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COMMUNITY-CENTERED PARTICIPATORY RESEARCH IN HEALTHCARE DESIGN EDUCATION

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PAPER ABSTRACT: Traditional design processes focus on humans/users and their needs which are rooted in their experiences. However, there is an increasing amount of emphasis being placed on community-related experiences and their impacts on human-product interactions (digital, physical, service, etc.). As such, the discovery process can benefit greatly from collaborative, participatory research and evidence-based design, which have become popular methods in the design and decision-making process. In the field of healthcare design, these approaches are especially important. Designing a classroom experience that involves multiple faculty and industry professionals, while simulating real-world, community-focused scenarios, can be crucial to developing the skills young designers need to succeed in this field after graduation. In this paper, we took a look at the processes, successes, and lessons learned over several semesters from a collaborative, healthcare design course involving industrial design and biomedical engineering students at Virginia Tech.

Keywords: Community-Centred Design, Participatory Design, Healthcare, Design Education, Community Based Participatory Research

1. INTRODUCTION

Our profession has begun a shift away from focusing only on user-centered design (Forlizzi, 2018), and designers have broader roles in designing experiences, systems, services, crafts, and many others. Even so, the common variable among all of those areas is still users/people. People tend to define themselves by the communities they belong to and are related to (Merriam-Webster. n.d.), and these communities can impact people's behaviors, decisions, and interactions with any design (MacQueen et al., 2001). Exploring design from the community point of view is also a proper avenue to advocate for diversity, equity, and inclusion (Soni et al., 2022, Wallerstein & Duran, 2010). Community-Based Participatory Research (CBPR) has been used as a valuable and reliable method in social science and healthcare topics for decades (Liamputtong, 2019). Especially within the field of healthcare, understanding each community and its needs are essential aspects of research, especially when exploring the most reliable and effective ways of communication (MacQueen et al., 2001). The success of this approach is rooted in community engagement principles (Chen et al., 2020), which we will discuss in section 4. Healthcare and its related topics are one of the growing areas for designers, and with an increasing demand for

healthcare solutions (www://health.gov/), industrial design programs in universities can make this area a strong path for the future of the profession and education of the students. This requires educators to explore the possibilities of utilizing a more comprehensive range of teaching strategies and tools in research and design (in some cases unconventional to industrial design). In this paper, we will take a look at the pedagogical shift that can evolve the learning experience for students by considering transdisciplinary work, experiential learning, and community engagement as three fundamental pillars in this transition, as they relate to healthcare design.

2. MULTI/INTER/TRANSDISCIPLINARY STYLES IN TEACHING

Topics related to healthcare and public health are complex by nature (Gómez Puente et al., 2013), and the goal is to discover/create the most appropriate solutions for the world's complex healthcare issues. To understand, explore and solve these problems, designers must consider the needs of humans and their communities. (Choi & Pak, 2006). Working on these topics requires the capability to collaborate with a team of people with diverse expertise. In the classroom, simulating the kinds of experiences that focus on interdisciplinarity and the real-world issues of communities creates an environment where students can be immersed and find novel and effective solutions (Self, et al., 2019). However, fostering a proper learning environment that encompasses all the new critical thinking skills and requirements while maintaining the ability-to-make in the traditional design definition requires reshaping the studio teaching setting.

Within a professional company or research team that works on complex projects (e.g., healthcare), the role of each person is clear, and each member has expertise in at least one discipline. Also, the company's basic structures, such as working hours, location, equipment, budget, etc., tend to closely follow the project definition and its requirements. With these aspects in mind, if two or more academic disciplines can simulate this same experience for undergraduate students, it allows the students to adapt and broaden their intellectual horizons while learning how to interact with other disciplines. This process will help them gain collective knowledge about that subject beyond their individual perception, which would not be possible without this collaborative setting (McMurtry & Gagnon, 2013). At the same time, they will also experience first-hand the challenges and obstacles that can result from working with other disciplines.

For creating this setting/experience, faculty need to consider curriculum principles and requirements in each discipline and come up with a time frame and a new design for the course/project that fulfills the traditional definitions for disciplinary infrastructures but also fits with the interdisciplinary practice objectives. As Douglas Kaufman, David M. Moss, and Terry A. Osborn mentioned in their book, Beyond the Boundaries: A Transdisciplinary Approach to Learning and Teaching (Praeger, 2003), humans created these artificial boundaries in the educational system in order to turn knowledge into digestible bites for students. Consequently, each discipline creates a narrow perspective of knowledge that does not

provide a realistic experience for the students (Kaufman et al., 2003). However, it is plausible to reshape the curriculum, pedagogy, and assessment to fit this narrative and its goals in cases dealing with teaching research and design for complex topics such as healthcare. Other impacting factors include sharing resources (technical or human), similar complex topics that require different points of view, and professional settings that require individuals to work with others in an increasingly globalized world (Baker, 2015; Klein, 2018)

To better illustrate this setting, Figure 1 shows how faculty from three hypothetical disciplines within an educational setting (in this case design, biomedical engineering, and medicine [a]) can collaborate on a project. Each of these faculty is a member of a larger community in their discipline [b], which can help them to design this type of collaborative educational experience either in the form of a module (short course), full course, design sprint, or a single undergraduate project [c]. As shown in Figure 1, section C, this system is developed and facilitated through close communication and collaboration between faculty. And even though this is a collaborative process, the roles and the responsibilities for each faculty can differ in each stage. One role might be more dominant in one stage, and another might take charge in another stage. The important thing is to be open, communicative and flexible, as this also serves to model healthy work habits for the students.

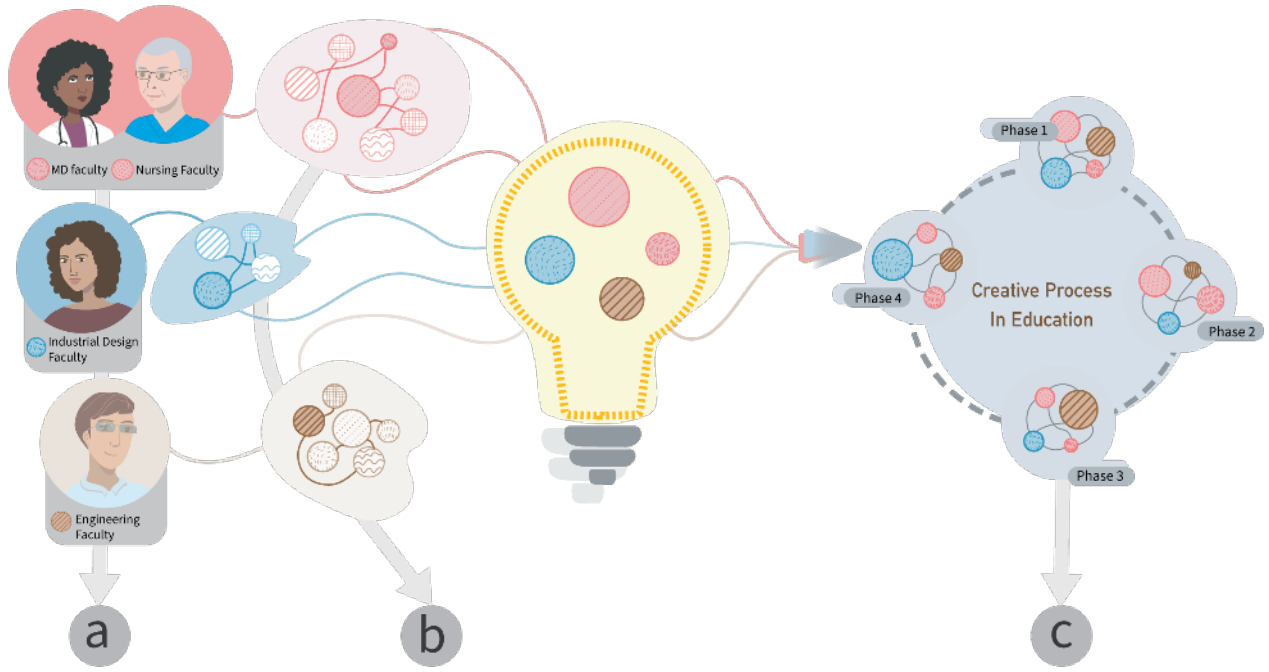

Figure 1 Transdisciplinary teams and the educational design process[1]

[1] This illustration is based on a cross-listed course that has been running for the past 3 years at Virginia Tech.

For faculty designing these experiences for students, keeping the balance in the overall process between the team members and disciplines is essential. In the case of design for healthcare, the complex nature of topics requires teams of subject-matter experts in various professions to work and collaborate. For example, in our cross-listed course comprised of industrial design (ID) and biomedical engineering (BME) majors[1], students were organized into teams of three BME and two ID students. In the stages of the design process that were related to human interactions, ergonomics, and user experience, ID students took the lead. For topics related to technologies and regulations, BMEs shouldered more of the load. However, this does not mean they were working separately at any stage of the process. (Author, 2021)

In this example, BME and ID faculty designed the course content and process (lectures, regular meetings, assignments, clinical immersion, site visits, etc.) to provide the ultimate interactions for the students while respecting the professional knowledge of each major. One important goal was to practice effective communication that helped them consider different perspectives and make collective decisions. While their new knowledge in these areas expands, they also learn how effective communication, open-mindedness, and flexibility leads to more innovative solutions/deliverables.

Figure 2: Left, First dialysis center visit 2022; Right, A lecture by a healthcare professional to transdisciplinary teams of ID and BME students, 2020 (Morshedzadeh et al., 2021).

3. EXPERIENTIAL LEARNING

In order to foster an environment that enables the students from different disciplines to collaborate and practice using their disciplinary knowledge, there is a need for projects with defined goals and objectives. Scientists and researchers use Experiential Learning (EL) methods such as case study exercises, simulation exercises, and case competition in healthcare and public health (White et al., 2018). EL has also become a popular teaching methodology in university programs, including design and innovation, which can increase learners' learning motivation (Liu et al., 2019). EL is the process of creating knowledge through transformative experiences and involves a continuous cycle of doing,

reflecting, learning, and testing (Kolb, 2015). These characteristics make EL a perfect fit for tackling real-world problems while teaching interdisciplinary teams (Seow et al., 2019). Through these endeavors, students develop the skills necessary to collaborate, recognize unforeseen challenges, and solve open-ended problems (Singh et al., 2018). Building confidence in these areas is crucial for preparing industrial designers to focus on healthcare design in post-graduation professional roles. For this goal, they must learn to collaborate with biomedical engineers, business experts, and clinical professionals while navigating complex user and stakeholder journeys to develop innovative healthcare solutions.

It should be noted that simulating a real-world healthcare problem, its circumstances, and the scenarios involving personnel can be costly, time-consuming, and complex. Therefore, creating a setting that fosters experiential learning for multiple academic disciplines in this field requires a significant commitment from all parties involved in this industry

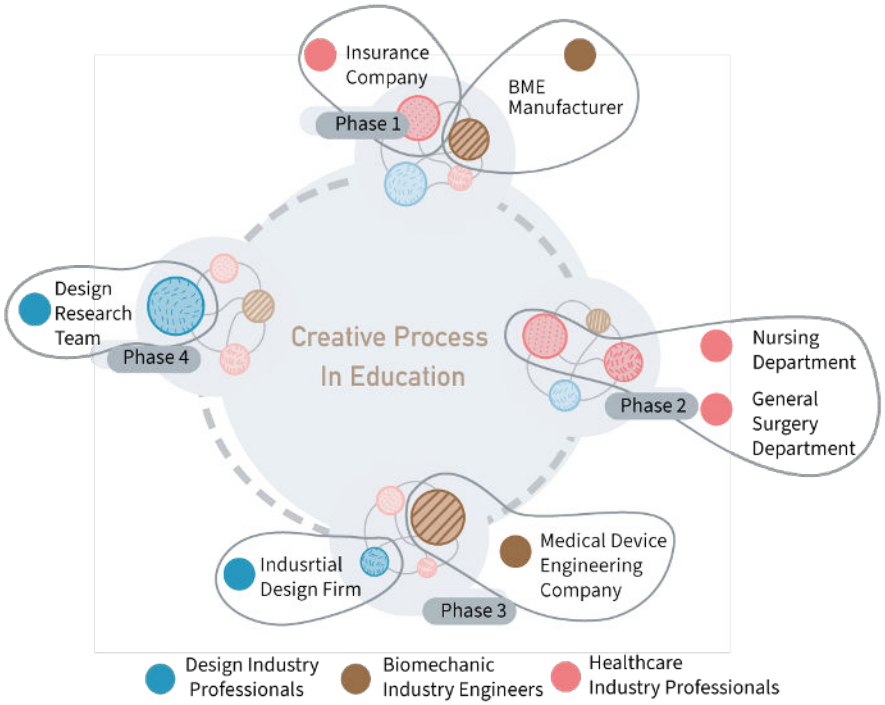

Figure 3: Access to Professional Industry Settings

Looking back at Figure 1. each faculty member has a network of professionals with the potential to become a viable link to a professional setting and its resources (Figure 3). An innovative course with access to academic resources that is focused on a real-world problem can persuade industry and healthcare collaborators to form a long-term partnership/sponsorship with these programs. For example, in our cross-listed course at Virginia tech, ID and BME partnered with the Walter Reed Army Medical Center in Bethesda, MD, the Carilion Clinic Center for Simulation, Research, and Patient Safety,

and the Salem VA Medical Center in Salem, VA. This collaborative partnership enabled faculty to provide students with opportunities for clinical immersions and interactions in three clinical departments: Nephrology, Podiatry, and Gerofit2 (a physical activity program for seniors). Students could visit and observe these three departments in person, learn about a variety of technologies, and develop possible solutions while interacting with each other and professionals while completing the required tasks and practicing the skills for this course.

Figure 4 Images from students' clinical immersion experience in April 2022 and March 2020.

Also, in addition to these visits, medical and other industry professionals provided lectures to students on various topics related to these criteria. In Figure 5, you can see the course layout that was offered to the Industrial Design and Biomedical Engineering students.

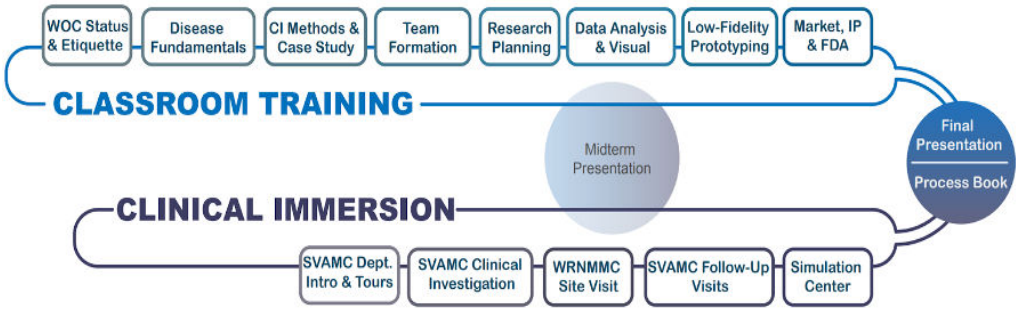

Figure 5 Needs Identification Course Design (Arena et al., 2020)

An interdisciplinary, experiential learning program can create a unique opportunity for undergraduate students. A program like this creates the space for the students to continue the work and projects with medical devices and service development professionals outside of the usual class format and length. In our case, an interdisciplinary team group of students who enrolled and passed the course continued their collaboration with external partners and professionals in designing a solution for "Improving AV Subcutaneous Access" (a selected need within nephrology). Their experience during the course prepared them to maintain and extend their connection with subject matter experts (industry and medical)

[2] Gerofit is an exercise program that promotes health & wellness for Veterans. Participants in the program have demonstrated improved health, mental, physical function and well-being. (https://www.va.gov/GERIATRICS/pages/gerofit_Home.asp, 2022)

towards prototyping and testing their design. This approach to teaching can help them improve the students' cognitive, interpersonal and intrapersonal competencies (Seow et al., 2019).

4. COMMUNITY ENGAGEMENT

Universities can be one of the positive core entities of a city's infrastructure if community members become engaged with university activities and events (Bruning et al., 2006). This can create a significant source of diverse knowledge within the community, and while the EL method provides an exceptional educational experience for students, its intersection with community engagement and collaboration can enable direct interaction and, in turn, a deeper understanding of the stakeholders involved (Thamrin et al., 2019). Also, the collaborations between academia and communities have become an attractive addition as EL and rethinking the purpose of education and its practical impacts on society grows (wellbeing, economics, and environment) (Clifford & Petrescu, 2012). Integrated with community engagement, EL can be interpreted as a type of service-learning that focuses on fostering a community-based project for ID students' practical learning and their reflections on their individual experiences (Salam et al., 2019). Topics like this can lead to a remarkable growth in student learning objectives, such as working in/with diverse groups, civic engagement, critical thinking, and cross-cultural awareness (Spear et al., 2020).

In order to provide the infrastructure for community engagement, the process should have three steps: 1) introducing students to interdisciplinary team projects, 2) exposing them to stakeholders and industry professionals' critiques, regulations, and etiquettes, and 3) guiding them through a semester-long project that offers an immersive experience with community engagement. Senior thesis projects, by nature, are an excellent vessel for integrating these three cores. For example, in Figure 4 you can see two healthcare-related projects that were integrated with our ID senior thesis studios. On the left, "ZIDA: Neonatal Harness" (for monitoring vital signs in infants) was designed by two industrial design students in collaboration with multiple faculty and industry professionals in TEAM Malawi[3] as well as students from Biological Science, Mechanical Engineering, Masters of Public Health and the Carilion Medical School. This design's first prototype (second image from left) was used in clinical testing on infants in Carilion Children's Hospital in Roanoke, VA. The second iteration (first image on the left), which was designed by a second interdisciplinary team, was tested in Malawi in spring 2022, with community members in the actual environment.

The two images below on the right show another concept designed by senior ID students, which addressed certain community and user needs related to the home-birth process in Haiti. The student design was widely accepted by the local community members and midwives. Neither of these projects

[3] TEAM Malawi is a multidisciplinary collaboration of industry professionals, faculty and students based on a community wellness model of health, designed to meet the challenges of a developing nation through an approach of community-based participatory research, design, and pedagogy.

and their outcomes would have been possible without the strong connection and collaboration between the community representatives and university partners.

Figure 7 Left: "ZIDA Neonatal Harness", Designed by: Amber Baden Lopez, Shiva Challa, John Harris, Kristen Merrifield, Emilie Baker, Colleen McDonald, Caitlin Steen, Spring 2018. Second from left: Designed by Dana Werlich, Spring 2020. Community collaborators: TEAM Malawi, Judy Chen, Faculty Advisors: Elham Morshedzadeh, Andre Muelenaer, Akshay Sharma, John Bird. Right: "Swensak: Building a Better Kit", designed by: Laura Haggerty, Nicole Norris, Fall 2017. Community collaborators: Sara Simeunovic, Nadine Brunk, Junior Beauvais, Faculty advisors: Elham Morshedzadeh, Andre Muelenaer, Akshay Sharma.

Through this type of experience, the student/designer can be exposed to a series of deep interactions with a range of stakeholders. These communications can provide new points of view, insights, vocabulary and knowledge that can have a long-term impact on the project and even the future career path for the student. This interaction and understanding would not be possible if they (the students) simply followed traditional research methods such as developing persona profiles and sending out surveys. For example, in the "SwenSack" project example, students had the opportunity to hear and discover key insights from local midwives in Malawi, a location and environment none of the students had had prior experience with. These midwives routinely walk miles to visit pregnant women, most of whom are uneducated and do not trust physicians from "the outside." It was important to understand the midwives' struggles in helping pregnant women with their immediate needs, as well as empowering them with better education about their bodies, conditions and health.

Here in Figure 8, we illustrated how a water filtration technician who works in a dialysis center has more to offer because of being their mother's primary caretaker who has type 2 diabetes. Also, them, being a member of the LGBT community adds another level to the designer/student team's knowledge that can affect their decision-making process and its result.

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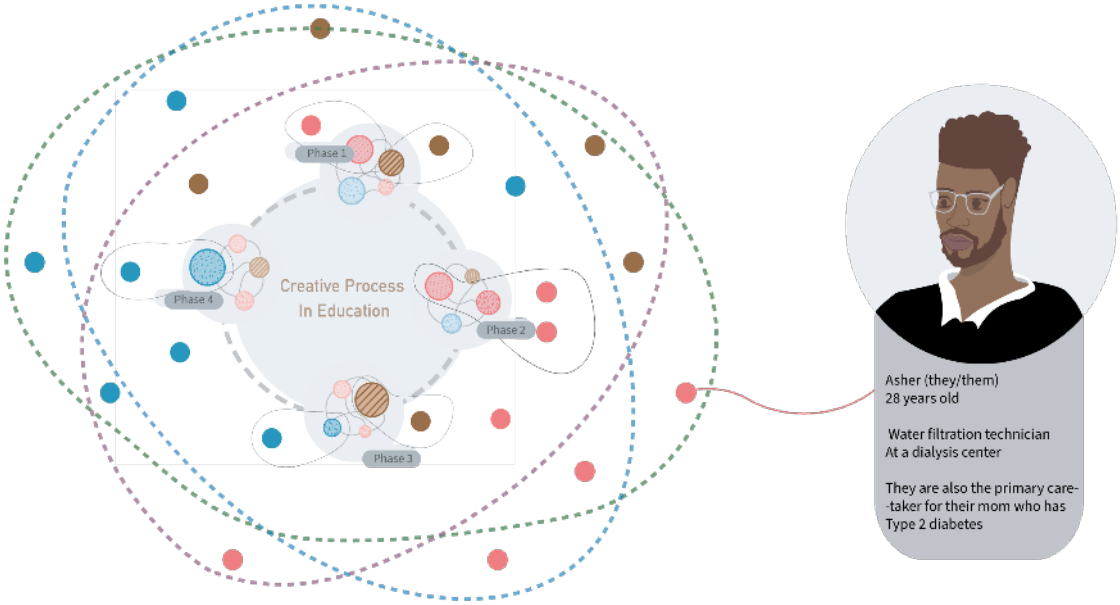

Figure 8 who they can meet

While this teaching style is rewarding in many aspects for all entities involved, creating a sustainable engagement between academic and community entities is still one of its biggest challenges. One way to maintain this relationship is to create satisfaction within a structure that helps the design outcome be implemented in the community. This is only possible if the plan is backed up by "policies and processes aimed at articulating a place of influence for community voices" (Mbah, 2019). A sustained engagement with a complex unit such as a community is possible with a united and committed group that values the community's capacities in building and immerses in positively addressing the needs in each dimension (Clifford & Petrescu, 2012). For example, the design in Figure 9 is a system developed in 2021 that includes physical, educational, and digital components that help the community (public and professionals) to address opioid overdoses. This solution was heavily influenced by deep and frequent communication with local communities (substance users, caretakers, healthcare workers, EMTs, etc.). This project resulted from a collaboration between Virginia Tech's Institute for Policy and Governance and the Industrial Design Program. Later in 2021, this design was funded for production by a local manufacturer and tested in the community. Currently, the research team is working on manufacturing 100 units for a pilot study.

Figure 9 "Connection to Care: Opioid Epidemic", Designed by: Anna DiNardo, Blythe Rowe, Connor Howerton, Cristina Dunning, Wesley Rogers, Fall 2019. Community Collaborators: Mary Beth, Dunkenberger, Lawson Koeppel. Faculty Advisors: Elham Morshedzadeh, Akshay Sharma

5. WHY DO WE NEED THIS?

Teaching based on the trajectories described in this paper, and planning on a long-term pedagogical system with focus on healthcare and healthy communities, allow for a tremendous variety of beneficial interactions and experiences for students. This approach also require multiple complex procedures and steps of preparation in various directions, such as: a) introducing and adapting a nontraditional teaching approach into the traditional curriculum structure; b) developing collaborative liaisons with community partners in course planning to defining mutual goals, develop the syllabus and assignments, and formulate expected outcomes for all parties; c) building and maintaining relationships and effective communication throughout the course; d) designing the tools for reflection, dialogue and feedback from the community and other partners as well as students; and e) potentially evolving the project into long term/high impact endeavors that can be carried out for several years by different groups of students. (Culhane et al., 2018)

Teaching design with a community focus requires educators to become more aware and responsive to community needs and the future needs of design education. Creating a living, growing, participatory-design system that integrates healthcare-focused experiential learning into traditional ID courses can lead to exciting new innovations and more opportunities for community-centered collaborative learning experiences for students.

Settings similar to this give undergraduate ID students the chance to have a unique journey (figure 10) working with tools and techniques that might have not been available in a conventional setting.

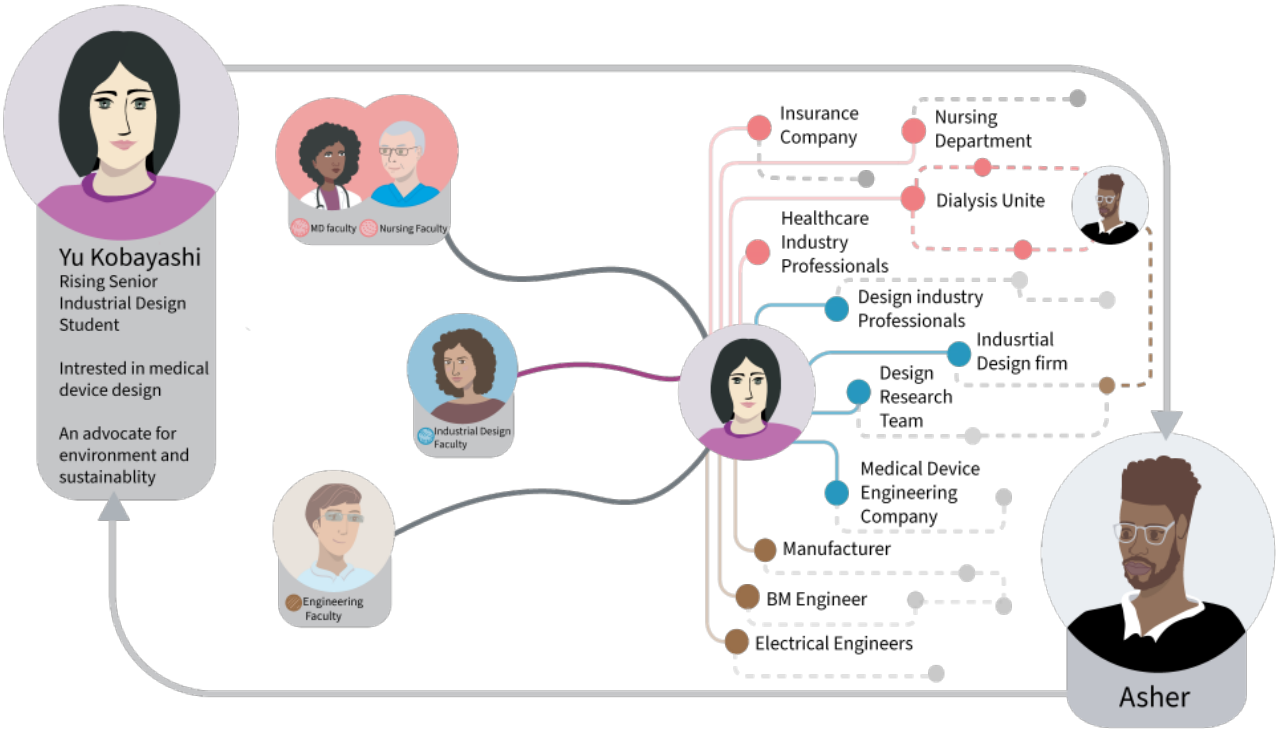

Figure 10 Yu's journey

Witnessing that an ID student (Yu Kobayashi), have the chance to meet and know Asher and their life story, opens a new perspective to a topic that she would have not experience it in a traditional teaching setting. These are paths that can be crucial in training future designer who are more compassionate about the communities and impacts their design.

Ultimately, our hope is that these experiences create students who are not just designers, but advocates for user needs who have a sense of civic responsibility and who are also highly sought after by companies who are making a real difference in our collective quality of life.

ACKNOWLEDGMENTS: This research and its outcomes would not be possible without the invaluable insights and collaborations with my colleagues at Virginia Tech and Carilion Clinic. I would also like to thank our students, who fearlessly embraced new opportunities for experiential learning and surprised us so many times along the way.

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