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Developing Interfaces for Rehabilitation: A Graduate Level Course for Students from Multiple Disciplines

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ABSTRACT
This paper describes the design of a graduate level course focusing on developing interfaces for purposes of rehabilitation, catering to students from multiple disciplines. Students work on projects relating to the needs of individuals with disabilities, under the supervision of internal and external mentors. The course has been designed to help students develop both research and mobile interface technical design skills. Course structure and deliverables are described, along with the challenges faced and lessons learned from multiple offerings of the course.

CCS Concepts
CCS → Social and professional topics → Professional topics → Computing education → Computing education programs.

Keywords
Accessibility; Graduate Course; Inclusive Design; Rehabilitation;

1. INTRODUCTION
A graduate level course entitled 'Developing Interfaces for Rehabilitation', offered through the Department of Information Systems at UMBC, provides an opportunity for students to focus in depth on rehabilitative and assistive technologies to better support users with diverse abilities. The course appeals to students from a range of disciplines including Human-Centered Computing, Computer Science, Psychology and Education, attracting those with professional or personal interests in designing for rehabilitation. In this paper, we describe the format of the course, skills which are developed, along with the lessons learned through offering the course. The aim is to offer guidance to instructors interested in teaching rehabilitative interface design to students from an array of educational backgrounds.

2. RELATED WORK
Courses have been developed to introduce computing and non-computing students to topics relating to universal access, disability, technology and society [6] and assistive technologies [11]. Best practices have been developed to support instruction (e.g., [8, 10]), either for targeted courses or integrated into the curriculum as a whole. These include providing real-world learning environments to students, exposing them to accessibility topics in multiple ways, and the need for instructor initiative to support learning [8]. However, opportunities exist for providing courses with a greater emphasis on rehabilitation or remediated initiatives, which may provide users with the skills to utilize assistive technologies.

3. COURSE DESIGN
3.1 Objectives, Topics and Course Structure
The objectives of the course developed at UMBC, are to (1) gain an understanding of the challenges faced by individuals with disabilities, and examine the ways that needs may change over time; (2) demonstrate an understanding of a functional approach to the assessment of rehabilitation and assistive technology needs; (3) apply design concepts to interfaces for rehabilitation. Topics covered include introductions to needs assessment, adaptive system and multimodal interface design, robotic, prosthetic and orthotic interventions, design for mobility, and ergonomic and workspace design. Weekly readings from texts such as Cook and Polgar [3], Cooper et al. [4] and other conference papers, are suggested to supplement each class.

Each class is divided into two sections, a lecture component, followed by an interface design practical. Lectures focus on the ways in which technologies can be designed to support users with disabilities. These are often interspersed with in-class activities to consolidate knowledge gained from the lecture. Students learn to use drag-and-drop style mobile prototyping tools (MIT AppInventor 2 [7]) by following a set of tutorials, with a view to applying skills developed to the design of a mobile rehabilitative game as part of a final project. Although programming experience is advantageous, students without experience are welcomed.

3.2 Guest Lectures
Similar to the best practices identified in [8], lectures from subject-matter experts complement the course by providing alternative perspectives on ways to support rehabilitation. Examples include (1) rehabilitation engineers from local organizations, such as V-Linc [9], who cater to the needs of users for whom off-the-shelf products may not support; (2) clinicians specializing in physical medicine and rehabilitation (physiatry) to provide an overview of the ways in which they work in concert with other professionals (e.g. speech therapists, occupational therapists) and rehabilitation designers to support individuals with disabilities; (3) educational technologists to discuss evidence-based instructional practices and technical solutions to support learning in K-12 environments for children with emotional and learning disabilities. Students are able to gain an insight into the strategies adopted by professionals and identify ways to position themselves, should they wish to pursue careers in these areas.

3.3 Mentorship for Projects
Prior to the beginning of the course, applications are solicited for external mentors to set and supervise group-based projects. External mentors include educational specialists, speech therapists, occupational therapists, and physiatrists from the local area. Students meet with external mentors three times either face-to-face or remotely per semester to discuss progress. Internal

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mentors are also recruited who can offer day-to-day guidance relating to techniques for interface design or evaluation.

3.4 Course Deliverables

- **Individual reports**. Students address a research question through evidence from scholarly papers. Research questions relate to topics such as technologies to assist the rehabilitation of stroke survivors, supporting skill development among individuals with disabilities etc. The aim is to equip students with skills in critically analyzing papers relating to rehabilitative interventions.

- **Semester-long group projects** relate to designing rehabilitative solutions (e.g. games to support improvements in behavior, strengthen word building skills, prompting solutions for daily living tasks, apps to support/promote movement of joints and muscles). Deliverables include a **detailed report** describing the design and evaluation of a mobile game, and a **poster** summarizing the research conducted. This is presented at an event, to which mentors and members of the campus community are invited. Students are able to practice disseminating their research at the event.

4. OPPORTUNITIES

- The course attracts a small number of students with disabilities, in addition to students with experience of working in rehabilitation environments. **Leveraging student experience** to offer insights into rehabilitative practices has been found valuable to foster discussion within the class.

- Students have been able to **continue the relationship with their mentors**, extending their semester projects by conducting larger scale evaluations of interfaces. These have led to a range of publications [2,5], and helped to inspire the development of outreach activities [1]. The partnership with mentors allows students not only to **focus on a topic of interest which may not be covered in depth** due to issues of time, but also allows the university to maintain **links with organizations and community groups** in the local area.

5. LESSONS LEARNED

- **Managing mentor's expectations for the project.** It is made clear from the outset, that due to the relatively short duration of the course, students will likely be able to deliver a functional prototype of a system, not a final, polished version. Projects can be extended into independent studies/theses, where more time can be invested into design and evaluation.

- **Recruitment of subjects**. A class IRB protocol is submitted prior to the beginning of the semester. Students are able to familiarize themselves with the ethical considerations in order to conduct studies. Due to the restrictive nature of the protocol, coupled with logistical issues recruiting disabled users, testing is conducted with individuals without disabilities. To gain greater exposure to the needs of individuals with disabilities, approaches similar to those of [6] will be adopted, where the technical interactions of disabled users from videos sourced from video-sharing sites (e.g. YouTube) can be analyzed.

6. CHALLENGES FACED

- **Difficulties performing usability studies with children.** Projects suggested by educational specialists from K-12 environments have been difficult to evaluate with their own students aged below 18. Mentors are asked to have IRB protocols in place at their own institution to expedite the process of testing with target user groups.

- **Mobile prototyping alternatives.** While students with programming knowledge may favor developing gaming interfaces using different languages/tools, challenges can be faced by those with limited programming experience. Alternative tools are suggested to design interactive prototypes (e.g. Axure, Balsamiq, JustInMind).

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