GUEST EDITORIAL

Design pedagogy: Representations and processes

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This Special Issue of *AI EDAM* is devoted to research on design pedagogy. In particular, the papers focus on the ways that explicit representations of design knowledge can influence the ways we teach design. The papers use a variety of research approaches and span many areas of design including engineering and architecture, but they all share a concern both for the design process and the practical concerns of design educators in the classroom and in the studio.

Design pedagogy raises significant challenges for researchers in design theory, methodology, and artificial intelligence. When people learn engineering design or seek to improve their skill as designers, both the teacher and the student must actively structure their knowledge. The teacher seeks to formalize and structure a body of knowledge gained from design experience. The student is challenged to observe design processes (their own and those of colleagues and teachers). Based on their observations they form hypotheses and test them through projects. The best design processes that emerge from these cycles of practice and reflection must be both effective and teachable. Many design methods have been proposed with great ambitions to improve professional practice. If the improvements do not materialize, which happens all too often, it frequently turns out that the method is not well understood by those seeking to apply it or that the method is not being applied as intended by its developers. It is not an exaggeration to say that a process that cannot be learned or implemented by the majority of designers is a method that cannot succeed in practice. For these reasons, an appreciation of knowledge representation and pedagogy could be a key to better design outcomes.

The first three papers seek to link ongoing design instruction to quantitative research. In "The Design Studio "Crit": Teacher–Student Communication," the architecture studios at the Technion were in effect used as a research setting. The interactions among students and teachers were recorded. Coding of verbalizations and linkography were used to provide insights into the differences among students and teachers and the various styles of feedback in the studio. Similarly, in "A Study of the Role of User-Centered Design Methods in Design Team Projects," the design courses at MIT were employed as a source of data. During the design projects, the frequency and duration of interactions with users were recorded. The design outcomes were not a function of the amount of user interactions but appear to be related to their timing. Late in the design process, when design knowledge is most richly represented via prototypes, users can provide a significantly different sort of input to the process than is possible earlier in the process. Thus, in the first two papers, quantitative observations of educational activities give rise to practical advice for design educators. A different approach is taken in "A Course for Teaching Design Research Methodology"; the course is not an object of design research, but rather a means to convey design research methodology. It is interesting to consider how such a course might have affected the other papers in the Special Issue.

The next two papers seek to draw upon concepts and methods in social sciences to advance design pedagogy. In the field of cognitive psychology, decision-making heuristics have long been studied as a cause of systematic errors. More recently, heuristics have been analyzed as a strategy for simplifying problem representation that can be effective in realistic contexts. In this second vein, "Cognitive Heuristics in Design: Instructional Strategies to Increase Creativity in Idea Generation" provides evidence that design heuristics can help students generate a greater variety of solutions and solutions that are judged to be more creative. Methods for semistructured interviewing and analysis of the resulting narratives are also emerging from the social sciences. Although other techniques, such as protocol analysis, seek to reduce the influence of subjective experience on the results, some studies now focus on the individual's perceptions as the primary object of study. The views of 19 experienced design educators are studied in "Scrutinizing Design Educators' Perceptions of Design Process." The resulting impression is that experienced designers quickly shift among many representations and processes as they "pick and mix" as the circumstances seem to dictate. In both papers, readers will see the

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tools and concepts of social science employed and reinforced to the benefit of design education.

The last two papers seek to draw lessons from long-term institutional programs in design pedagogy. A 5-year project at the University of Strathclyde, Stanford University, and Olin College sought to support global design projects using technology. A major goal was to explicitly represent knowledge (even tacit knowledge) in a digital library. The second long-term project, launched at Texas Technological University's T-STEM Center, is intended to support primary through grade 12 educators as they seek to keep young people interested in science, technology, engineering, and math. A key product of this effort is a representation of the design process tailored for its particular audience.

We hope that this collection of papers will be of interest to a broad range of readers. Many will find specific techniques and concepts to apply in the classroom. Others will be interested in the variety of research methodologies applied to a common set of concerns in design education. We believe that this Special Issue demonstrates the value of applying many different perspectives to the difficult professional challenges we face in design education.