# Editorial: Importance of pedagogy

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A significant thread runs through the articles in this issue of the journal – a focus on pedagogy. As a collection, insights are provided into pedagogy in informal, maker space settings with young children, undergraduate engineering courses, undergraduate design courses and postgraduate courses, including one where the focus is on design for health. The pedagogies presented vary from those that are loosely structured to those that are highly structured. Some involve working with professional contexts, some are explored across disciplines. One thing that the articles have in common is putting the learner at the centre. A range of approaches to doing this are portrayed, providing excellent detail and examples to be shared. A common feature is the tricky and challenging management of a shift from transmissive to transformational educational experiences. Through this issue's collection, there are lessons to be learned and ideas that can be unpicked that can transcend both age and educational level boundaries.

The importance of placing the learner and learning at the heart of pedagogic practices is highlighted at the outset through this issue's Reflection piece by Richard Kimbell, (Goldsmiths, University of London, UK). In *Transformations* he explores this through the lens of the 'butterfly' effect – how a small change in one place can have the ability to create massive and unexpected change somewhere else and, in an educational context, especially when pedagogy is at the core.

In the first research article - *A study of children's relationship with making and use of CAD in collaborative, informal environments and the implications for institutional learning environments,* Denise Allan, Samantha Vettese and Paul Thompson (Edinburgh Napier University, UK) report on a study undertaken in an informal education setting with children who attend a 3D printing club. The research focuses on how children engage with digital making processes in an unstructured environment. Drawing on literature on learning in the context of digital making, online communities, builder gaming and digital technologies, the researchers developed research analysis underpinned by constructivist learning. Through this they explored how an informal club setting can affect outcomes of children's learning, designing and making experiences, how children's online hobby led activities compare with learning outcomes in the club setting and to consider how the results may relate to institutional environments. The article reports on a study that involved over 100 children, focusing in detail on two contrasting case studies, one of a six year old and the other of a ten year old. Both children were using the same modelling software and their behaviour illustrates insights identified across the larger group, including differences in approaches to open ended exploratory play and problem solving and more goal focused approaches and how being part of online maker communities impacted on aspects such as perseverance. The authors conclude the article with comments on positive approaches that could be transferred to institutional setting that can help acquisition of a range of skills such as team work, research, communication, designing thinking, innovation and cooperative learning.

In *Learning Engineering through the Flipped Classroom Approach - Students' Perspectives,* Wendy Fox Turnbull (University of Waikato, New Zealand), Paul Docherty and Pinelopi Zaka, (University of Canterbury, New Zealand), begin by providing a brief background on, and incentives for exploring, a flipped classroom approach. Interestingly there are some parallels here with the previous article by Allan, Vettese and Thompson, drawing on similar learning theorists and a focus on learner-centred pedagogy, the value of learning communities and teacher as facilitator. The research explored flipped learning within a condensed summer school setting, two years in succession, with first year engineering undergraduate students. The methodology used was interpretivist, using interviews to gather perspectives from students involved. Student comments were divided between aspects relating to how students' learning behaviours and teachers' teaching behaviours differed from more traditional approaches. Within this, students highlighted aspects such as gaining a deeper understanding of materials as a result of advance reading, followed by peer discussion, for example how collaboration involved discussing differing opinions that helped advance knowledge and understanding. They also highlighted the additional time they needed to invest in the course but the ability to adjust course content delivery rate. Interestingly the students also considered that they needed to have a pedagogic understanding of the approach. Summary recommendations for lecturers included having varied and quality materials, signalling workshop materials in advance and preparing students for the pedagogic approach of flipped learning. Recommendations for students included having a positive attitude, thorough preparation, being organised, managing time and understanding the value of collaborative learning. The research reported here focused on engineering students. The next stage is to explore further with design and technology students in secondary and tertiary settings. Watch this space.

In *Exploring the relation between students' research behaviours in project courses and open innovation*, Ilgim Eroğlu (Mimar Sinan Fine Arts University, Turkey) and Deniz Ekmekçioğlu (Ondokuz Mayıs University, Turkey), explore the concept of open innovation more generally, and then focus specifically on how this is used and understood by undergraduate product design students. The authors highlight two areas of study of open innovation – that focusing directly on designers and that which focuses on management and linked use of design thinking. They suggest that for design students, both design and management opportunities provide good reason to highlight open innovation. A detailed background is provided to scope out what previous studies have already provided insights into, and the strong relationship between open innovation and processes of designing. They then report on research undertaken with senior design students to understand their awareness of open innovation. Data was collected from undergraduate students across five universities in Turkey. Students responded either by interview or in writing to questions focused on Likert style and open responses. The questions had three focuses: first how students conducted research; second how, and if, they shared information; and third their general awareness of research processes and open innovation. Findings indicate that students' explicit knowledge of open innovation processes is slight, but their research actions do align with open innovation processes. However, the authors consider that the lack of explicit understanding of the concept may prevent them fully understanding the value of sharing information and hamper them in future professional settings.

In *Design Divergence Using the Morphological Chart*, Naz Börekçi (Middle East Technical University, Turkey) focuses research on the potential of morphological charts to support idea generation when designing for complex functions. The article begins by providing a background on morphological chart method and its value in providing analytic support to creating both design divergence and convergence. The author then introduces research undertaken with graduate students from a range of design and other backgrounds that explored the factors that affected performance and strategies employed when using a morphological chart based on a short-term design project on drip filter coffee machines. The article provides a detailed outline of the pedagogic structure of the project presented to the students. This includes trialling existing products, determining sequences of operation, identifying product components and sub-functions, how components interact, undertaking a morphological analysis, preparing a morphological chart and then undertaking re-design. Detailed analysis of the impact of each pedagogic aspect provides valuable insight into the approach and how the structure allowed students to take a more holistic approach to their designing. A set of conclusions provide clear insight into how the approach supported students in manifesting design divergence. Despite being undertaken with graduate students, insights provided in this article could usefully be drawn on by those supporting design projects at any level of education.

*In Problem based learning: developing competency in knowledge integration in health design*, Katherine Sullen (OCAD University, Canada) provides insight into how students deal with the challenges of different stakeholders and multiple 'truth' regimes when designing. The specific context of the article is that of design for health and the reported research is undertaken with graduate (M.Des) students. The students were engaged in re-designing a re-habiltation centre within a geriatric psychology unit. The article presents an overview of the structure of problem based learning within the M.Des curriculum in question and how they are introduced to the concept and various categories of potentially conflicting truth regimes of "Scientific", "Mundane", "Symbolic" and "Governmental" truths. The author shows how these 'truths' help structure a framework that can be used by students to work across truth regimes to seek out new knowledge, to encourage reflection on diversity of perspectives and to support integrating knowledge across regimes. It also supports students to consider the position and responsibilities of the designer within and across these regimes and how design's 'truth' can be made visible beyond the world of design. Sellen concludes by highlighting the challenges of implementing a model that engages with knowledge that extends far beyond what might be considered design knowledge. However, she also highlights the potential for hybrid approaches to design and integrating across truth regimes.

In *Design for Manufacture (DFM) within Professional Practice and its Relationship to Design Education*, Tom Page (Nottingham Trent University, UK) explores how Design For Manufacture (DFM) is taught in higher education and compares this with the requirements of professional practice. The benefits of DFM are highlighted through a review of literature, but the author reports that it is less clear if an understanding of these benefits is explored in tertiary design education. The latter formed the focus of research for this article. The research data was gathered by two sets of questionnaires: the first undertaken by current and graduate Industrial Design and Product Design students, the second with companies that had either employed or offered placements to former students from the same

university courses. Student data was collected on their experience of industry (e.g. via a placement), what they saw as the most relevant skills for professional practice and how their university courses could be improved in the context of preparing for professional practice (and in particular DFM). Companies were asked to prioritise the four most important skills in graduates and also to identify which skills needed most development when graduates entered the workplace. They were also asked at which stage the company considered DFM and whether students had enough understanding of its role. The research revealed that both students and companies placed Computer Aided Design and DFM as the most important skills needed, highlighting the importance of DFM. However, the companies considered that the university students had inadequate understanding, while the students highlighted a need for more focus on teaching DFM at university. While the focus of the research was on one specific university, the industry view was that this university prepared students as well, if not better than other universities. A thread running through the article is the changing role of designers. The shift caused by the development of new technologies was seen as significant in this. The article makes a claim for the contribution of Industrial and Product Designers in managing this shift and for a consequent need for greater emphasis on DFM within design education.

The final two articles in this edition of the journal are from Mauricio Novoa (Western Sydney University, Australia), both reporting on research that has focused on major development in design education curriculum at the tertiary level.

In *Innovating Industrial Design Curriculum in a Knowledge-Based, Participatory and Digital Era*, Novoa provides the story of three years of research that led to an innovative undergraduate industrial design curriculum that created a shift from a transmissive teacher-centred model to a transformational learner-centred model that draws on a human centred approach, critical design and making, design heuristics, Conceiving, Designing, Implementing and Operating (CDIO) and Science Technology Arts and Mathematics (STEAM). An aim was to provide a foundation for education towards a 4.0 industrial revolution, enabling a focus aspects such as human computer interaction, machine learning, hacker cultures and open-source developments. The development was explored by reviewing existing structures and recent developments using epistemology, Cultural and Historical Activity Theory (CHAT) and curriculum lenses that provided the impetus for writing a vision and mission that led the re-positioning and development of a new curriculum.

In a companion article, *Industrial Design Education as Innovation Broker through Making, Pivot Thinking, Autopoiesis and Expansive Learning*, Novoa reports on research undertaken in the context of a final capstone project with industrial design students. The focus is on the behaviour, cognitive and social learning of the students though four specific processes: critical making, pivot thinking, autopoiesis and expansive learning when they became active junior designers in a design agency environment. The article introduces the four processes and then provides a detailed account of the research and pedagogic development that took place over eight years of iterative trialling, reflection and further development supported by Participant Action Research (PAR) and Developmental Work Research (DWR). The story told through the article is one that exemplifies how a visionary model can employ an active, evolutionary approach to meticulously and painstakingly

create a curriculum model that makes a major shift from a transmissional to transformational approach, where the outcomes equate both to the achievements of the students involved and pedagogical messages that can be passed to other educators. The latter include what are identified at the end of the article as 'tipping points' - post-mortem recommendations made by students experiencing the programme. The article provides both a model and an inspiration to anyone with aspirations to make major changes in an educational setting.

Finally, this issue of the journal concludes with a review by Danah Abdulla (Brunel University, UK) of a new book *by Alice Rawsthorn - Design as an Attitude*. The book presents a set of chapters drawn together from a series of articles on the topic of design as attitude, written by Rawsthorn for Frieze magazine. The review provides a critique that highlights the value of the book but that also, reflecting from the perspective of 2018, takes issue with matters that are absent from the book's agenda.