An Interdisciplinary Assistive Technology Minor

Richard C. Simpson[1]

[1]*Duquesne University (Pittsburgh)*

ABSTRACT

We have implemented a pre-professional specialization in assistive technology for undergraduates. Duquesne's Minor in Assistive Technology prepares students to design and fabricate assistive technologies and provide assistive technology services. The minor combines coursework from Occupational Therapy, Biomedical Engineering and Special Education. Students learn cardboard carpentry, computer-aided design and 3D printing, electronics and programming skills.

INTRODUCTION

Duquesne University's Minor in Assistive Technology, in combination with a student's chosen major, prepares students to design and fabricate assistive technologies and provide clinical assistive technology services. The minor is an inter-disciplinary program that combines coursework from Occupational Therapy (OT), Biomedical Engineering (BME) and Special Education. The minor was designed based on the following constraints:

- The courses within the minor need to attract enough students that they can be offered on a regular basis.

- The minor is intended for students from Occupational Therapy and Biomedical Engineering, so the courses cannot assume too much OT-specific or engineering-specific knowledge on the part of the students.

- The minor needs to accommodate the course schedules for students in OT (most flexibility in years two and three of a five-year program) and BME (most flexibility in year four of a four-year program) and University requirements (e.g., all courses must be completed before the end of students' fourth year - when students' Bachelor's degrees are conferred).

All of this ruled out a minor that looked like a post-professional certificate or Master's degree, with separate courses focusing on topics like wheeled mobility, computer access, or job accommodations. Instead, the minor was designed around the following outcomes:

- Give students the knowledge and skills necessary to integrate assistive technology within their own field of study.

- Expose students to multiple areas of assistive technology, to encourage some to pursue additional training to become rehabilitation engineers or assistive technology professionals (ATPs).

- Teach students how to design and fabricate devices so that, once their discipline-specific training is layered on top, they feel comfortable configuring, modifying and combining existing solutions and fabricating new solutions for individuals with disabilities.

APPROACH

The Minor in Assistive Technology requires 15 credits of classroom and laboratory work. Table 1 shows the course sequence for students in OT and BME. The "core" of the minor consists of three courses that teach students about designing and prototyping technology using assistive technology as motivating examples [1, 3]:

- Fabrication Of Assistive Technologies: Hardware (3 credits) exposes students to assistive technology concepts in seating and positioning, computer access, and orthotics and prosthetics. Students learn to fabricate assistive technologies using cardboard carpentry, computer-aided design software and 3D printing.

- Fabrication Of Assistive Technologies: Software And Electronics (3 credits) teaches assistive technology concepts in cognitive aids, augmentative communication, and electronic aids to daily living. Students learn to fabricate assistive technologies using mobile computing devices (e.g., smartphones, tablets), microprocessors, sensors and actuators.

- Fabrication Of Assistive Technologies: Studio (3 credits) requires students to combine the skills they learned in the previous courses to design and fabricate assistive technologies intended for general use or for specific individuals in the community.

Grading in all three courses is project-based. Unlike many project-based courses focused on assistive technology (e.g., [4,5]), students do not design solutions for specific consumers. The first two courses in the sequence are intended to teach a range of technical skills and the studio course is intended to let students choose one or more technical areas (e.g., programming, electronics, cardboard carpentry, computer-aided design) in which they want to deepen their understanding. Students identify the skills they want to develop and then specify and plan their own projects (with assistance from the instructor) and complete them either individually or in groups.

Students are also required to take two additional courses that focus on commercially-available assistive technologies. These courses emphasize issues like the assessment process, funding, integrating multiple assistive technologies, and clinical documentation:

- Environmental Adaptations and Rehabilitation Technology (3 credits) covers assessment and modification of the environment to increase function and independence. Topics include assistive technology, home modification, and environmental accessibility.

- Foundations of Inclusive Educational Practice (3 credits) focuses on inclusive educational practice as it relates to the principle of least restrictive environment. Students learn to develop instructional supports for students with diverse learning and behavior needs based on individualized assessments.

Table 1. Course sequence for students in OT and BME

Semester	OT	BME
Year 2 Spring	Foundations of Inclusive Educational Practice	
Year 3 Fall	Fabrication Of Assistive Technologies: Hardware Fabrication Of Assistive Technologies: Software and Electronics	
Year 3 Spring	Fabrication Of Assistive Technologies: Studio	Foundations of Inclusive Educational Practice
Year 4 Fall		Fabrication Of Assistive Technologies: Hardware Fabrication Of Assistive Technologies: Software and Electronics
Year 4 Spring	Environmental Adaptations & Rehabilitation Technology	Fabrication Of Assistive Technologies: Studio Environmental Adaptations & Rehabilitation Technology

DISCUSSION

As shown in Table 2, student evaluations of the design courses have been overwhelmingly positive. In its first year (the 2018-2019 academic year), twelve OT students and one BME student took at least one course within the minor and eleven OT students completed all the courses required for the minor. In the current academic year, four OT students and one BME student took at least one course within the minor.

Table 2. Responses to Student Course Evaluation Surveys

Semester/Year	Course	N	Avg Rating (out of 5)
Fall 2018	Fabrication Of Assistive Technologies: Hardware	13	4.62
Fall 2018	Fabrication Of Assistive Technologies: Software and Electronics	12	4.60
Spring 2019	Fabrication Of Assistive Technologies: Studio	8	5.00
Fall 2019	Fabrication Of Assistive Technologies: Hardware	5	4.99
Fall 2019	Fabrication Of Assistive Technologies: Software and Electronics	5	5.00

One goal that has been achieved is teaching OT students about technology development [6]. Examples of projects completed by OT students for the studio course include:

- One-handed scissors fabricated with a combination of cardboard carpentry and 3D printing.

- A device that uses a force sensor and microprocessor to prompt someone to perform periodic pressure relief after a pre-determined amount of time without movement observing.

- A smartphone app that connects via Bluetooth to a wireless display to provide real-time transcription for individuals who have an auditory impairment.

- An attachment for a rollator that uses a sonar sensor to trigger a laser that displays a line on the floor that an individual with Parkinson's Disease can "step over" as a means of initiating movement.

- A smartphone app that provides a simplified interface for making phone calls and sending text messages. This app was selected as a winner of the LiveWell RERC Student App Challenge in 2019[1].

ACKNOWLEDGEMENTS

REFERENCES

[1] Cohen, H. (2016). Assistive Technology: An Occupational Therapy Perspective on the Importance of Making, Inclusion, and Use. *SIS Quarterly Practice Connections*, 1(4), 23-25.

[2] Morgan, M., & Schank, J. (2018). Making it Work: Examples of OT Within the Maker Movement. *OT Practice*, 23(14), 19-22.

[3] Porco, K., & Salinas, S. (2014). Applying 3D printing to occupational practice. *OT Practice*, 22(14), 17-19.

[4] Barbareschi, G., Holloway, C. S. M., & Sprigle, S. Assistive Technology Design Courses: The Mutually Beneficial Relationship between Engineering Education and the Provision of Orphan Devices. In J Anschutz & R Pagadala (Ed.), *Proceedings of the RESNA 40th Annual Conference*. New Orleans: RESNA Press; 2017.

[5] Goldberg, M. R., & Pearlman, J. L. (2013). Best practices for team-based assistive technology design courses. *Annals of Biomedical Engineering*, 41(9), 1880-1888.

[6] Proffitt, R., Schwartz, J. K., Foreman, M., & Smith, R. O. (2019). Role of Occupational Therapy Practitioners in Mass Market Technology Research and Development. *American Journal of Occupational Therapy*, 73(1), 7301347010p1-7301347010p6.

---

[1] http://www.livewellrerc.org/news/2019/6/19/2019-student-app-challenge-winners-announced