:** AI can also provide assistance to students with learning needs. For instance, in the Engineering Product Life Cycle module students who have health concerns or learning support plans utilised Gen AI-generated (NaturalReader.com) for the outreach activity videos. This implementation enabled students who may feel hesitant about speaking to engage in the project, promoting inclusivity and catering to diverse learning preferences. Gen AI has been shown to help students improve their writing and presentation skills to different audiences. Students in the engineering lifecycle module as part of their requirements to create a CV, were able to convert the work done to a resume format information where the technical jargons were removed along with personal pronouns making the text more appropriate for a non-technical audience such as HR personnel.

By incorporating AI into the CDIO framework there are advantages to be gained; including enriching the learning experience and fostering quality and innovative engineering projects. When educators harness AI they can provide students with an education that is at the forefront of advancements, equipping them to navigate the complexities of today's engineering landscape. It is crucial however, to strike a balance between leveraging AI as an enhancement tool and emphasising thinking and ethical considerations. This ensures that students not only develop proficiency in engineering, but also cultivate responsible and creative approaches to applying technology.

## **PRACTICAL IMPLEMENTATION STRATEGIES**

Incorporating artificial intelligence (AI) into the CDIO framework in engineering education requires planning and strategic execution. The objective is to improve learning experiences and uphold assessment standards while equipping students for the changing world. Here are some specific strategies to effectively integrate AI within the CDIO framework:

### **1. Designing AI out of assessments**

*Complex Problem Solving/ CDIO Capstone Project:* crafting assessments that necessitate a comprehension of the situation, analytical reasoning and imaginative problem solving all demand abilities with which AI often encounters difficulties. Problems to be solved for a stakeholder, therefore a unique problem. Therefore, assessments that emphasise these aspects are less prone to be influenced by AI assistance.

*In Class Activity:* Assign in-class essays or short-answer questions that require students to apply knowledge and think critically within a limited timeframe. These assessments are difficult for Gen AI to assist with in real-time. Equally activity as oral activity examination, presentation, and debate where students verbalise their understanding, application and critical thinking. This approach is challenging for Gen AI to replicate as it requires real-time comprehension and communication skills.

*Application-based Tasks:* tests that only require students to recall knowledge should be avoided, and instead introduce tasks that involve applying concepts in unique situations. This could include engaging students in design challenges, real-world problem-solving scenarios or analysing situations where Gen AI would struggle to replicate thinking processes. For examples in the exam written for the FEA Module- the students were asked a question 'how can angular forces be applied to geometry without using a vector direction?'

One student copied the question into ChatGPT, and the response was a 330-word explanation of different forces that exist and how can they be applied into the software. Another student prompted "I am completing a finite element exam about using the FEA simulation program Ansys Workbench. the question is about boundary conditions; what are angular forces, and how can a force be applied without using a vector direction?". The answer did have a hint towards the answer after 175 words of related information but did not answer the question raised – and the student did not use the hint in their answers.

*Peer Review and Group Work:* by encouraging students to engage in peer assessments and collaborative projects that assess their teamwork and innovation skills, students' abilities can be promoted and advanced. Assessors should ensure that the evaluation encompasses a wide range of competencies that cannot be replicated by AI alone.

## **2. Using AI as a Teaching Tool**

*Personalised Learning Pathways:* incorporate intelligence to analyse the performance of students and develop tailored learning journeys that enhance their comprehension in areas where they may be weaker. This can be accomplished through learning platforms that adapt the difficulty of content according to the learner's progress (Tapalova & Zhiyenbayeva, 2022).

*Simulations and Virtual Labs:* utilise ML AI-powered virtual labs that enable students to engage in hands-on design and implementation experiences within a virtual setting. This not only offers a protected learning environment for exploration and experimentation, but also introduces students to the possibilities of AI integration in engineering applications. Yahyaeian (2023) and Groenewald et al. (2024) provides evidence on how ML AI-enhanced virtual labs can improve learning outcomes in engineering education, supporting the argument that AI, when properly integrated, can enrich the educational process without compromising integrity.

While studying FEA students were challenged to use Gen AI (eg. ChatGPT, BARD, Gemini) to consider the different applications of a metamaterial and they used Gen AI to look at applications. Students also used it to identify potential boundary conditions, for e.g., they were asked to create a simulation for the bending of a pole vault beam used in the sport. For a person who might not understand the sport, AI would deliver the explanation of the process the athlete might use in the sport.

*Intelligent Tutoring Systems:* incorporating Gen AI tutoring systems into education can be highly beneficial for students. These systems can offer feedback, explanations and guidance, acting as a resource to supplement traditional classroom learning. Additionally, they provide support outside of class hours.

## **3. Training Students and Faculty in AI Literacy**

*Curriculum Integration:* incorporate AI literacy into the curriculum to ensure that students have an understanding of the abilities and constraints of AI. This involves teaching subjects

such as AI ethics, data analysis, machine learning principles and the societal implications of AI.

*Faculty Development Programs:* provide the faculty with development programs aimed at keeping them updated on AI technologies and pedagogical strategies. These programs will help them effectively incorporate AI into their teaching methods and equip them with the knowledge to identify and address any misuse of AI.

*Ethical Considerations and Critical Thinking:* incorporating ethics into engineering practices is crucial when using AI. It is important to encourage students to think about the impact of AI in their work and in society. This promotes a mindset of innovation and responsibility.

#### 4. Enhancing Collaboration with AI Industry Experts

*Partnerships with AI Organizations:* create alliances with companies and institutions that specialise in intelligence. This will allow students to gain knowledge of the industry trends, practices and obstacles. Opportunities such as guest lectures, internships and joint projects can be offered as part of this partnership.

*Real-world AI Projects:* incorporate real-world AI projects into the curriculum to engage students in hands-on experiences. These projects should involve developing AI solutions, preferably in collaboration with industry partners. By working on these projects students will gain experience and a deeper understanding of how AI can be applied in real-world scenarios.

In some cases, student were encouraged to use Gen AI to generate ideas but they we not able carry out the entire project using the tool. They were able to generate short potential projects which then lead to discussions which challenged their thinking and provided ideas which they might not have thought about.

#### 5. Continuous Evaluation and Feedback

*Regularly Update AI Strategies:* given the nature of the field, it's important to update teaching methods, tools and materials to stay aligned with the latest advancements and insights in AI.

*Feedback Mechanisms:* incorporate methods of gathering feedback to assess the success of integrating Gen AI and LLM AI within the CDIO framework. This should involve obtaining input from students, faculty members and industry collaborators in order to consistently enhance and modify AI strategies.

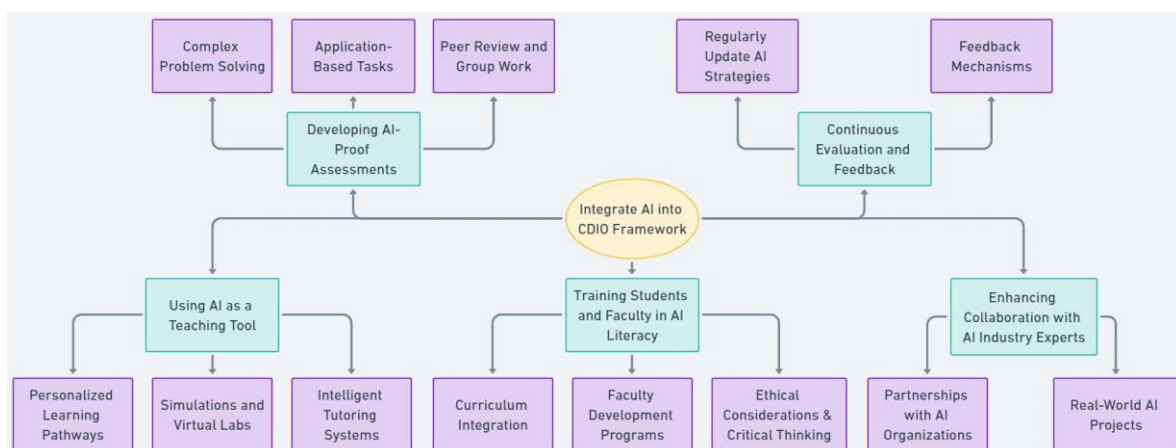


Figure 2. How to implement AI in a CDIO framework in a way that enhances learning and assessment integrity (Diagram made with Whimsical)

Through the application of these tactics' teachers can seamlessly incorporate AI into the CDIO framework, enriching the environment for engineering students while upholding the importance of authentic and applicable learning experiences and evaluations. These strategies are shown in Figure 2. The goal is to nurture graduates who possess not only technical skills but also a deep understanding of ethics and a penchant for innovation, all in preparation for making positive contributions to the field of engineering and society as a whole.

## **CONCLUSION**

The incorporation of AI into the CDIO framework is an advancement in engineering education. In this paper the opportunities and challenges that arise from AI's presence in engineering education have been examined. It is crucial to adopt an approach that capitalises on AI's strengths while also addressing its drawbacks. By implementing assessments that are resistant to AI manipulation, utilising AI as a tool, and fostering AI literacy among students and faculty members, educators can enhance the learning process and preserve the integrity of engineering education. The AI in particular tool to support student Self-directed learning activities, which historically students struggle with in CDIO activities need SDL scaffolding, (Wong and Cheah, 2022). Gen AI can provide that scaffolding.

The strategies discussed in this paper offer a path for incorporating AI into the CDIO framework. By emphasising the development of problem-solving abilities utilising AI in education, and consistently considering aspects with which teachers can equip students, their success in a future driven by technology can be ensured. Moreover, it is essential to collaborate with experts from the AI industry to continuously adapt to the changing landscape of AI in order to ensure that the curriculum remains up to date and forward thinking. Some examples of the benefits of using AI and how it can be designed out of the curriculum have been briefly explained.

In summary, as the age of AI has arrived, the CDIO framework's flexibility and comprehensive approach make it an invaluable model for incorporating technologies into engineering education. By innovating and adapting educators will prepare a generation of engineers who possess not only technical expertise but also a strong ethical foundation to tackle future challenges. The process of integrating AI into engineering education is a journey and the strategies and insights presented in this paper contribute to this conversation, guiding us towards a more knowledgeable, effective and ethical implementation of AI in engineering education.

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## DECLARATION OF AI-ASSISTED TECHNOLOGIES IN THE EDITING PROCESS

During the preparation of this work the author(s) used AI for diagram creation and proofreading. After using these tools, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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**Dr Adil Imam:** is a Senior Lecturer in Engineering. Adil's research focuses on Education, the simulation and testing of sporting equipment and personal protective equipment. He holds membership in the International Sports Engineering Association and serves as a committee member for the British Standards Institution, specializing in standards governing sporting PPE. Adil's prior experiences include skin injury research for World Rugby, which culminated in revisions to Regulation 12/ body padding specifications and has held positions as a Sports Engineer for the International Tennis Federation and a design engineer in the oil & gas industry.

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