

Guest Editorial

Artificial Intelligence has come a long way since the first rule and case-based systems which could solve problems in specific domains. Developments in large language models, deep learning, neural networks and generative AI have led to systems that can search through vast amounts of data to find patterns that might elude us, and create valid responses with text and images (for example) in response to user prompts. Such so-called intelligent systems have implications for engineering education. Academic staff and their students, who use these tools effectively, now have easy access to a wide range of sources which can help the former to design curricula, modules and assessments, and can help the latter to tackle course work and assignments. Intelligent systems can also be used in laboratories to generate answers to students' basic questions about how an apparatus works, for example, and to guide them towards the right answer when they have a query, or make a mistake.

The important terms to remember when we use these systems are Tool and Help. Engineers have always used tools (such as calculators, spreadsheets, and search engines) when they solve problems and design. The new AI-based tools are just far more sophisticated and powerful. But, when we collaborate with them, and use their help, it is the human engineer who must evaluate, criticize and judge, and determine when a particular solution which AI has generated, is the correct or appropriate one.

Students who over-rely on these AI systems for doing coursework run the risk of losing their connection with basic principles, calculations, materials and processes, which forms the first important layer of their engineering experience, and which should last for their professional lifetime. They need to be reminded that such tools, for all their apparent sophistication, are based on powerful algorithms and the availability of large volumes of relevant data. Indeed, some (such as Roger Penrose) claim that Artificial Intelligence is a misnomer and should be replaced by Artificial Cleverness. These systems cannot think. And they cannot encompass the broad vision of engineering, where routine calculations and codes of practice must be viewed alongside important considerations of health and safety, the environment, costs, ethics, and innovation.

Therefore, if we are to embrace Artificial Intelligence as a valid tool and collaborative assistant in engineering education, we have to ensure that it is used ethically, effectively and wisely. Students must be drawn towards the idea of engineering as a profession which is based on mathematics and the sciences, but which uses this technical foundation in creative and innovative ways, along with personal and the historical experience of past generations, to find novel and cost-effective solutions to difficult problems for the benefit of society. AI tools can help, by performing or checking some routine calculations and design tasks, but they are only one subservient tool in the wider, and far more complex, problem-solving and design process.

And academic staff should not only focus on promoting the ethical use of AI, but must concentrate on designing assessments which test students' deeper skills of evaluation and critical judgement. Thus, AI could be used by students to generate initial ideas for design solutions in group-based projects. This initial AI-generated push can help to stimulate students' creativity and form the basis for group discussions and debate. But, the real assessment focusses on how the group evaluates and criticizes these initial ideas, and how the students add significantly to them or abandon them entirely. Assessment tasks themselves must move from those with "closed" solutions to ones which are open ended, and force students to call on a range of varied skills and to view the problem from different and contrasting perspectives.

We must also remember that education, teaching and learning should aim to engage and enlighten the student, as a pathway towards acquiring sound and lasting knowledge and critical thinking. It is difficult to see how an AI system could replace the live lecture, where an expert engineer uses their professional experience as a basis for actively engaging a student audience with some complex ideas in thermodynamics or structural design. It is difficult too to see how an AI system could replace the engineer whose back of the envelope calculations and sketches, based on years of experience, help them to form an initial but valid response to an ill-defined problem. AI tools do have their place in teaching and learning. They can remove the drudgery of basic calculations, and they can help with the initial exploration of design ideas. But the broader view of engineering must never be lost. We should never forget the basic skills that engineers need, nor the satisfaction that we felt and will always feel when we, as engineers, work, design and create without these so-called intelligent (or clever) systems.

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