A SUCCESSFUL IMMERSIVE EDUCATIONAL MODEL:
INNOVATING DESIGN THROUGH COLLABORATION BETWEEN INDUSTRIAL DESIGN & OCCUPATIONAL THERAPY

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PAPER ABSTRACT

Combining industrial design and occupational therapy graduate students together to create adaptive products for individuals living with Fibrodysplasia Ossificans Progressiva (FOP) offers a unique opportunity to facilitate an interdisciplinary approach that better meets the needs of end-users and reinforces development of complementary discipline-specific skills. Four, first-year master of industrial design (ID) students worked directly with a pair of third-year occupational therapy doctoral (OT) students to research, design, and prototype adaptive equipment for individuals with FOP. Throughout the process, ID students interacted with end-users for research and feedback and received input at their final presentation from multiple end users and physicians specializing in the care of FOP patients. Industrial design and occupational therapy students benefited from a collaborative learning model by drawing on each other's core discipline-specific strengths, as evidenced by improved communication skills and increased understanding of end-user perspectives during each phase of the design process. This paper highlights the key components of this project and aims to offer insight into facilitating more collaborative educational experiences for design and occupational therapy students.

KEYWORDS: Industrial Design, Occupational Therapy, Education, Interprofessional Education, Collaboration

1. INTRODUCTION

Industrial design has a long history of collaboration. In recent years, higher education has begun catching up by placing emphasis on interdisciplinary collaboration, opening more doors for deep connections between designers and areas in need of design input, such as healthcare. As a result, it has become easier to bring together student teams across campuses to attempt to develop skills and break out of professional silos. Education research shows that classrooms are uniquely situated to give students the opportunity to build the skills necessary to tackle the multifaceted issues facing our increasingly interconnected and globalized world through interprofessional and innovative collaboration experiences (Carlisle, Cooper, & Watkins, 2004). While many of these programs have existed in some form or fashion at various times, they are not well documented in the literature, specifically, the unique collaborations between industrial design and occupational therapy programs (Dong, 2010; Larkin, Hitch, Watchorn, Ang, & Stagnitti, 2013; Watchorn, Larkin, Ang, & Hitch, 2013). This paper explores the successes of one such collaboration at a comprehensive, urban university with strong connections to both the design industry and a healthcare network.

2. COLLABORATION OVERVIEW AND BACKGROUND

In 1998, the university's industrial design and occupational therapy departments began looking at collaboration as a new way to expand skill development and learning opportunities for their students. For 20 years, these departments have created collaborative projects within their existing curricula, as well as entire courses for their students to reap the benefits of interprofessional contact. In 2018, this evolved into a program bringing together first-year master's of industrial design students with third-year occupational therapy doctoral students for a full year as peers embedded in all core aspects of learning.

For those who are unfamiliar, occupational therapists do not help people find jobs (despite their name). Instead, they work with individuals through the therapeutic use of everyday tasks and activities, or "occupations," to improve clients' participation in anything important to the client, such as home life, personal care, education, and leisure activities (American Occupational Therapy Association [AOTA], 2014). They are trained extensively in activity and environmental analysis in order to better understand the needs of their clients, be they social, physical, or mental needs, and are frequently tasked with recommending adaptive equipment and modifications to increase accessibility in client environments (Allen, 1987; De Couvreur & Goossens, 2011). Most occupational therapists, however, do not have design backgrounds or training in materials, manufacturing, or other sophisticated processes that industrial designers bring to their work. Occupational therapists often find themselves creating relatively unsophisticated solutions for their clients with everyday household items like cardboard, duct tape, and glue that wear down over time and are aesthetically unappealing (Wagenfeld, Reynolds, & Amiri, 2017).

Together, industrial design and occupational therapy students can learn, share, and grow together while collaborating on design projects. In these peer relationships, students are allowed the freedom to discuss and explain ideas with less fear of failure or judgment while still strengthening their personal identities as professionals. Industrial design students take the lead on individual projects while occupational therapy students serve as consultants and intermediaries between designers and end users. One of the key elements of this year-long collaboration is knowledge exchange between both groups of students. Occupational therapy students attend design studio courses to learn more about design processes and visual communication skills through project critiques, classroom discussions, and sketching exercises. At the same time, occupational therapy students conduct a series of activities for the design students on topics such as client interviewing and use of person-first language to decrease stigma.

3. FOP PROJECT LAUNCH

In the 2019 Fall semester, the ID faculty were approached with the project request by an anesthesiologist who specializes in the treatment of individuals with Fibrodysplasia Ossificans Progressiva (FOP), a rare chronic and progressive condition in which a person's connective tissues (muscles, ligaments, tendons, etc.) gradually turn to bone (Kaplan, Glaser, & Emerson, 2019). Individuals with this condition develop bone growths in soft tissues that lead to the fusing of their joints, significantly impacting how they function with objects necessary for everyday life. During a meeting between ID faculty and members of the FOP community, it immediately became apparent that there was a great need for improved tools after seeing the homemade products these individuals created to support themselves. Most people with FOP require assistive devices, such as dressing sticks, reaching/grabbing devices, and wheelchairs, to live their lives. However, because of the uniquely fused body positions of these individuals, many off-the-shelf assistive devices are rendered useless because of such severely restricted freedom of movement. People with

FOP, and their caregivers, are often forced to creatively adapt tools and devices to meet their specific needs (Figure 1).

Figure 1. Homemade adaptive tools designed by an individual with FOP.

As a result, assistive devices developed with FOP in mind require a recalibration for designers as to what freedom of movement is actually available from an end-user, and how a device may be adjusted to accommodate for sudden changes in an end-user's abilities. Individuals with FOP frequently require customized seating and mobility devices, adaptive eating, dressing, and reaching devices, and thoughtful choices in clothing (Velcro closures, elastic shoe laces, and waistbands) to increase participation in meaningful activities (Kaplan et al., 2019). Additionally, some individuals also benefit from home and work environment modifications, such as grab bars, ramps, and accessible bathrooms and kitchens (Kaplan et al., 2019).

The FOP project was officially introduced to students in late October 2019. Each of the four industrial design students were responsible for researching problems facing the FOP community and developing solutions to address an issue of their choice with support from the FOP community, occupational therapy students, and other medical professionals as they were available. Through partnership with the FOP community, students made regular contact with multiple individuals and families living with FOP throughout the rest of the project for additional research and discussion of their design ideas.

4. EDUCATIONAL EXPERIENCES

Between starting research in October 2019 and completing their final presentations in May 2020, ID students were given multiple opportunities to research, discuss, collaborate, prototype, and receive feedback on their designs, both in and out of the classroom. Throughout this time, ID and OT students

maintained close, regular contact with each other, evolving a rich understanding of both professions that allowed them to provide a significant level of support to each other. Since the collaboration went for a full school year, interactions happened more frequently and deeply as a result of the embedded experience—a stark difference from more typical, time-restricted collaborations. The educational experiences supporting this project are detailed below.

4.1 STUDIO COURSE

Twice weekly in the Fall and Spring semesters, ID and OT students attended a 3.5-hour studio course. This course provided ample opportunity for discussion, critique, and didactic work. The extended time together allowed for the ID and OT students to mesh as peers. In other relationships, collaborative work can often fall victim to a “divide and conquer” mentality. However, because the OT students were embedded into the studio and research courses and regularly completed work alongside the design students, they were viewed more as peers and less as an outside consultant resource to be brought in selectively. Soliciting feedback from the OT students became common practice, and the ID students’ comfort increased, frequently self-initiating dialogue with the OT students as awareness of the areas of expertise the OT students brought to the human factors side of design. Additionally, as the design students generated ideas, the OT students were introduced to various considerations such as specific materials, mechanisms, and manufacturing realities that translate into a clinical solution in their more typical professional practice arena.

During the FOP project specifically, the prolonged time students spent together was invaluable for the transfer of information between the disciplines, both informally and formally. ID students frequently presented ideas that were considered from the ground up and included complete reconsiderations of existing devices and mechanisms. The OT students were able to offer feedback from their own professional perspective accounting for end-user interaction and function, as well as factors for device adoption. Other more time-limited working relationships may not allow such continuous contact and immersion within both disciplines. Instead, disciplines are often found working separately, coming together briefly for meetings or check-ins, and then pushing apart again to complete the project tasks apart, losing sight of the bigger picture. During this immersive experience, both ID and OT students were able to focus on the iterative process of designing for people, building skills in a reflective and practical manner, and receiving and applying feedback throughout the entire design process without concern for “protecting” their initial concept.

4.2 IFOPA ANNUAL MEETING

In the Fall semester, students were invited to attend the International Fibrodysplasia Ossificans Progressiva Association’s (IFOPA) annual meeting to meet individuals living with FOP, attend educational sessions, and learn more about the available assistive devices used by this community. ID students, along with faculty, attended the conference and researched how people with FOP, as well as their caretakers and family members, manage their day-to-day lives. Additionally, the students were introduced to medical professionals specializing in patient care for people with FOP, particularly dentists, anesthesiologists, and general physicians. Challenges presenting in treating people with FOP were discussed, including the lack of specialized medical devices. IFOPA organized a panel of individuals with FOP who use and create their own adaptive equipment, and the OT students virtually joined the ID students during the panel interviews to gain a better sense of the areas of need in adaptive equipment for this population.

4.3 PRE-OPERATIVE APPOINTMENT FOR AN FOP SURGERY

Students had the opportunity to observe a surgical team meeting planning a procedure for a patient with FOP. The meeting brought together a wide array of medical professionals, including physicians, nurses, and anesthesiologists, which afforded students the chance to understand the depth of effort involved in providing services for this population. While students were first unsure as to how much they could gain from the meeting and felt “out of place,” they were rewarded for powering through the initial discomfort. The parallels between design thinking and procedure planning were obvious; carefully mapping actions, altering plans iteratively as problems arose, and even using 3D printed models as prototypes. Even more so, the experience cast a light on yet another way in which the lives of individuals with FOP are complicated that are more straightforward for most other people (the procedure was a relatively common operation for reproductive health).

4.4 OT STUDENT-LED MODULES

As part of the occupational therapy doctoral capstone experience, the OT students developed multiple educational modules based on the results of a previously conducted needs analysis. The OT students delivered these modules over the course of the Fall and Spring semesters. While the topics were not specific to FOP, they did supplement the project by providing an introduction to disability etiquette, research interview and communication techniques, and simulation experiences to help build empathy and increase understanding of adaptive equipment use. This served the dual purpose of enhancing ID student’s understanding of how OTs could be helpful in their projects as well as pushing the OT students to understand where they needed to be more vocal in the design process to make the greatest impact.

The OT students also led simulation activities that allowed hands-on practice with existing adaptive equipment, such as reaching devices, dressing sticks, mobility devices, wide-handled utensils, and long-handled shower equipment. The design students were given tasks to complete and simulated specific diagnoses to better understand the use of the tools they encountered. ID students were also asked to complete typical tasks around campus, such as checking out a library book and buying a soda at the campus market, while using a wheelchair for mobility. Students reflected on the expected and unexpected challenges they encountered, as well as their overall experience, and applied a new understanding of potential end-user needs to their projects. The OT students also facilitated a rapid prototyping exercise using common household materials. Final device outcomes and constraints were randomly generated, and the teams of 3 (2 ID and 1 OT) had 30 minutes to prototype their ideas. This activity simulated individuals with disabilities creating their own devices due to lack of readily available tools designed to meet their needs. These activities built empathy and respect for users with different needs and perspectives, which all ID students later commented on as crucial for their project success.

4.5 MEETINGS WITH PATIENTS AND FAMILIES

Students made connections with individuals at the IFOPA conference, but were also put in touch with several other individuals that were more local (within 2 hours of the university) who were willing to allow students time in their homes to discuss their use of adaptive equipment and experiences within their daily lives. Design students coordinated with these individuals and traveled to their homes to interview them. The OT students joined these visits as well, both in-person and virtually, to support the interview process through the lens of human function and performance. During the visits, students performed informal task/activity analysis and observation. It was after these initial visits that the design students chose the direction of their individual projects. Students selected an area that was meaningful for the individuals they met, such as independently bathing, eating, and transporting items, and the development began.

The inclusion of highly invested end-users in the design process was significant for student learning, as people with FOP were extremely forthcoming with information and ideas about their lives, taking a forward stance in the relationship to support themselves and find solutions to their own problems. Interviews and regular contact between patients and students served the dual means to gain deeper insight into the lives of people affected by FOP and to establish the impact of the disease in concrete terms, increasing the potential for usability and adoption of design. All students demonstrated significant buy-in to the project and were highly vested in the outcome of their designs due to the significant feedback they received throughout the process from the end-users. These experiences also simulated "real world" interactions with clients in professional settings and increased opportunities to learn about extracting important information from clients before and during the design process. When end-user feedback was not readily available, the OT students were able to suggest considerations for potential end-user needs within the designs.

4.6 PROJECT RESPONSE TO COVID-19 PANDEMIC

Due to the global COVID-19 pandemic, on-campus classes were abruptly halted and transitioned online in mid-March. Students demonstrated innovative and resourceful ways of continuing to prototype with household items and materials. In some cases, students recorded task analyses while simulating potential constraints of a person with FOP- for example, tying their arms down to simulate fused shoulders. Their comfort in this transition to uncommon distance learning may be due, in part, to the rapid-prototyping exercise and simulations completed with the OT students "breaking the ice" for prototyping under less-than-ideal conditions.

5. CONCLUSION

Each project reflects the development of a deeper understanding of users than the students reported they had at the beginning of the experience, which they attributed significantly to the inclusion of occupational therapy students into their courses and to the active learning experiences conducted throughout the year.

- Soft foods feeding system: Independence with self-care (such as eating, bathing, and toileting) is a frequent response when individuals with advanced FOP are asked about what types of activities they want to do but cannot. This student chose to focus on feeding as a way to allow a person, once set up, to eat without assistance from a caregiver. Arms and jaws locked in place mean a FOP patient can neither get food to their mouth nor chew it. Their solution was an automated, portable self-feeding system for soft foods designed to independently control food release from a standardized refillable pouch via pressurized air and fit the profile of a water bottle. The evolution of this device's design shifted significantly after the OT students discussed the social aspects of dining. There is a stigma associated with assistive feeding devices, and inconspicuous design allows for this stigma to be decreased substantially when it looks like a typical food-related object, such as a common tumbler (Figure 2A).
- Multi-functional wheelchair armrest: Individuals using power wheelchairs often have issues with storage on their chair and body. One student noted that this problem is exacerbated by conditions such as FOP that may limit a person's ability to access pockets, backpacks, purses, and other typical forms of personal storage. To deal

with this, they designed a modular wheelchair armrest clip and item holder system to enable users who can't access pockets or bags to turn, hold, hand over, and free their hands of objects (Figure 2B).

- Self-shampooing/massaging showerhead: For virtually all individuals with FOP, their limbs become locked into positions that make touching their heads impossible. Because of this, hair care requires the help of another person, putting one more task into a caregiver's very full hands. A student dealt with this issue by designing a self-lathering and massaging shower head to lessen caregiver burden and return the personal intimacy of one's hygiene routine to the individual who cannot lift their hands to their head (Figure 2C).
- Adjustable modular reaching device: Assistive devices to extend a person's reach are used by countless individuals for an equally countless number of reasons; however, they present a particular challenge for individuals with FOP due to the locked position of their limbs and disease progression affecting the usefulness of certain angles of motion. One student tackled this with an adjustable reaching device with multiple attachments and reaching angles to progress with a person's condition rather than being rendered obsolete by disease exacerbation (Figure 2D).

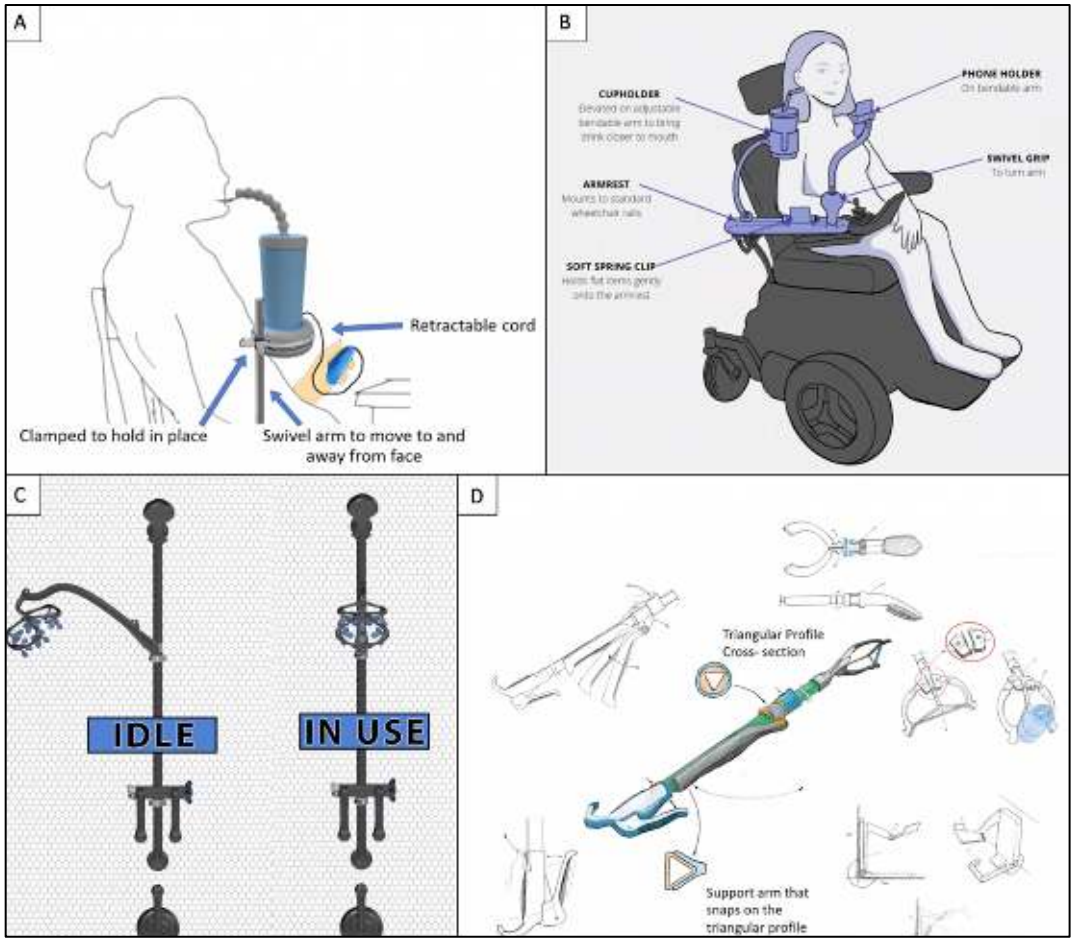

Figure 2. Student projects: Soft foods feeding system (A), redesigned wheelchair armrest storage/holding system (B), self-shampooing/massaging shower system (C), adjustable, multi-purpose reaching device with attachments (D)

While the ID/OT collaboration has successfully run for two years, this specific project highlights the value of such a unique educational program. Its success is due largely in part to the willingness of the individuals with FOP and their families to share their stories and experiences, and the advocacy of the physicians who saw a need within their patient population and sought awareness and action in the design of adaptive equipment through this interdisciplinary project. Because of the enthusiasm of these people to freely communicate with the students and faculty, this unique and critical project became a highlight of the collaboration.

The benefit of bringing designers and occupational therapists together in an educational program to create user-centered products is far-reaching. Students in both disciplines developed more mature professional identities. Design students strengthened professional skills by conducting interviews, developing prototypes for review with end-users, and articulating reasoning behind material and design choices based on their research & feedback. Additionally, the design students' consideration of universal design increased with the awareness of the scope of their potential users' abilities. Likewise, the OT students were able to increase their practice in activity analysis, research and interview skills, and broaden their visual communication skills through sketching practice. In their roles as consultants and researchers, the OT students developed deeper knowledge and understanding of materials for use in a clinical setting and rethinking the design of products from the ground up. This project is planned to continue on a yearly basis because of its recent successes, educational value to the students, and the ample ongoing opportunities for unique design projects.

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