Teaching Innovation Using Multidisciplinary Collaboration
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ABSTRACT
The University of Detroit Mercy Departments of Engineering and Nursing have collaborated to provide unique assistive devices to physically challenged individuals living in the Detroit metro area. A team of engineering and nursing students are paired with a physically challenged individual. The engineers design and build an assistive device identified by the client as being useful to improving the quality of their life. The nursing students evaluate the device and the client for any potential health related issues. The interdisciplinary student team works together to provide a safe, useful, and health conscious device with the goal of improving quality of life. This paper will describe the multidisciplinary approach used to educate students while developing innovations that meet the needs of the physically disabled.

Introduction
Millions of people are affected by physical disabilities that impact their ability to perform daily activities. The Technology-Related Assistance for Individuals with Disabilities Act was passed in 1988 by the US Federal Government. Two objectives of the act were to increase the availability of assistive technology and to increase the capacity to provide technology-related assistive devices for disabled people. Consistent with this federal act, the departments of Nursing and Mechanical Engineering at the University of Detroit Mercy (UDM) collaborated to provide unique assistive devices to physically challenged individuals living in the Detroit metro area while teaching multidisciplinary collaboration. Following classroom instruction, the student teams, under the supervision of nursing and engineering faculty, meet people from the local community with a physical disability. Individuals requiring assistance are identified through a variety of developed partnerships such as Michigan Rehabilitation Services, Veterans Administration (VA) Hospitals, Michigan Spinal Cord Association, and personal contacts. The students interact with the client to assess his or her needs. Collaboratively, the students and the client determine a device that could be built in order to improve the life of the disabled person. Nursing students inform the team about the specific physical disability and its implications, help with design ideas, and evaluate the device and the client for any potential health-related issues. Engineering students design and build the assistive devices identified by the client and make necessary iterations until a satisfactory device is completed. The multidisciplinary student team works together to provide a safe, useful, and health-conscious device with the goal of improving quality of life. Nursing faculty and engineering faculty collaboratively teach bi-weekly in the classroom and also facilitate the multidisciplinary student interactions as they build the devices for the clients. This paper describes the multidisciplinary approach used to educate students while working toward meeting the needs of the physically disabled.

Background
Dramatic changes in health care, movement toward a global society, continued budgetary restrictions, learning needs of new millennium students, and increasing multidisciplinary efforts to accomplish a variety of goals were a few of the reasons the University of Detroit Mercy (UDM) has developed a unique collaborative multidisciplinary course. Creating multidisciplinary learning environments can enrich the educational experience of students beyond that of a single-discipline approach (Kijima 2009). The multidisciplinary program was initiated in 2008 when the College of Engineering requested collaboration with the College of Nursing to ensure client safety in created technology. The overarching goal of the multidisciplinary program at UDM is the innovative development of technology to enhance the lives of the physically disabled. Additional objectives of the multidisciplinary course include improving communication and collaboration skills necessary for the workplace, providing a unique and enhanced educational experience, and finally to graduate professional, ethical, and team-focused individuals able to effectively improve the lives of others. The multidisciplinary course has continued to evolve and has been highly effective in meeting the established goals and objectives. The remainder of this paper describes how we designed and established the course, the approach, rationales and methods, limitations, and future plans for multidisciplinary education.
Interdisciplinary education occurs often on campuses and in the workplace (Harvey and Koubek 1998; Nelson et al. 2008; Syrett and Taylor 2003; Wright et al. 2009), but interdisciplinarity collaboration is much easier than a multidisciplinary approach. Interdisciplinary teams generally speak the same language, understand the same written codes, and work with similar objectives. For example, in healthcare, an interdisciplinary team may consist of nurses, respiratory therapists, nutritionists, radiographic technicians, physicians, and aides. Each member of the team uses their specific skill set to ameliorate symptoms of patients, they can read and understand medical terminology and can easily communicate with one another with explaining themselves, and are familiar with healthcare and living environments (Nelson et al. 2008; Syrett and Taylor 2003). Engineering also practices interdisciplinary collaboration when different specialists such as mechanical, electrical, or civil engineers design and work to build a variety of products. Multidisciplinary education and work requires greater effort, but can produce substantial results. The increased effort is due in part to different perspectives on a situation, different ideas of how to solve problems, different professional language and communication styles, different schedules, and a variety of personalities. Nonetheless, multidisciplinary work is greatly needed in the increasingly global society. Therefore, learning how to collaborate across disciplines should be taught in educational institutions.

Some literature has described multidisciplinary collaboration in the workplace. O'Neill et al. (2004) and Rantz et al. (2005) detailed work between computer engineers and nurses to develop technologies used in advancing electronics and are familiar with health care environments. The usefulness of multidisciplinary approaches to solve problems has been described in published papers. Kijima (2007) stated that in addition to multidisciplinary collaboration and synthesis of systems sciences, the production of a shared map of differentiated and fragmented scientific knowledge from human, social and natural/engineering sciences, in such a way that it can provide a transparent perspective of them, should be one aim of systems sciences. Kijima (2007) also articulated that a variety of scientific knowledge from different communities and disciplines, such as reduction, induction, and abstraction, is needed to achieve multidisciplinary collaboration. Interdisciplinarity has reached a stage where the single-minded pursuit of expertise in a single subject is insufficient to solve complex problems. The multidisciplinary approach needs to be applied to all fields of knowledge, from the sciences to the humanities, from the social sciences to the technical sciences, and to all levels of educational experiences (Kijima 2007, 583).

Examples of Effective Multidisciplinary Collaboration: The Clients

Our clients are identified through a variety of partnerships, including the Michigan Department of Community Health, Ford Foundation, American Library Association, University of Michigan, and the Smiley Foundation. These partnerships have included community needs assessment, feasibility studies, and information gathering and interpretation. The partnerships have been successful in identifying and addressing the needs of our clients.

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During our initial meeting with KM, the multidisciplinary team was making note of his rare disease while assessing his physical disabilities and ways to ameliorate his difficulties. After a few minutes of talking to KM, it was identified that KM’s disease was prohibiting him from being able to hunt due to an inability to stabilize a gun. He asked the multidisciplinary team if a stabilizing device could be built that he could attach to his wheelchair that would allow him to stabilize items such as his gun or camera so he could return to his outdoor hobbies.

Designing the Product

The primary design goals of the device were that it would be durable, reliable, safe, and effective. The multidisciplinary design team, including students and professors, took the idea of designing a device to allow KM to stabilize items such as his gun or camera and returned it to the multidisciplinary team.

The multidisciplinary team assessed the current market for availability of products that might be of assistance for KM. No devices matching KM’s needs were identified. Therefore, the multidisciplinary team began to brainstorm and discuss potential ways to assist KM’s physical needs and desires. Numerous iterations of the device were attempted and developed. A variety of harness and stabilizing hardware were evaluated for potential use. Different materials such as plastic and metal were assessed for use in the device. Battery operated and manual type devices were also considered. KM tried the various designs for weight, functionality, comfort, and design. The engineering part of the team evaluated the effectiveness of the materials and functionality of the device. Nursing students evaluated the health risks versus benefits of each attempt. KM’s skin, nerves, and muscle function were considered with each revision of the device.

After several iterations, satisfaction from all multidisciplinary team members, and approval from KM, a final design was created and accepted. The device was secured to the back of KM’s wheelchair with the option of bringing it forward and into place when stabilization was needed.
is required or keeping it folded behind the chair when not needed. In addition to providing stability for equipment, the design team instituted other applications for the device, including an umbrella holder and grocery carrying capacity. The unique assistive device was deemed a successful and effective product which allows KM to stabilize devices such as guns and cameras so he is able to perform more the activities that he enjoyed prior to developing spinocerebellar ataxia. KM’s case is one example of a successful multidisciplinary collaborative effort in higher education with significant local impact. KM’s physical disability was somewhat ameliorated through this innovative approach, and he was extremely happy to be able to enjoy his outdoor hobbies once again.

The multidisciplinary teams met regularly to work on the project. Faculty were not present at these meetings for the purpose of allowing the students to independently solve problems, collaborate, assign roles, discuss ideas, and build relationships. Faculty were always available for consultation and led bi-weekly classroom discussions. The students presented their proposals to other classmates, faculty, and clients throughout the process. The final products from the multidisciplinary student teams were showcased in a conference at the end of the course.

Conclusions

The lessons learned from this multidisciplinary collaborative educational approach to helping people with physical disabilities have gone well beyond that of a traditional classroom.

The nursing students learned a great deal about the process of designing and building a product. The engineering students gleaned considerable new knowledge about health care and people with physical disabilities. Both sets of students gained knowledge and experience using their specific skill sets on multidisciplinary teams, learning how to build relationships, working with people, and utilizing their collaborative expertise to improve quality of life. These lessons are invaluable as we graduate these students into the professional arena.

Students have voiced great satisfaction about using their expertise to help those in need and how much they enjoyed the collaborative experience. Students become personally vested in the projects. One engineering student stated, “This isn’t a simulated project, we don’t want to let the patient down!” Another engineering student wrote about the unique design challenges associated with “not being able to completely understand the difficulties of the everyday life of the handicapped person.” One of the nursing students stated, “It was awesome to see the final product. I didn’t think we could do it, engineers just think so differently from us.” The collaborative projects help students understand how working together is valuable because clients are counting on them for results.

The professors from both colleges work well together in educating the students. The professors involved in the course have learned much from the process and continue to improve the course. Challenges such as scheduling conflicts, communication barriers, personality issues, and processing issues remain. Resolutions to some of these problems require flexibility and creativity. For example, because nursing students often have scheduled clinical time during engineering classroom time, they are unable to attend the theory portion of the course. One solution to this scheduling conflict is the increased use of technologies such as Skype, Blackboard discussion boards, online campus meetings during evening and weekend hours, Facebook, and Twitter. Communication between engineering and nursing students requires explanation from both groups regarding the meaning of discipline-specific jargon. Initially, communication is slower because of the need for term explanation but with continued encouragement, both disciplines gain a new understanding of terminology. Another barrier is the lack of time to move the designed products to the marketplace. Students are encouraged to distribute, market, and pitch their designs to potential buyers or even develop a company to manufacture the innovations. Students are taught entrepreneurial skills, but because the course is only two semesters in length, they must take the initiative to commercialize their products following graduation. However, with continued determination and purpose, the outcomes of multidisciplinary collaborative education are proving to be vastly rewarding for both faculty and students. It is our goal to continue to educate students using more multidisciplinary collaboration and, more importantly, to use those collaborative efforts for innovation to improve the lives of people in need.

References

