

Enhancing Undergraduate Engineering Education through Meaningful Assistive Device Design
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Part I) Nontechnical Description

This grant provides first-year and senior engineering students at the University of Dayton meaningful design experiences that will directly improve independence and quality of life for individuals with disabilities in the Dayton-Cincinnati, Ohio region. Teams of students in engineering design courses at the University of Dayton will design assistive devices that address everyday needs of at least nine specific patients each year of the three year grant. These design experiences will be driven by needs identified by the occupational therapy staff at Kettering Health Network's NeuroRehab and Balance Center, an outpatient rehabilitation center that treats individuals with neurological disorders. Fully functional prototypes will be designed and tested to ensure usefulness. These designs may evolve to impact even more potential users as students are taught how to determine when universal design approaches versus individualized orphan/assistive device design approaches are appropriate. Rehabilitative engineering projects have been shown to appeal to students traditionally underrepresented in engineering, making this project important in the recruitment and retention of female and minority students. This project maximizes this impact by carrying out a portion of the design activities in an existing all-female first-year design course. Throughout the project first-year and senior students will be brought together for shared learning and supporting activities, enabling opportunities for mentoring and community building. The grant efforts also include the development of curriculum modules that will help students understand how to make engineering design decisions based on disability-related considerations, as well as the advantages of designing in a team where diversity of thought and experience is present. The outcomes of this grant will be disseminated broadly through professional society workshops and publications so that other instructors nationwide can adopt similar educational approaches that incorporate a focus on assistive device designs. The students engaged in these efforts will also assist in designing hands-on assistive device design challenges that will be used to inspire K-12 students.

Part II) Technical Abstract

This grant leverages an existing and successful partnership between the University of Dayton (UD) and Kettering Health Network (KHN) to enhance undergraduate design education at both the first-year and senior capstone level. In this three year project, students will work in small teams in established UD courses to design assistive devices that meet the needs of local individuals affected by neurological disease. Occupational therapists from KHN's NeuroRehab and Balance Center will identify these needs and serve as sponsors of the project, overseeing student teams. The objectives of this grant are to: 1) Provide meaningful, real-world engineering problems in a project-based learning environment that allow participating students to gain a greater understanding of: the engineering design and innovation process as a framework for systematically approaching engineering design problems; the importance of purposeful and regular interactions between designer, client (sponsor), and user moving from identified need to functional, tested prototype; how to make engineering design decisions based on disability-related considerations; and the advantages of designing in a team where diversity of thought and experience is present. 2) Develop and disseminate undergraduate educational materials and other curricular elements to train students to: understand and appreciate disability as a continuum of functional loss; determine when to utilize universal design approaches vs. assistive device/orphan technology approaches; develop and ask clarifying questions to assess patient need and functional abilities; make engineering design decisions based on disability-related considerations; and consider issues of manufacturing and marketing in advancing assistive device designs. 3) Improve quality of life for at least 9 patients with neurologic disease and disability annually, for each of the 3 years, through the development of clinician-driven assistive device design. This grant builds off demonstrated strengths and prior successes to enhance undergraduate engineering education, while directly improving the lives of individuals with neurological diseases. It has long been proposed that rehabilitative-type engineering design projects appeal to students traditionally underrepresented in engineering. This project will offer the unique opportunity to explore this, longitudinally, in an existing all-female Engineering Innovation class. It is envisioned that seeing how engineering can improve an individual's life through project-based learning will be a transformative engineering design experience that increases the likelihood of persistence in the field, especially for underrepresented minorities. Findings of this work and developed curricular resources will be disseminated broadly to provide others a framework for similar partnerships that bring real-world needs to engineering courses. Additionally, an educational outreach component will engage college students to inspire area K-12 students.