A Design Education Special Interest Group report on:

Digital Solutions for Design Education

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Foreword

The discussion presented within this report took place at the International Conference on Engineering Design 2023 at the Université de Bordeaux, France on Friday 28th July 2023. A panel discussion on **Digital Solutions for Design Education** was organised on the broad topic of design, engineering and technology education to discuss novel challenges in educating students on and with the next generation of digital solutions proposed by technology vendors. The panel included representatives of technology providers supporting Industry (Ansys, Dassault Systèmes and Immersion) and academia. The aim of the workshop was to discuss the existing challenges for design education and future opportunities to improve teaching and learning.

The panel session attracted an audience of academics and students. In turn, the panel began by introducing their companies and the technology solutions they offer. They each highlighted the challenges as they understand it from a technology vendor and educational perspective. Following this, four key questions were used to support the discussion. These were:

- How new keywords/trends (AI, Digital Twin, AR/VR, sustainability) are embedded in your organisation and in your digital solutions?
- How far digital technology evolutions should impact teaching activities?
- How new technologies can foster future collaborations between academics and industries in the future?
- Is there a “dark side” of the evolutions of digital technologies in teaching/learning activities?

These questions guided the discussion however topics spanned across many questions reflecting the complex and wicked nature of technological interventions. In total the session lasted two hours. A recording of the session was transcribed, and key themes were identified.

What follows is a summary of the discussion that took place at the panel discussion and key outcomes for design educators.

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Summary of the discussion

Student reliance on digital tools

All technology has its benefits and its drawbacks. Technology enables a user to do things that were not achievable before. However, it might limit the user to a particular viewpoint or a particular perspective of how a problem can be solved. If a student becomes a 'button pusher', they may not fully poses the intellectual knowledge that was required to solve the problem without the use of that technology.

In an education environment, the challenge is to ensure that the tool doesn't become an instrument. The challenge for the educator is to become mediators with the technologies to help students to understand and learn about the underlying science and engineering principles.

Professors will sometimes resist. Some might comment that software is too much like a video game, and the taught knowledge is lost. Students may forget the fundamentals simply because they don't have practice applying this knowledge.

The technology should not be the focus, the focus is the science, the engineering, the projects that are conducted.

The emphasis for industry has been to make technological software solutions that are more intuitive, and to make documentation of how to perform tasks using this software easily understood.

In addition, misinterpretation of the answers provided by the computer software can contribute engineering decisions made.

Industry perceives itself as a provider of tools in order to help teachers provide skills for future engineers.

Novel technologies can play a role in supporting the types of skills learnt within an educational environment including critical thinking, reflection and fundamentals. Virtual reality is one solution which allows students to visualise what computation is occurring. Complex calculations can be explained visually where equations were once needed. Perhaps including the rationale alongside the computation is needed for student versions of software.

In recent years, the number of Artificial Intelligence (AI) software has increased bringing new challenges such as plagiarism detection, and exacerbating challenges of overreliance on technology software.

One role of the Design Society, or the Design Education Special Interest Group could be in supporting the creation of a vision or Road Map for technologies successful use in the classroom.

The same software is being used in academia and industry. Academic editions of software do not enhance the educational experience but perhaps only deliver a selection of abilities. The use cases are not the same for academia and industry because academia is interested in educating students on the fundamental principles and how to use the software. Perhaps education specific software is required. However, it is a benefit to have the software be identical as the students will be train in the software as part of their education.

The difference between an expert and a novice (student)?

With the introduction of novel AI technology systems such as Chat GPT, anyone can access what is perceived as expert knowledge. An expert is someone who knows the state of the art and therefore students could perceive Chat GPT as the expert. Students question why they need to become an expert by developing their own knowledge.

Students believe the answers that they receive from computer-generated sources, which can result in a reduction of critical thinking on their part. This is a major concern. With expansion into AI, this is a social challenge for academics and industry alike. Academics need to change their educational approach. But how?

Whether the information that is provided by these novel AI technology systems is accurate or not, the perception of its accuracy is supported by the communication of the information. It is transmitted as trustworthy. It is convincing and well structured. How might academics teach students to be more critical of the information they receive from these systems and to evaluate the precision of the information provided?

Pedagogical milestones of the past, for example, Wikipedia offer an understanding of how adoption of new technologies might develop. When Wikipedia became popular it was not a useful tool. It lacked functionality and users were not good at searching for reliable information. Nowadays, Wikipedia is one of the largest collective endeavours of intelligence. It has revolutionised teaching for students and teachers. However, it introduced the 'copy paste' culture into education as a bad practice. Early use of novel AI tools is introducing bad practices again and it is for academics and technology vendors to learn how to overcome this.

In some situations, industry needs engineers that are trained to press the right buttons. But this cannot be applied to all engineering roles. Engineers must know and apply engineering principles. Software can be introduced to increase productivity. How might academia and industry collaborate on this?

Recent trends in technology

VR headsets are an immersive technology with limitations despite the extensive research completed in VR, CAVE environments etc. People are not truly immersed. This is difficult to achieve due to sense of presence, the feeling of the uncanny valley, and stimulation of other senses.

Academics and industry experts need to come together to overcome these challenges. When industry adopts a technology too quickly you often get many bad examples of how it is used. This is discouraging people from using new technologies before useful and relevant applications have been trialled and developed.

Stronger collaborations

There are many mechanisms to support collaboration. Centres of Excellence are one example enabling engaged individuals to collaborate on common topics. Government has a role to play in this initiative and has demonstrated this through investment in skills identification.

There is certainly a difference in the amount of research and support between developed nations and the global south. This can lead to growing inequality in engineering skills and quality or outcomes.

There needs to be a clear understanding between academics and industry as to the types of engineers required by industry.

Expanding the curriculum into multidisciplinary skills development, produces unique engineers, for example, an engineer with specific Python coding skills who can specialise and go beyond a typical candidate to achieve something unique for a company or communicate between specialised teams within a company.

Early career academics provide opportunities for technology providers and industry in the development of novel tools. They understand the potential of these technologies across society.

Summary of the outcomes

The outcomes of this discussion represent challenges and developmental opportunities for research in the area of education and technology development:

- The Design Education Special Interest Group could propose the creation of a vision or roadmap for technology solutions development for education.
- Opportunities for the co-development of future industry tools between academics and technology providers and evaluation of systems solutions before use within the classroom or industry.
- The development of focused educational software packages that teach students the fundamentals of engineering principles.
- How can academics ensure that students are critical thinkers and not following an established procedure.
- How can academics ensure they are teaching appropriate practice to learners in the use of novel technologies.

We strongly encourage the design community to come together to address these challenges associated with the use of novel technologies, both in academia and in industry, and collaborate on research ventures.

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