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ORIGINAL ARTICLE

Embedding Inclusivity, Innovation, and Industry Relevance in Engineering Education: A Reflective Practice Journey

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Abstract

This paper reflects on innovative teaching strategies in engineering education, aimed at enhancing student engagement, collaboration, and professional readiness. It explores three interconnected strands of practice developed by the author: embedding Equality, Diversity, and Inclusion (EDI) to ensure all students can participate fully and develop a strong sense of belonging; adopting blended and flipped learning approaches to promote flexibility, active engagement, and learner autonomy; and aligning teaching with industry practices through authentic, interdisciplinary projects. Drawing on the author's classroom experiences across multiple engineering modules, as well as student feedback and peer observations, the paper presents practical examples illustrating how these strategies have improved engagement, confidence, and employability. It argues that meaningful and sustainable improvements in engineering education emerge not from isolated initiatives, but from a continuous cycle of listening to students, adapting teaching approaches, and refining practice. The outcomes demonstrate that integrating inclusion, innovation, and industry alignment can better prepare graduates to enter a diverse, global, and rapidly evolving professional landscape.

***Keywords*— Engineering education; Author's experience; inclusion; blended learning; flipped classroom; interdisciplinary; reflective practice.**

***JETLP Category*—Practice**

Introduction

In the early stages of teaching engineering, the author's focus was on the clear delivery of technical content, precise explanations, and the measurable attainment of learning outcomes. However, over time, specific classroom experiences revealed the limitations of a purely content-driven approach. For example, a high-performing international student consistently underachieved in laboratory assessments, not due to a lack of ability, but because the practical examples were disconnected from their cultural and professional context. Another technically gifted student withdrew from group activities, concerned that an unfamiliar accent might undermine perceptions of their competence. In an interdisciplinary design project, a

team's innovative concept ultimately failed in execution due to weak coordination and ineffective communication.

Such instances underscored the need to address more than technical mastery. Research into engineering education strongly supports this shift, showing that active learning approaches lead to significant improvements in student performance and engagement, particularly for underrepresented groups (Freeman et al., 2014). Flipped classroom models, for example, not only encourage greater preparation but also promote ownership of learning, with students arriving ready to question and adapt taught methods (Khoo et al., 2015; Baytiyeh and Naja, 2017).

Effective preparation for the modern engineering profession also requires attention to how students learn, who they learn alongside, and why their work matters. Frameworks such as CDIO (Conceive–Design–Implement–Operate) demonstrate that embedding authentic, industry-aligned projects can develop both technical competence and transferable skills (Abdulla et al., 2020). At the same time, critical scholarship cautions against uncritical adoption of purely industry-led agendas, emphasising the importance of reflective, socially responsible pedagogy (Mitra and Raskin, 2024).

These insights informed the development of three guiding principles for the author's teaching practice: (1) Inclusion—creating learning environments in which every student feels valued and supported; (2) Innovation—employing teaching approaches that are active, relevant, and adaptable; and (3) Industry alignment—designing activities that mirror professional practice and ensure readiness for employment. The following sections examine each of these strands in depth, drawing on pedagogical reasoning and practical outcomes. Examples are taken from three modules taught by the author, these are Microcontroller and Interfacing Electronics, Finite Element Analysis, and Product Design and Life Cycle Analysis, with classroom experiences and student feedback providing the basis for reflection.

Embedding Equality, Diversity, and Inclusion in Author's Teaching

The author embeds Equality, Diversity, and Inclusion (EDI) throughout teaching practice by designing learning experiences that are accessible, relevant, and inclusive. This involves purposeful group formation to promote collaboration between students with complementary strengths, selecting case studies that reflect diverse societal contexts, and creating digital resources that enable self-paced learning. Tools such as anonymous polling give every student a voice, while personalised support ensures that individual needs are recognised and addressed. Together, these approaches foster a learning environment where all students feel valued, represented, and empowered to contribute fully. Some good practices for EDI are mentioned below.

Inclusive Curriculum and Group Work

In the Electronic Circuits module, the author moved away from allowing students to self-select lab partners, instead pairing those who excelled in theoretical problem-solving with those confident in practical assembly. Initially, some students were uncertain—one remarked, "I've never worked with someone who thinks so differently to me." By the end of the semester, however, many of these pairings had developed into genuine partnerships. One quieter student shared that

having a partner who valued their calculations gave them the confidence to speak up in class for the first time.

Representation and Relevance

The author began deliberately choosing examples from renewable energy, biomedical devices, and assistive technologies—fields with clear societal value. The change was subtle at first: more questions in class, more attentive engagement during explanations. Then, one international student stayed back after a lecture to say, "Seeing a prosthetic limb case study today reminded me of my uncle back home. I never thought my engineering degree could help people like him." That conversation crystallised for the author how relevance and representation can be transformative..

Accessible Digital Resources

Finite Element Analysis (FEA) can overwhelm even the most confident students, so the author created a resource set combining written guides, annotated screenshots, and short video demonstrations. These were uploaded to the Virtual Learning Environment (VLE) to allow students to review the material at their own pace. One student, who had been struggling with quizzes, later commented, "I watched the video three times before it finally made sense. I just needed to go at my own speed." That single adjustment—enabling self-paced review—improved not only student marks but also morale.

Encouraging All Voices

When the author first used Mentimeter for live polling, the sheer volume of anonymous responses was striking. Students who had been silent throughout the term suddenly submitted thoughtful, even challenging, ideas. One particularly quiet student contributed a correct but unconventional solution that sparked a rich class debate. This experience confirmed for the author that silence often conceals insight, and that anonymity can serve as a bridge to participation.

Personalised Student Support

As a personal tutor, the author has learned that a brief, honest conversation can change the trajectory of a student's education. One tutee, who had a hidden disability, was on the verge of withdrawing. Following their discussion, the author connected the student with the Disability and Inclusion Support team. With assessment adjustments in place, the student not only completed the module but achieved a strong grade. This experience reinforced for the author that inclusion is not just about policies—it is about relationships and proactive care.

Innovating Through Blended and Flipped Learning

The author uses blended and flipped learning approaches to create varied, engaging, and student-centred experiences. By combining lectures, labs, group discussions, and online activities, teaching is kept dynamic and allows different strengths to emerge. Flipped models encourage students to arrive prepared to question and challenge, while tools like Tinkercad provide safe spaces for experimentation before hands-on work. Co-creating assessment tasks with students fosters ownership and relevance, and formative feedback loops—such as pre-deadline submissions—

enable timely, targeted support. Together, these strategies promote active engagement, flexibility, and a sense of shared responsibility for learning. Some good practices are mentioned below

Diversifying the Learning Experience

The author aims to maintain a natural rhythm in teaching by blending lectures, labs, group discussions, and online activities. This variety breaks the monotony and creates opportunities for different students to excel. In one lab, the author observed that a student who had seemed disengaged during lectures came alive when soldering a circuit, explaining the process to peers as if taking on the role of the instructor.

Flipping the Classroom for Active Learning

When the author first implemented a flipped model, there was concern that students might not engage with the preparatory materials. Instead, many arrived in class ready with questions and challenges. One student remarked, "I tried the method in your video, but I think there's a faster way." This kind of ownership over the learning process was exactly what the author had hoped to cultivate.

Using Simulation to Support Understanding

Introducing Tinkercad transformed how students approached circuit building. Previously, the author had observed students freeze at the sight of a breadboard, fearful of making costly mistakes. With virtual experimentation, students could fail safely and arrive at the lab feeling confident and prepared. One student summed it up perfectly: "It's like having a rehearsal before the real show."

Co-Creating Learning with Students

When the author began sharing draft assessment briefs with students and inviting feedback, the initial response was silence. However, when one student suggested adding a real-world constraint to make the task more realistic, others started contributing their own ideas. The resulting project became one of the most successful the author had run, largely because students felt they had played a role in shaping it.

Embedding Formative Feedback Loops

The author asks students to submit simulation screenshots and short reflections before major deadlines, enabling targeted feedback early in the process. One student later remarked, "It was like getting a rehearsal mark before the performance." This metaphor resonated with the author, capturing precisely what formative assessment should feel like.

Embedding Industry-Aligned Interdisciplinary Learning

The author embeds industry alignment into teaching by integrating professional tools, fostering cross-disciplinary collaboration, and developing transferable skills. Activities such as DFMEA and PFMEA introduce students to industry-standard risk analysis methods, while structured teamwork

between engineering and project management students builds the ability to collaborate across professional cultures. Opportunities to present to non-specialist audiences help students translate technical expertise into clear communication, enhancing employability. Continuous refinement—guided by student feedback and supported through workshops, rubrics, and example cases—ensures these industry-focused activities remain both authentic and accessible, preparing students to apply their learning confidently in professional contexts. Some good practices are mentioned below.

Bringing Professional Tools into the Classroom

Introducing DFMEA and PFMEA was initially met with resistance, as students perceived them as additional paperwork. However, as projects progressed, they began to recognise the value of systematically identifying risks. One graduate later emailed the author to share that they had used DFMEA in a job interview and believed it had contributed to securing the role.

Building Cross-Disciplinary Teams

Pairing engineering students with project management students revealed both friction and growth. Early in the semester, one team argued over deadlines; by the end, they were joking about having learned to "speak each other's language." This cultural shift, from competition to collaboration is exactly what such projects are designed to foster.

Developing Transferable Skills

Students not only developed technical skills but also learned how to present their ideas to non-specialist audiences. The author observed one particularly shy engineering student deliver a clear and confident project pitch to a mixed audience, earning praise from both peers and faculty.

Refining the Approach

The first time the author ran the FMEA activity, student feedback was clear: they valued the realism but wanted more guidance. In response, the author introduced earlier workshops, clearer rubrics, and example cases. The following year, both the quality of work and student confidence showed noticeable improvement.

Impact and Reflection

Across EDI, blended learning, and industry alignment, the author has learned that improvement occurs when teaching is approached as a dialogue rather than a monologue. The most significant changes such as adjusting group structures, selecting relevant case studies, and refining resource formats have come from listening to students, whether through formal feedback or quiet observation. The impact has been evident in many forms: students who once sat at the back in silence now contribute ideas in discussions; project teams have transformed early frustration into productive collaboration; and graduates have written to share that the skills practised in class gave them confidence in interviews. These outcomes affirm for the author that education is not just about delivering content, it is about shaping professional identities and building human confidence.

Conclusion

The author's journey has shown that inclusion, innovation, and industry alignment are not separate threads but parts of a single tapestry. An inclusive classroom fosters the trust needed for innovation; innovative approaches keep learning relevant and adaptable; and industry alignment ensures that students recognise the tangible value of their education. Each year, the author continues to adapt, responding to changes in technology, industry needs, and student experiences. The true measure of this teaching lies not only in exam results, but in seeing students graduate as capable, confident engineers ready to contribute to a diverse, global profession.

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Author Bio

The author is a Lecturer in Engineering Design and Manufacturing at Kingston University London, specialising in electronics and instrumentation systems for both research and teaching. Her research interests span sensor systems, sensor fabrication and characterisation, flexible and printed electronics, sustainable electronics, interfacing circuit design, printed circuit boards, device development, and performance evaluation. During doctoral studies at IIT Kharagpur, the author designed and developed a low-cost instrument to address the societal challenge of milk adulteration. From 2021 to 2022, she worked as a Postdoctoral Researcher in the Department of Electronics and Nanoscale Engineering at the University of Glasgow, successfully developing a printed tag for food quality monitoring. Industry experience includes a role as Senior Research Engineer at the Advanced Manufacturing Research Centre, University of Sheffield (2023–2024). The author has also served as Assistant Professor in Electronic Product Design at the Department of Design, IIT Guwahati, India. The author has published 18 research articles, held one Indian patent, and brings over eight years of combined academic and industry expertise in teaching and research.

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