Making: An Interdisciplinary Assistive Technology Project

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Figure 1: *A) Modeling with Fusion 360, B) 3D Prints, C) Preparing 3D Prints for the Pour, D) Aluminum Pour, E) Reveal.*

Abstract

We teamed engineering and art students together to develop assistive technology projects in our sculpture and computer science classes. Together, they and their instructors honed their teamwork skills as teachers *and* learners, as we all collaboratively designed and fabricated the projects. As a group, we examined the notions of ability, the needs of and societal reactions to differently-abled people, and then created assistive devices. We explored alternative designs in foam and 3D modeling software, and cast parts in bronze or aluminum before fabricating the final prototypes. Design was emphasized throughout the project, with respect to both form and function.

Keywords: assistive technology, fabrication, interdisciplinary, multidisciplinary, project-based learning, disability

Concepts: **• Human-centered computing~Accessibility • Human-centered computing~User centered design • Social and professional topics~Model curricula • Social and professional topics~People with disabilities • Applied computing~Computer-aided design • Applied computing~Media arts • Applied computing~Collaborative learning**

1 Introduction and Background

According to Walter Isaacson "… the truest creativity of the digital age came from those who were able to connect the arts and sciences [2014]." This assistive technology project, designed in multidisciplinary teams, exists at that exciting intersection of art and science. It is also relevant. Is there anyone who hasn't experienced disability – their own or that of a family member or friend? Over 50 million people are classified as disabled in the United States [US Census 2012]. Relevance is important because it motivates student learning [Etkina and Mestre 2004]. To build empathy with differently-abled people and thereby emphasize relevance, we had six assignments (described in [Bruce and Reiser 2015]) to help students reach an understanding of Critical Disability Theory, which asserts that disability is socially constructed and that the environment can be the disabling factor. We looked at universal design, with a goal of creating an environment accessible to everyone. A poignant scene in a University of Michigan video [Chuang 2004] that depicts a student stranded at the base of the library stairs while the snow is being shoveled off the steps illustrates the importance of universal design. The student points out that if the worker had shoveled the ramp first, everyone – including her - could have used it. However, our students do not just learn about Critical Disability Theory, they also address a particular user's disability by creating an assistive device to improve that user's life. Projects ranged from a hiking cane with talons to a bejeweled hearing aid.

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The applied project gives students the opportunity to create a tangible assist for a differently-abled individual. It represents a synthesis of Critical Disability Theory, empathy with a user, and fabrication skills – both art and engineering skills. Making the device exemplifies active learning as described by John Dewey and espoused by Black Mountain College. Louis Menand eloquently describes Black Mountain College founder's Andrew Rice distinction between making and knowing [2015].

> *Rice believed that making something is a different learning experience from remembering something. A lot of education is reception. You listen to an expert explain a subject to you, and then you repeat back what you heard to show that you learned it. Teachers push students to engage actively with the material, but it's easy to be passive, to absorb the information and check off the box.*

Multidisciplinary classes are not unique [Carter 2014; Chakravorty 2015]. However, our interdisciplinary project involved both faculty and students from art and engineering. It represents a collaboration between four professors from the departments of art, new media, computer science, and engineering; lab assistants from art and mechatronics; and the students in our four classes.

2 Connecting Computer Science and Art

Four classes participated in the fall 2015 iteration of the project: three intermediate and advanced sculpture classes taught by Brent

Skidmore and Jackson Martin, and an introductory computer science course co-taught by Rebecca Bruce and Susan Reiser. Students in the advanced sculpture classes were all art majors, and students in the computer science course were all engineering majors. Self-selected teams were formed consisting of one art student and one engineering student. Initially students expressed significant skepticism about the pairings and the team project, however, by the end of the semester almost all teams were successful and cohesive and, in fact, most publically commented on the benefits of the collaboration.

2.1 Assignment

Student teams were to work collectively to brainstorm, design, and produce an assistive device in the form of an enhancement of or modification to an existing device, or it may be a completely new design.

Goals of the assistive device project included 1) learning Autodesk's Fusion 360 cloud-based 3D modeling software in order to create a 3D print, 2) working within a multidisciplinary team, 3) making a ceramic shell mold, complete with gates and vents, 4) using a lost-wax, or in this case, a lost 3D print casting technique to produce a bronze or aluminum part, and 5) being able to recognize and employ the elements of art and the principles of design.

2.2 Project Design

Students worked in their teams to create models of their assistive device, then each team chose one size-restricted part of their device to 3D print and cast in either bronze or aluminum. Each student created one cast. After the bronze and aluminum pours, students completed their fabrications independently: the art students in the Art Studio and the engineers in the Machine Shop.

The sculpture faculty staged a gallery show (See Figure 2) to exhibit the fabricated projects. The show and our classes' collaboration was well received by students, faculty, and the campus community.

Figure 2: *Art Mechatronics Critique and Show, 12/8/2015*

3 Conclusion and Future Work

Relevance motivates. Assistive technology and a course-focus on disability connect the project and our classes to humanity, thereby illustrating the relevance of the project. Designing and fabricating the project clarifies the contributions of our respective disciplines. Creating the interdisciplinary project in multidisciplinary teams requires communication, cooperation, and project management – skills that employers and our accreditation boards want. One of the ancillary benefits of the collaborative project is that the participating faculty members publicly model the role of life long learner – higher education's ubiquitous goal more typically modeled behind office or studio doors in course prep. However, in this team-taught effort, we openly model both teaching *and* learning (e.g., when the computer science faculty learn to cast metal and the art faculty learn 3D modeling).

We look forward to more multidisciplinary collaborations linking art and engineering. In the spirit of Black Mountain College, located just fifteen minutes east of Asheville, we include both knowing and making in our classes because the combination is an effective, fun, and exciting way to teach.

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