

Differences, similarities, themes

Prof Kay Stables, Goldsmiths, University of London, UK

Dr Erik Bohemia, Loughborough University, UK

With a new year and a new Volume (our 23rd) of the Journal, we once again provide a range of articles from different levels of education, different national educational contexts and different areas across Design, D&T and Technology Education. This issue includes contributions from India, Ireland, Turkey, the USA, Italy, New Zealand and the UK with focuses on mainstream schooling, higher education design, architecture, outreach work with underrepresented communities and individual child and adult innovators. But across this range of difference, the threads of interest and concern for learning and teaching appear. As editors, one of the pleasures of reading all contributions is seeing links between what seems at first to be disparate pieces and the insights, understandings and reinforcement that comes, for example, from three quite different articles that have in common a thread of insight into the impact that digital tools have on the way people learn and perform.

Much as we value the serendipitous nature of a journal with such a wide spread, we are also concerned to support deliberate curating of links. The Journal has a history of themed issues with guest editors and with this new volume we are introducing a slight twist to the approach that will mean that some issues will be completely mixed, while others will have both a guest edited theme section and a more open 'all comers' section. Issue 1 of Volume 23 is of the 'all comers' type. But Issues 2 and 3 will both include guest edited sections, drawing together articles developed from conference papers from the 2017 Engineering and Product Design Education Conference. We hope this approach will ensure that people submitting individual articles will be able to see these coming to publication as quickly as possible, while we also offer a space for articles that have a shared focal point. We welcome proposals for themed sections, and please make contact if this is of interest.

But now we turn to this Issue, which begins with current musings of Richard Kimbell, this time reflecting on how value is created. In *The limit of zeros* he ponders on ways in which wealth is expressed. He starts with a 6th Century mathematician and astronomer named Brahmagupta who explained the importance of zero when computing number. This is followed by a wry comment that current day hedge-funders make use of that by turning small sums into large ones. He points out that having a balance sheet with lots of zeros doesn't allow one to express wealth as forcefully as owning a Fabergé egg, creating the Sistine Chapel or owning a 1962 Ferrari 250 GTO, all products of creativity and of the made world that express enduring value of material culture.

The research articles in this issue start with a fascinating study undertaken in India that explores differences between children and adults as innovators. In *A comparison of problems at the grassroots level in India identified by adults and children: Implications for Design and Technology Education* Sachin Datt and Sugra Chunawala (Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research, India) draw on a national database of innovation to analyse differences between innovations and innovators. The database itself is extremely interesting (<http://nif.org.in/award-profile>). Held by India's National Innovation Foundation it showcases grassroots innovations from problems self-identified by either adults (post 18 years old) or students (pre 18 years old) that have been given an award by the Foundation. Datt and Chunawala analysed 246 innovations awarded between 2012 and 2015, focusing on differences in problems identified by adults and school students and exploring what the reasons for the differences could be. They were keen to gain insight into implications for design and technology education, including what young people saw as authentic problems to tackle. Innovations were placed into one of 21 categories (for example agriculture, health, pest control, tree climbing) and then divided into adult or student innovators. Some categories featured both groups, some had only students or adults and these differences became a further focus of their attention. Analysis revealed more divergent ideas in the adult population, and differences in focus, for example adults focusing on agriculture, health and cooking, while students were concerned with 'prohibition' innovations – technological approaches to dealing with human behaviour such as bullying or people not stopping at zebra crossings. Findings are related back to literature on creativity and on novices and experts and the authors suggest that their findings are potentially contradictory to views that children are more creative than adults. Finally, the analysis opens up insights into what young design and technologists see as authentic and relevant challenges to be tackled, extremely valuable for all those engaged in education at school level.

The next three articles each explore links between design and technology education and the use of digital tools.

The first focuses on learners in the upper age group of mainstream schooling. In *Balancing Curriculum Intent with Expected Student Responses to Designerly Tasks* Jeffrey Buckley (KTH Royal Institute of Technology, Sweden) and Niall Seery, (Athlone Institute of Technology, Ireland & KTH Royal Institute of Technology, Sweden) examine the effect of parametric and non-parametric modelling systems on designing. The research was undertaken in Ireland with learners studying a certified course in Design and Communication Graphics that has two overarching aims: developing creative and designerly competencies and developing technical expertise. The aim of the research was to see if, by controlling the CAD system the learners used (either parametric or non-parametric) there was an effect on the output of their designing and the learning outcomes achieved. Two equivalent groups were compared, both groups with the same design brief, but one group

using a parametric CAD system (SolidWorks) and the other a non-parametric system (CRE8). Findings indicated that, from the outset, differences were seen. This included the non-parametric group making more use of sketching and annotation while the parametric group used technical drafting and text, the non-parametric group's designs were more organic and showed more depth in their ideas. The authors draw attention to the extent to which the learners' mode of operating appeared to be controlled by the tools they were using and the ways that teachers can 'orchestrate' activities that manipulate how learners respond and what they learn. The split that appeared between creative and technical responses causes them to call for teachers to create a balance in the experiences provided.

In *The Use of Metaphors as a Parametric Design Teaching Model: A Case Study* Asli Agirbas (Fatih Sultan Mehmet Vakif University, Turkey) presents research conducted with undergraduate architecture students. The focus of the research was to explore the potential of metaphor as a stimulus for designing whilst teaching parametric architecture tools. After providing a range of historic metaphoric architecture created before the introduction of computer aided design, Agirbas moves to suggest that, with the advance CAD software based on non-Euclidean geometry, it is important for architecture students to learn how to use it. The research questions addressed were "How can effective teaching of parametric design tools be done in a limited period of time?" and "Is it possible to use metaphor in a methodological way within the system of parametric design education, which can guide the student in the design process?". Students were introduced to a range of software not previously used and to digital fabrication processes, alongside being introduced to the idea of using metaphor in designing and this was followed by students applying both in a design project. The impact of the approach was explored through studio observation and one to one discussions with the students in addition to an analysis of project outcomes. The research provided insights into how the students used metaphor in the development of their designs, into the versatile thinking that that learned as they combined the different aspects integrated into the project (coding, digital fabrication, material based thinking etc.) alongside more general learning, for example developments in time management. As the author points out, while the insights from the project of particular value in architecture education, they also hold value across design education more generally.

A further article that focuses on learning and digital tools is provided by Tilanka Chandrasekera (Oklahoma State University) and So-Yeon Yoon (Cornell University). In *Augmented Reality, Virtual Reality and their effect on learning style in the creative design process* they explore learner preferences when designing between Virtual reality and Augmented Reality interfaces. Following a detailed discussion of learning styles, creativity, motivation and acceptance, in relation to learning preferences, they present a study where the learning preferences of 30 design students were compared when using the two interactive environments. The study suggested that users perceived Augmented Reality to

be easier to use, more useful and more likely to be used in future. They anticipated that kinaesthetic learners would prefer an Augmented Reality environment and found this to be so, but also found that visual learners also preferred this – something which surprised them. While theory makes connections between perceived ease of use and creativity, their study did not confirm this.

Taken together these three articles provide valuable insights into processes of designing as more and more digital tools are utilised- something of considerable importance for design and technology educators working with learners at any stage in education.

The final two articles are concerned with aspects of design and technology education (first architecture and second STEM) and its impact on future employment.

In their article *Reflecting on architecture curriculum through a survey on career switching* Shenghuan Zhao and Enrico De Angelis (Politecnico di Milano, Italy) and Dongqing Ma (Dalian, University of Technology, China) provide interesting insight into the ways in which Chinese architecture graduates are switching careers away from architecture and report on their research to see how this relates to the architecture curriculum. They report on a large scale survey that identified the reasons why architects are shifting careers and then on an analysis of university architecture curricula pinpointing mismatches between current needs of the profession, mission statements by universities and the actual curricula that form the basis of the students' education. Based on this they identify the need for a shift in curricula that allow more time for integrating emerging technologies and developing self-learning skills while reducing time spent on art and human science courses. They suggest that there is an existing over pre-occupation with these courses in Chinese architecture education. It would be interesting to see the extent to which other architecture educators agree.

The final article, *Outreach programmes using the Triple Helix model to encourage interest in Science and Technology among underrepresented youth* by Sangeeta Karmokar, (Auckland University of Technology, NZ) and Aruna Shekar, (Massey University, NZ) provides a case study of an initiative that focused on raising awareness of entrepreneurship and STEM education amongst underrepresented groups, in the authors' New Zealand context this focused on Māori and Pasifika school students. The project adopted a triple helix model, bringing together business, government, universities, researchers and school students and their parents. The article provides some background the underrepresented groups generally and also in the context of New Zealand, with a particular focus on STEM. The research aimed to explore activities that would increase aspirations towards STEM in underrepresented young people. These aspirations were facilitated through a set of workshops that provided an approach that transformed a traditional classroom approach into a discovery zone focused on inquiry based problem solving. The approach involved both inspirational speakers and hands-on designing and making workshops that were based on

engineering education, but that made connections to indigenous cultural and social values of the participants. The authors report on the positive reactions from the students and, based on the workshops, make suggestions of ways to engage students from underrepresented communities including collaborating with communities, encouraging drawing on values and traditions of the participant groups and projects with real world challenges, involving role models from their communities and drawing together stakeholders through a triple helix approach.

Finally, this issue concludes with reviews of two recent books that will be of great interest to any reader of the Journal.

First, we have a review, provided by Derek Jones, of *Art and Design Pedagogy in Higher Education: Knowledge, values and ambiguity in the creative curriculum* by Susan Orr and Alison Shreeve. Focused on Higher Education and with a background in the UK context, the book provides a wealth of insight into studio-based pedagogy, taking on the challenge of exploring what the authors themselves describe as the ambiguity, contradictions and paradoxes of practices of creative teaching and learning and what they refer to as the 'sticky' curriculum.

This is followed by a review provided by Jeffrey Buckley of the latest publication from Loughborough Design Press - a collection edited by Eddie Norman and Ken Baynes entitled *Design Epistemology and Curriculum Planning* that contains chapters by both editors as well as those by Stephanie Atkinson, Alison Hardy, Steve Keirl, Graham Newman, Tristram Shepard, David Spendlove and Xenia Danos.

Taken together, these two books provide much needed focus on pedagogy and curriculum and give a depth of opportunity for critical reflection on the practices of design education.

We hope you enjoy reading the articles and reviews in this issue and, as always, welcome comments.