

Guest Editorial

This special issue of the *International Journal of Engineering Education* includes the papers which detail the proceedings of the Clive L. Dym Mudd Design Workshop XII, “Designing Through Making.” The papers included in this special issue were screened over two rigorous review processes. Abstract submissions were evaluated for fit and content alignment with the workshop theme prior to the workshop. Following the conclusion of the workshop, authors revised their manuscripts which were then submitted to peer review prior to inclusion for publication. I believe readers will benefit from this exposure to the workshop presentations and discussions, albeit indirectly, if not in attendance.

The workshop was supported by Harvey Mudd College’s Department of Engineering and the Center for Design Education. The workshop included 70 participants and was held as a virtual conference from May 27 to May 29, 2021. The decision to hold the workshop online was a response to travel and gathering size restrictions imposed by the coronavirus pandemic. There were concerns that the online nature would compromise the workshops’ hallmark interpersonal interaction so that the character would be undermined. Thankfully, the associated Canadian Design Workshop conducted in December of the prior year demonstrated a productive path for such an online workshop. Design educators and practitioners explored making in the context of design and the ways in which making encourages design students as well as the aspects of making education that should be considered when considering making in curricular and co-curricular contexts. The selection of the making process as the focus for this workshop was driven by the related issues of how to shape best instruction practices for making, how to support making as informing the design process, and how to guide and create authentic making applications within design, which are critical questions for design educators addressing making.

The workshop began with a very brief welcome and introduction including a short recognition of the nature of an online workshop that is typically focused on interpersonal interaction. The challenge of connecting across the internet was embraced by the participants to a very great extent. Given a wide range of opinions and interpretations of the theme, vigorous discussion was expected. It was rewarding that participants did not recoil from listening to others as well as sharing their own perspectives.

The workshop featured two excellent keynote talks which were delivered as opening sessions on Thursday and Friday of the workshop. Our first keynote was delivered by Dorothy Jones-Davis who discussed *Made for Design: Leveraging the Maker Movement to Enhance Engineering Design Education*. Her observations were particularly impactful regarding the prioritization of modern high technology tools and the skills to use them compared to traditional making skills such as woodworking or welding. The broader involvement of the community of designers in a more equitable manner inclusive of different skill sets and formats was identified as an unmet need in the educational arena. Our second keynote was delivered by Amar Hanspal on Friday on the topic: *When Two Disciplines Collide: Design meets Manufacturing for Seamless Product Innovation*. His vision for far more integrated design and manufacturing approaches to problem solving began with the concept of addressing mis-aligned design approaches and making competencies and tools but extended to jointly leveraging capabilities and perspectives in the service of user needs. These keynotes were thought-provoking and well received by the attendees. They were the source of continued discussion and extension for the remainder of the workshop.

The workshop included five sessions of invited presentations of four or five grouped talks and one poster session. Themed sessions included Making beyond the physical, Perception and graphical representation, Early prototype education and interaction, Virtual and remote experiences, and Prototype models and processes. Additionally, we enjoyed a reflective wrap up session and poster presenters delivering a brief introduction to the poster topic. The usually quick pace and high level of content delivery were maintained with intentionally short presentations followed by long periods of discussion and questions. Our online workshop necessitated a transition to breakout room type discussions prior to a return to our main room for feedback from the individual discussions. It may be that the smaller breakout sessions and internet format resulting in even greater attendee interaction.

Consistent with prior iterations of the workshop, the session format consisted of sequential two-hour panel presentations with a moderator appointed from the organizing committee. Each speaker on a panel was given just ten minutes to present a summary of their work. While this may appear to be entirely too brief a period to discuss work in appropriate detail, the intent is to emphasize the discussion of the concepts and questions for the panelists. The breakout rooms of about four to six attendees were sometimes given prompts from the session moderators, which, in their enthusiasm or alternative discussion points, were sometimes overridden

by the individual discussion groups. This process felt highly inclusive and the resulting observations were shared with the larger group following the breakout sessions. As has become typical, the resulting summaries stirred further interest in the topics for which insufficient time was available to explore to the satisfaction of the participants. The thoughtful participation of the attendees, their curiosity, and their desire to apply the topics to their own instruction results in what seems to be an insatiable need to discuss beyond any time allotted.

The poster session involved briefer presentations of individual work by the authors. Though somewhat briefer, this session permitted a greater selection on the topics of interaction with the individual poster authors. Unfortunately, poster authors were largely unable to interact with other poster authors as they were separated by breakout room. This will be addressed when the sessions are again conducted in person.

This special issue contains papers describing the research and positions of the panelists attending the workshop. The intentional decision of the workshop organizers to seek the positions of authors invites speculation which may exceed the support of the data from their research. The risk of speculation is balanced by the need to solicit authentic perspectives on the challenges and opportunities within the design education field related to making and making as design. As a result, the collective set of papers in this issue represent the workshop participant contributions to the body of knowledge in addition to their experience. The goal of this collection is to share knowledge that may be applied by practitioners as well as examined further within the research field. Ideally, such knowledge will have broad application in how making is presented and investigated within programs and courses.

This workshop introduced considerable confusion on the topic of making and, in particular, when making begins in terms of a project. The making process, though applicable throughout a design process at stages from discovery of needs through delivery of solutions, had appeared to begin with physical realization ranging from low-resolution to fully functional prototypes or production level artifacts. This distinction became less clear when the process of making was addressed as including modeling or other design activities. It became difficult to limit the making process to physical artifact production when making a discussion guide or mind map were valuable aspects of the design and making process. Similarly, the purpose of a prototype to answer a question can be replicated by a good model or set of questions and often at a reduced cost. This reframing of the making process was a useful construct for the attendees' discussion, though it did not appear that a consensus was fully reached on this topic.

The Mudd Design Workshop organizing committee again worked hard to create the atmosphere of collaboration permeated the workshop. This was especially important and challenging in the context of an online workshop and it appeared to be quite successful. With each session, I heard participant observations that were exciting, innovative, and inspiring. I was pleased with the positive responses of participants regarding their experiences.

I gratefully acknowledge the support of the members of the Clive L. Dym Mudd Design Workshop XII's Organizing Committee. As in prior years, they worked hard to maintain the MDW's reputation for providing an informative, stimulating, and inspiring venue for discussing engineering education: A. M. Agogino, University of California, Berkeley; A. Altman, United States Air Force Research Laboratory; R. Bailey, University of Virginia; S. Daly, University of Michigan; G. Fine, Boston University; A. Ibrahim, M. Kokkolaras, McGill University; G. G. Krauss (committee chair), Harvey Mudd College; M. Lande, South Dakota Mines; C. L. Magee, Massachusetts Institute of Technology; K. H. Sienko, University of Michigan; M. Siniawski, Loyola Marymount University; J. P. Terpenney, The University of Tennessee; J. Turns, University of Washington; V. Wilczynski, Yale University; and M. C. Yang, Massachusetts Institute of Technology. The Organizing Committee in addition to their many duties ensuring the quality of the workshop were valued for setting the tone of a workshop that is productive and fun.

Harvey Mudd College extended continuing support to the Mudd Design Workshop. In particular, Liz Orwin, Chair of the Department of Engineering earned the gratitude of the workshop organizers and participants for her support of the workshop series. Students Max Castro and Ethan Carroll were very helpful in organizing the workshop and managing sessions during my periods of limited internet connectivity. I especially thank Sydney Torrey of HMC's Department of Engineering for her many contributions to the workshop from logistical to editorial as well as the Department's Sue Lindley for a variety of helpful administrative actions.

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