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CO-DESIGNING WITH THE DISABILITY COMMUNITY

CASE STUDY ON A GRADUATE INDUSTRIAL DESIGN STUDIO

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It is well-established that professional industrial designers who have designed and launched consumer products must gather and respond to feedback from users to create a design that is well received in the market. Designing in a silo leads to implicit bias, exclusion of diverse opinions, expensive mistakes, and other such problems that make products unacceptable to produce.

Industrial design students are learning co-designing techniques in the classroom that they can take with them to the workplace. Students who co-design with an intended user are more successful in creating products that are accepted by the users than students who work in silos.

In this case study, I facilitated and examined a graduate-level industrial design studio where students partnered with persons with disabilities from the local community to co-design accessible products. In this paper, I present findings from interviews with the students whose projects were positively received by the intended community and recommend the tools and techniques that they used to other design educators and practitioners.

Keywords: Co-Design, Accessible Products, Universal Design, Disability, Empathy

1. INTRODUCTION

This paper describes a case study of an industrial design graduate studio in which the students partnered with volunteers from a local disability organization, the North Carolina Spinal Cord Injury Association, to identify and solve problems through the generation of accessible products for the disabled community. Volunteers from the disabled community are referred to as the user throughout this paper.

The students worked with a diverse user base who presented complete and incomplete spinal cord injuries that resulted in various levels of mobility impairment, as well as a variety of congenital disabilities such as spastic hemiplegia cerebral palsy. Some volunteers used wheelchairs exclusively or a combination of wheelchairs and walkers, and their pain points mostly focused on their relationship with their equipment and accessories to the mobility aids. Others used no walking mobility aids and instead experienced challenges with donning and doffing clothes, shoes, or grasping handheld devices and accessories such as phones and car keys. Each user's needs were unique, and by regularly involving their partners in the design process and considering the principles of universal design, students created solutions that both met the needs of their user and unintentionally addressed the needs of other people with and without physical disabilities. This case study is designed to share some of the results of their successful collaboration as well as some of the challenges that they experienced.

2. UNIVERSAL DESIGN AND THE CONTEXT OF DISABILITY

The concept of universal design was first established at North Carolina State University in the 1980s, thanks in part to the efforts of Ronald Mace, an architect who recognized that design needs to respond to the needs of people with disabilities (PWD). The Center for Universal Design describes "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (NC State University, Center for Universal Design, College of Design, 1997). The students participated in the design process in a highly collaborative fashion to identify unique problems and to create early prototypes of concepts for products that are better fit to be "usable by all people."

While these students worked with users who were permanently disabled, either due to a spinal cord injury or a congenital condition, there are many forms of temporary and situational disablement that people experience which produce similar problems. A temporary disability can dismantle a person's relationship with a product that they previously depended on. For example, a person may break her foot and become temporarily unable to use an umbrella in the rain because her hands are now occupied by holding crutches or a walker, or she may use a wheelchair that has no method to hold an umbrella. Kat Holmes describes in her book Mismatch: How Inclusion Shapes Design, ways in which people are excluded by designs that "don't fit our ever-changing bodies". She challenges the assumption that there is an average human for which designers should consider (Holmes, 2018). While this case study focuses on users with permanent disabilities, several of the students' solutions can work for anyone at different times during their life, and co-designing helped to get them there. Co-designing is the process of "spending time with a community partner, in their space, learning about needs, and working together through all stages of design" (Costanza-Chock, 2020).

Professional industrial designers are well versed in the benefits of ethnography and yet rarely have the bandwidth to spend time with a user in their space, developing an understanding of their needs. The students, where possible, spent time with their users in their homes, observing first-hand many of their daily challenges. Their solutions are biased, even with feedback from users, from the designers' able-bodied perspectives, but their collaborative process helped to mitigate some of this bias.

3. STUDIO METHODS AND PROCESSES

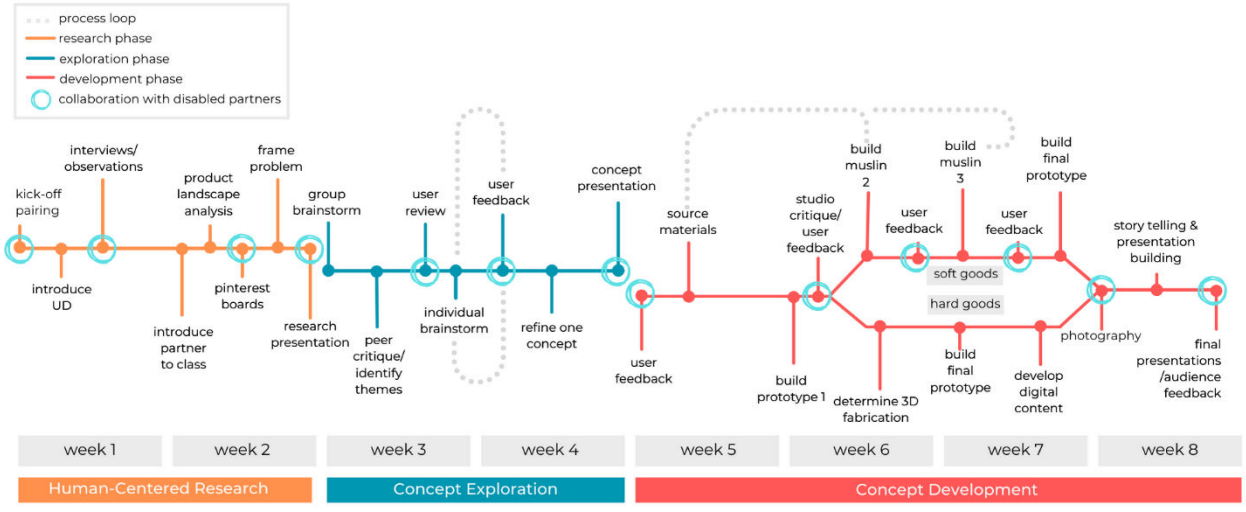

Figure 1. Timeline of project, highlighting key moments of collaboration

3.1 KICK-OFF AND PAIRING

This project was conducted over the course of eight weeks. To kick-off it off, students from industrial design, textiles, and the users attended an in-person meet-and-greet where the process of industrial design was introduced to those who were unfamiliar with it. Users then shared with the students and faculty personal details about their disability and what problems affect them in their daily lives. Several users demonstrated the challenges that they experience with their wheelchairs or walkers first-hand. After introductions, students and users broke into small groups to begin getting to know each other and to dig deeper into the problem areas that needed to be addressed. In this way, each student was paired with a user based on the student's preference and skill sets. Since these were graduate students, all of them had undergraduate degrees, both in industrial design and mixed degrees, and many had professional backgrounds and experience that informed their solutions. A student with experience in textiles and developing soft goods could more easily cut, sew, and assemble an accessible bag than a student who had never worked with soft goods before. For this reason, students were paired with users based on the type of solution that was needed.

3.2 COMMUNICATION

Students returned to the studio and were introduced to the seven principles of universal design - 1. Equitable Use, 2. Flexibility in Use, 3. Simple and Intuitive Use, 4. Perceptible Information, 5. Tolerance for Error, 6. Low Physical Effort, and 7. Size and Space for Approach and Use (NC State University, Center for Universal Design, College of Design, 1997). They created a list of ideas and a mind map with their user at the center to organize and visualize pain points and the cause of suffering. They developed a schedule and a communication plan to keep in touch. Communication methods varied depending on the preference of the user. Everyone used some form of texting, email, Facetime, or phone calls to sustain regular collaboration with their partner, having contact on average 2-3 times per week. Two users shared their personal blogs about their experiences with disability as a means for the student to learn about their lives and what their interests were. One student shared her design website with her partner as a mechanism for sharing progress at milestone reviews. All students used Miro boards to gather data, create mind maps, and organize content for meetings with their partners.

3.3 PRODUCT LANDSCAPE

Secondary research was performed by students over the next two weeks to investigate the existing product landscape for their problem area so as not to repeat solutions that were already available. Students sought to identify problems that had not been adequately addressed by solutions on the market.

3.4 AESTHETIC AND FUNCTIONAL COLLABORATION

Students who were designing a fashion-related product such as a bag were asked to use Pinterest to create aesthetic mood boards and gather images of functional adaptive closures and mechanisms. Several users engaged with the Pinterest boards with the students over Zoom calls and on their own time. Others who were not familiar with the website reviewed boards that had been prepared by

students over Zoom, providing feedback immediately about which mechanisms would and would not work for them in terms of functionality.

If a user said that they were unable to use zippers because of limited hand dexterity, students would research and make suggestions for other closure mechanisms such as magnets, Velcro, or oversized zipper pulls that can sometimes change a user's perspective about zipper functionality. In some cases, users were not aware of products that are already available to them, so this process was beneficial for both student and user.

3.5 BRAINSTORMING

Following research presentations and early collaboration to frame the problems, students began concept development with a group brainstorming session during class. Everyone brought their problem statement and several options for high-level ideas to the studio. Each student provided context into their user's problem, and the entire class contributed to brainstorming to benefit from each other's unique cultural and experiential backgrounds. The class included students from mechanical engineering, textiles technology, interior architecture, and biomedical engineering, to name a few. Students represented a culturally diverse population, having come to study in North Carolina from China, Taiwan, India, Iran, and Colombia, among other places.

3.6 CONCEPT REVIEWS AND NARROWING SCOPE

Students picked out themes from the group brainstorm and went home to continue concept generation and development. They each brought 12 concepts to review in class the following week and completed peer reviews to gather feedback. Students set up times to review concepts with their users after or during class, depending on schedules. They came to the studio the next day with a summary of feedback from their user, and they chose a single concept to move forward with and refine.

3.7 PROTOTYPING

The timeline of this project was brief, as this was a pilot for a new studio project, and the students had four weeks to build functioning prototypes to give to their user at the end of the semester. For this reason, some of the prototypes need further aesthetic refinement, and efforts were generally more focused on sourcing materials and execution of ideas to produce a prototype. Students who designed bags produced 3-4 prototypes, moving from muslin samples to a finished bag, using fabric that was representative of materials that could be sourced for a manufactured product. One to two prototypes were developed for hard goods solutions due to turnaround time with CAD and 3D printers.

3.8 FINAL HANDOVER AND FASHION SHOW

This studio culminated in a fashion show that was part of *A Voice at the Table, Conference for Women with Disabilities*, hosted each year by the North Carolina Spinal Cord Injury Association. The prototypes that students produced were showcased in the fashion show alongside an apparel design that had been created by a Wilson College of Textiles student. Members of the disability community gathered to watch the show and share feedback about the products. The two projects that are discussed in depth in this paper are those that were most positively received.

4. RESULTS OF STUDENT WORK

To gather data and feedback from this group of students, a series of semi-structured interviews were conducted online via Zoom to hear about their experiences with collaboration and co-designing after the completion of the semester. The interview questions were reviewed and approved by the Institutional Review Board (IRB) at North Carolina State University (IRB protocol number: 25885).

Because the needs of the community partners were so varied, the students' solutions represented a large scope of problem areas. Projects included, among others, a foldable rain cover for a powered mobility chair and a versatile utility strap for tethering a phone and other essentials. Community partners had diverse disabilities, and their requests of the students were informed by their personal needs and experiences. Several of the users are also advocates for PWD, and their insights to the project were based on a broader perspective from the disabled community. This helped to generate feedback that was applicable to many people.

The Permobil Rain Shield (Figure 2.) is a foldable rain cover for powered mobility chairs. The user for whom this product was made for was born with cerebral palsy, and she is unable to move her legs, feet, left arm, and left hand. She uses a high-end powered chair to help move her body. On days when it rains, she explained that it is very uncomfortable to get wet in a seated position because water pools in her lap, and her feet get splashed when moving through puddles. Another problem is that powered chairs are very expensive and have batteries that can get wet in the rain. The user's model was the Permobil F5 Corpus, and it can range in price from $20,000-$55,000, depending on features and capabilities (Permobil, 2023). Frequently, users had purchased their own wheelchairs if insurance had not deemed it as medically necessary. We learned from our users that a mobility aid is seen by a disabled person as an extension of one's own body, and everyone needs a different style of aid depending on their disability. When the designer asked what the user does when she needs to go out in the rain, she replied that she "does not go outside on rainy days because it is not worth the trouble". This prevents her from traveling as well.

Current solutions included umbrella holders for chairs, long raincoats, and rain covers that required the help of another person to set up. Umbrella holders were considered unusable in windy conditions, and raincoats were problematic when they got caught in the wheels of a chair. Observations, interviews, and a market analysis led the designer to create a rain cover that can protect the entire chair, be opened and closed with one hand, and detach from the chair when not needed. The solution is not powered and instead uses a drawstring to bring it within reach, then folds flat behind the chair. Considering universal design principle 7, it is no wider than the wheels of the chair so that it will not hinder access through narrow doorways. This solution generated much excitement from the community, and because the user for which it was made represented an extreme case by only having the use of one arm, the design is also easier to use for people who need to carry items in one hand while operating the rain cover with the other. The designer learned that keeping one hand free to carry items is a common challenge for PWD.

Figure 2. Permobil Rain Shield. Renderings by Hsin Li, 2022.

Hop-On (Figure 3.) is a lightweight utility strap for a crossbody bag that provides convenient access to a phone, credit cards, car keys, and other essentials. Users can use the utility strap with bags that have removable carry straps, and favorite bags can be modified to attach the strap. This solution can be used by a broad range of users thanks to its versatility and detachable design. The inspiration for this design came from the difficulty that the user experienced while twisting in her wheelchair to retrieve items from a purse that she attaches to the back of her chair. This is one of the only available locations to carry a bag on board. The user also expressed a desire to attach a dog leash and a water bottle to the strap.

The solution uses a TPU outer casing that houses a large neodymium magnet that the phone can attach to at the user's chest level and adjust in height to the user's preference. There is a tether that secures any sized phone to the strap by using the space in between the phone and its case, and this prevents the phone from being dropped. A problem that is regularly mentioned by the disabled community is that it is very difficult to pick up dropped items, even with the use of reaching aids. The utility strap has a pop-up credit card holder and additional attachment loops for other accessories, and it is fully customizable for the user.

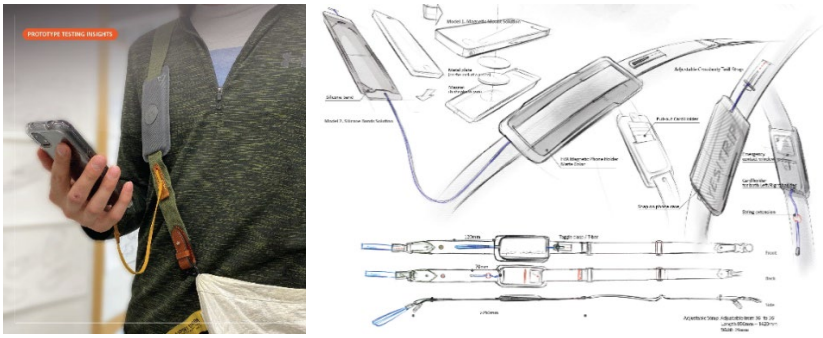

Figure 3. Hop-On Utility Strap. Prototype and sketch by Yingying Sun, 2022.

5. DISCUSSION FROM STUDENT INTERVIEWS

5.1 CO-CREATION AND COMMUNICATION

To develop rapport, one student said that "we talked about stuff that was unrelated to the project to help lower barriers. It wasn't like I was the designer, and she was the client. It was more like I'm her friend, and I'm designing something for her" (Yeh, A., personal communication, March 22, 2023). This relationship is unlike corporate sponsored studio projects. The motivation for the students to create quality designs came from somewhere other than their desire to satisfy a client's demands. Yes, the

users were clients in many respects, but the motivation was far more personal than designing a solution for a company. The students were very interested in making a product that would help their partner improve an aspect of their life. The users were vulnerable with the students when they shared intimate details of their lives, and the students appreciated this. They developed a mutual respect, and this strengthened the outcomes. In this way, the energy surrounding this project was different from other studios.

5.2 HAVING EMPATHY

Students showed empathy for the user in different ways. Two students watched all the videos in their user's blogs, saying that they were "taking an interest in her life and her creation" (Vargo, K., personal communication, March 24, 2023). Concept sketch reviews involved users demonstrating how a student's concept would or wouldn't work for them. For example, one user was paralyzed in one half of her hands and needed to use her pinkie fingers to open bags. She demonstrated her frustration by showing how her current bag had internal pockets that were not accessible because they used a zipper pull that could not be grasped. Users often asked students to role play a scenario themselves to relate to what it would be like in their position. One user asked the students to go home, sit on the edge of the bed, flex their feet, and try to put on a pair of jeans, to illustrate what it is like for her to get dressed every morning (anonymous comment, 2022). There were many examples of this type of interaction.

Students reported that observations and interviews helped them to empathize with their user, and a mind mapping exercise helped them to visualize the scope of problems. As Kat Holmes explains, "designing for the average serves no one" (Holmes, 2018), and having empathy is one method by which we can design for all. Where students had a gap in knowledge or experience as an able-bodied person, they used empathy as a tool to meet others' needs.

5.3 THE IMPACT OF VISUALS

Students used visuals to convey their understanding of a problem. They brought something visual to review (pictures of other products, sketches, renderings, photos of other people, prototypes) to every meeting because they recognized that without a visual, the conversation would not be productive. When they had concept reviews, users were generous with their time and often spent several hours on video calls with students to explain why a solution would or would not work for them, and they brainstormed together about alternative solutions.

5.4 MILESTONE REVIEWS

Students reviewed progress at every major milestone – problem scoping, mind mapping, idea sketching, mood board creation, concept refinement, renderings and/or prototype creation. Some students did not create digital renderings because they built physical prototypes without the use of CAD. In between milestone reviews, they texted, emailed, and had phone calls to get quick feedback. As one student put it, "texting was more about quantity of information, getting quick answers like 'yes' or 'no'. Facetiming was about getting qualitative feedback, and I could ask more questions" (Yankello, M., personal communication, March 22, 2023).

5.5 WHEN TO WORK ALONE

Students often worked alone after they had enough information from their user to complete the technical design work. They were sometimes concerned with brainstorming together with their partner because of the constraints it could produce. As one student said, “I worked on my own to brainstorm ideas because I wanted to bring in a new perspective. She might not be aware of the possibilities that we could implement as designers. I wanted to free myself from constraints on how to think about the problem” (Yeh, A., personal communication, March 22, 2023). At the end of every phase of working alone, students would circle back with their user to review.

5.6 UNIVERSAL DESIGN

Two students said that they designed for the “extreme case” by focusing on one user with a spinal cord injury. If they designed for the extreme case, then they felt that the solution would meet the needs of other people. To make designs that were universal, successful students kept the universal design principles close at hand to reference during concept development.

In some cases, students became too focused on aesthetic and functional opinions of their user and had a difficult time taking a step back to see how the design could still help their user and be adapted for many people. As they were creating a product to hand over to their partner, they occasionally felt pressured to make design choices that they would not have made otherwise.

6. CONCLUSION AND NEXT STEPS

In summary, what made this collaboration fruitful?

- In-person kick-off meeting and getting to know each other early in the project
- Partnering based on skills and interests of students with needs of users
- Diversity of students and users
- Vulnerability and trust from users (sharing personal stories, blogs, websites, etc.)
- Mutual respect and empathy among students and users
- Collaborative digital tools (Miro, Pinterest)
- Group brainstorming in studio, much like a design team with a common goal
- Sharing solutions with the greater disabled community at the fashion show
- Student motivation to help their user improve an aspect of their life
- Handover of final solutions to users

This project suggests methods in which designers can bring the user into the process of concept development in a meaningful way to address the needs of the disabled community and beyond. Over eight weeks, students got to know someone in their community on a personal level, with some users and students developing friendships from the collaboration. Solutions generated excitement and a desire for further engagement from the disabled community and medical professionals, especially physical and occupational therapists.

Considering that there are “an estimated 1.3 billion people” in the world who “experience a significant disability today” (WHO, 2023), and in view of the current landscape of accessible products that is both limited and expensive, there is opportunity to create something of value for many people.

One suggestion for future projects is to increase the time frame to a full semester to devote more time to prototyping and user testing. Several projects could have been developed further into business opportunities and graduate thesis projects. Another idea is to gather constructive feedback from users after the project ends. Because of the nature of student work, many users gave only positive feedback to students because they did not want to seem ungrateful. Honest feedback could have led to better design decisions.

Feedback from members of the disabled community has been overwhelmingly positive because they appreciate the investment that the students have made in their lives. On the other hand, there is a risk that projects like this can be frustrating when they do not lead to a tangible, helpful solution, as community members are volunteering their time and expertise. The handover of solutions at the end of the semester gave users a return on their investment.

It is possible that undergraduate students could participate in similar projects. Student-user meetings could happen on campus or online over Zoom in group meetings so that interactions can be overseen by a faculty member. It takes time and experience engaging with the disabled community to develop an understanding of disability appropriate language and interaction. Projects of this nature could require higher levels of maturity from students, which is one reason why it made successful graduate level project. With appropriate oversight and background knowledge from a faculty member, it could be replicated in undergraduate studios.

A final suggestion is for practicing designers and design companies. It is recommended to invest in the time and resources that it takes to do proper ethnography at the start of a project and to continue collaboration with users throughout a project's milestone reviews, in spite of pressing deadlines and budgetary constraints that frequently hinder this level of collaboration. It is the responsibility of the designers to advocate for this kind of collaboration at their jobs. However, young designers will need the support of upper management levels, from senior industrial designers to CDOs, to make it happen.

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