# Diversifying Accessibility Education: Presenting and Evaluating an Interdisciplinary Accessibility Training Program

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## ABSTRACT

There is a growing emphasis to educate STEM students about accessibility, so that they can become accessibility advocates. We introduce a community-based accessibility training program that brings together graduate students in STEM and related fields, called the Research and Education in Accessibility, Design, and Innovation (READi). Going beyond academic degree training, this program includes five training components: (1) a graduate course on accessibility and inclusive design, (2) an Action Team Project (ATP), (3) a Retreat, (4) Workshops, and (5) a Symposium. As our initial program assessment, we analyzed 22 students' written program reflection and found three themes that highlight what students learned about accessibility and professional skills (Theme 1: Learning Outcomes), what students planned on doing after the training (Theme 2: Future Endeavors), and how students want the program to improve (Theme 3: Program Improvement). We advance accessibility education by introducing an innovative training that embraces collaboration among local community, faculty, and multidisciplinary cohorts of graduate students.

## CCS CONCEPTS

• **Social and professional topics** → Professional topics; Computing education.

## KEYWORDS

Accessibility, Experiential learning, Graduate students, Assessment, Inclusive design

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## 1 INTRODUCTION

There is a growing demand for employees with accessibility knowledge and skills [17]. Pressure is placed on academia to provide a supply of accessibility talents who understand the needs and preferences and abilities of one billion people worldwide who have a disability [2, 19]. As a result, many computing educators have proposed various approaches to teach accessibility. But these approaches offer limited hands-on experience [1, 11].

In this paper, we describe our accessibility training program called the Research and Education in Accessibility, Design, and Innovation (READi). It aims to prepare graduate students in STEM and related disciplines for roles that influence accessibility (e.g., web developer, quality assurance analyst, accessibility engineer). We also evaluate the effectiveness of the program by asking the following research questions:

**Research Question 1 (RQ1):** Has READi achieved its program objectives?

**Research Question 2 (RQ2)**: How can READi improve to support student learning?

READi students documented their overall reflection about the program in an online portfolio. As our initial assessment, we conducted thematic analysis on 22 students' reflection and we report on three themes relevant to our RQs.

Our main contribution is building a pedagogical culture for accessibility education. READi is innovative in several ways. First, it embraces a community-engaged pedagogy in which local community organizations and faculty who are accessibility experts collaborate to support graduate students. Second, it trains multidisciplinary cohorts of graduate students from STEM and related disciplines and it encourages students to learn from each other's expertise. As prior approaches have been mostly dedicated to undergraduate students [8, 18], READi can become a reference point for educators who wish to teach graduate students about accessibility.

# 2 RELATED WORK

## 2.1 Accessibility Education in Computing Disciplines

There is a growing effort to create an inclusive and accessible society. Many regulations that mandate government, businesses, and nonprofits to remove and prevent accessibility barriers in all facets of society have been passed [5].

However, evidence suggests many professionals lack such knowledge [17]. The resulting outcome is a continual marginalization of persons with disabilities who cannot use many products and services [2, 15]. Given this, accessibility advocates have raised the importance of incorporating accessibility at all levels of education to make lasting shift towards the culture of accessibility [7]. If more students get exposure to accessibility-related topics, the more likely they will appreciate user diversity when they enter the workforce [2, 7].

In computing disciplines, much focus has been on educating undergraduate students and the most common method used to teach accessibility is incorporating accessibility topics and activities into existing courses. Wang [18] embedded accessibility-related topics (e.g., embedding accessible audio and video into a Web page) in an undergraduate multimedia and web design course. El-Glaly et al. [6] designed accessibility lab activities for undergraduate CS courses. Students go through each activity with "an emulation feature" meant to simulate a given accessibility condition. For instance, lab #1 teaches about visual impairment; students play a game as they normally would. Then, with an emulation feature, they go through the same game where the text is blurred to simulate what a person with a visual impairment would experience. Then students re-designed the game to be more inclusive.

Computing educators have also created standalone accessibility courses. In such course students partake in a semester-long project and build accessible technologies for persons with disabilities [8, 11, 12]. For instance, Ludi et al. [16] described their education interventions in which IT and software engineering students worked with fellow students with disabilities or discuss their prototypes with persons with disabilities. Among the two methods, the latter has adopted the principles of the experiential learning theory, encouraging students to engage with new hands-on learning experiences and apply theory into practice. The design of our program is also grounded in this theory [8] and offers new experiences in different formats in all training components.

# 3 OUR TRAINING PROGRAM

## 3.1 A Program Overview

The Research and Education in Accessibility, Design, and Innovation (READi) offers an interdisciplinary solutions-oriented and experiential learning training. Students come from diverse STEM fields (i.e., mechanical and materials engineering [$n$=15], HCI/IT [$n$=9], biomedical engineering [$n$=9], CS [$n$=3]) and from humanities (i.e., music and culture [$n$=3], cultural mediations [$n$=2], history [$n$=1]) and design ($n$=14). Students follow their home degree program and concurrently participate in READi. Since 2017, READi has trained over 56 graduate students (41 master's and 15 doctoral students; 31 female and 25 male students). The program faculty is an interdisciplinary group spanning the department and schools ranging from fields of engineering to IT and CS, industrial design, medicine, and art and culture.

READi has five learning objectives. By the end of the program, students should be able to (1) apply inclusive design principles to ideate and create products, services, and environments accessible to people of all ages, gender, and abilities; (2) interact with people of all ages, gender, and abilities in their research; (3) recognize and empathize with persons with disabilities; (4) discuss accessibility from multiple perspectives; and (5) become a life-long advocate for accessibility.

READi has five training components, which can be completed in one year. Students can document their experience after participating in READi activities and their overall program reflection in an online portfolio.

## 3.2 Program Training Components

### 3.2.1 *Accessibility and Inclusive Design Course.*

This course is offered in the fall academic term to help students establish foundational knowledge. It introduces current and evolving perspectives on disability and accessibility that are relevant to taking a lead in bringing accessibility to the forefront in the areas of engineering, ICT, and design. Table 1 presents the recent course syllabus.

### 3.2.2 *Action Team Project (ATP).*

In the winter and summer academic term, students are organized into Action Teams (~4 members/team) with varying disciplinary backgrounds. Action Teams engage in an 8-month interdisciplinary learning experience, focused on 'real-world' accessibility issues, identified by an external community partner (hereafter, ATP group partners). Students employ co-design rather than a traditional designer-client relationship. They are not expected to solve complex accessibility issues; these issues are wicked problems which have no single solution and require students' exercise of creativity to arrive at possible solutions [4]. The intention is their ideas and concepts will help 'move the needle forward' and offer ATP group partners tangible insights for future studies and improvement. Table 2 provides past ATPs.

### 3.2.3 *READi Retreat.*

This is a two-day intensive learning experience, with ATP group partners and end-users. Prior to the pandemic, this was held in person in an accessible location in between two cities where universities are located. This occurs mid-way through the ATP. It has formal (e.g., an interim ATP progress report, workshops) and informal elements (e.g., social activities), which is important to promote affective learning. A lived experience testimony also accompanies the retreat. During the pandemic, we have shortened this to one-day with reduced informal social times.

### 3.2.4 *READi Symposium.*

This is held at the beginning of the Fall academic year and invite READi's entire network (e.g., new and current cohorts, faculty, partners and the general community). Action Teams deliver a presentation about the accessibility issue that was tackled, the knowledge and ideas that were developed, and their learning journey. Other activities include keynote speakers on lived experience and a panel discussion on accessibility (e.g., new legislation).

**Table 1: The course syllabus**

| Module | Topic | Module | Topic |
|---|---|---|---|
| 1 | Disability Awareness | 6 | Accessibility for Neurodiversity |
| 2 | Accessible and Inclusive Design Definitions and Terminology | 7 | Accessible Environments |
| 3 | Accessible Gaming | 8 | Prosthetic Technology |
| 4 | Accessibility in Blindness | 9 | Accessible Standards and Legislation |
| 5 | READi Symposium | 10 | Practicalities of Working with Users |

**Table 2: Illustrative examples of past ATPs**

| Group | Organization | Project Description |
|---|---|---|
| 1 | Organization A | The group investigated the barriers that people with autism face when accessing the museum and identified accessibility features that can facilitate their access. |
| 2 | Organization B | The group investigated how to improve the accessibility of the gallery website. They did not target for a specific disability or impairment to improve the accessibility for all. |
| 3 | Organization C | The group explored how the organization can best support young caregivers (of people living with dementia) and how to increase public awareness of such resources. |

*3.2.5 READi Workshops.* There are interactive workshops offered on a variety of topics, including web and document accessibility; design thinking; assistive and adaptive technologies; attitudinal barriers to accessibility; entrepreneurship; networking with industry and accessibility experts (government representatives, disability advocacy groups, and researchers). These workshops are offered by subject matter experts, including collaborators, and invited external specialists.

## 4 INITIAL PROGRAM ASSESSMENT

We chose to analyze students' overall program reflection (vs. their reflection on the Retreat), as we wanted to understand the overall program impact. There were 22 students (out of 56) who provided their overall program reflection and hence we analyzed these available reflections; these students were trainees in 2017-2020. The first author conducted thematic analysis using Braun and Clarke's guidelines [3]; she iteratively read through each reflection and assigned codes to selected paragraphs relevant to RQs. Each code captured the explicit content of the data using NVivo [13]. She them grouped the initial codes into three themes based on their shared relationships. Students' responses were straightforward and having multiple coders was not necessary [9]. Exemplar participant quotes are denoted by a letter P, followed by a random number and the year in which they started READi. Analyzing student course outputs is suitable for initial program assessment to identify student learning outcomes before engaging in stakeholder interviews [6].

### 4.1 Study Findings

We outline three themes and its subcategories (Figure 1).

**Theme 1: Learning Outcomes.** We found two main learning outcomes: (a) increased accessibility awareness and (b) enhanced professional skills. Participants ($n$=17) showed increased accessibility awareness, which we define at multiple levels. First, they showed empathy towards the challenges that persons with disabilities faced and became aware of accessibility barriers in their daily life: "we looked at how some updated metro stations in [a city name] hadn't carefully looked at how people with visual disabilities could navigate them. I find myself thinking about case studies like this while I travel around in my day-to-day life" (P14, 2018).

Participants understood the fundamental principles of inclusive design and the importance of incorporating end-users. For instance, "prior to this program I would look at engineering design as "How will I get this to work? How do I imagine myself completing this task?", but now I see design as intrinsically related to the user. I find myself asking questions like "Who will be using this? . . . What design criteria would the user demand?" (P9, 2018). Similarly, "I naturally start to think about making my designs accessible earlier on in the design process, and I've started to actively find and eliminate design elements that may be difficult for some people to use" (P22, 2019).

Second, participants ($n$=3) showed a changed mindset towards disability and focused on the strengths of persons with disabilities: "Doing the ATP at [the organization] and seeing how [they] could use computers faster than I could in some cases if they had the right technology really made me realize how accessibility is about changing mindsets and technology, not changing people" (P12, 2018). Participants also saw a disability as a "a catalyst for designing products/services in a more inclusive and creative way" (P19, 2019).

Third, participants ($n$=11) viewed accessibility from cultural, social, demographic and legislative perspectives and understood creating accessible products, services or environments was a multidisciplinary effort. For the ATP, participants worked with team

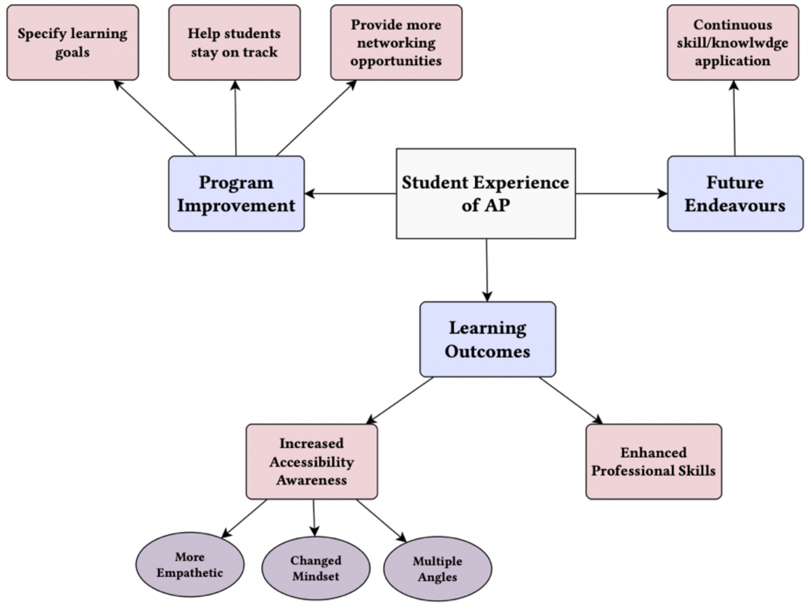


**Figure 1: Thematic relationship between each theme and its sub-categories**

members of different backgrounds, which forced them to step outside of their expertise. For instance, "I could barely imagine at the beginning how a history student could work together with engineers and inclusive designers. I['m] proofed wrong" (P17, 2019). Their appreciation for multidisciplinary effort towards accessibility was further facilitated by interaction with community partners, staff, and professors of various expertise, from the arts to engineering: "I think the program helped me to understand this issue by bringing together a diverse set of people from different industries who can come together to contribute to these challenges in different ways" (P14, 2018). Participants observed and learn from others through the ATP and accessibility and inclusive design course, including problem-solving approach and presentation skills.

Lastly, our analysis revealed that participants (*n*=8) developed professional skills, including team work, communication, and project management skills. For instance, "I also gained interpersonal skills and communication skills from working with the clients at [the organization name] by speaking with the clients I gained confidence and understanding of how people can use their various abilities to communicate" (P9, 2018).

**Theme 2: Future Endeavors.** Participants (*n*=18) said they plan on applying accessibility knowledge and skills in future projects: "My one goal for the future is to continue to apply the lessons I learned about accessibility to my engineering work, and to my role as a TA and teacher" and "For me, as an engineer, the goal to meet after this project is to keep in mind the principles of universal design for all my projects" (P13, 2018). Participants also said their learning journey will continue and showed a motivation to become an accessibility advocate: "I plan on finding employment in the area so that I can help continue advancements, acceptance and growth within the field of design relating to accessibility and inclusion" (P22, 2019).

**Theme 3: Program Improvement**. First, participants (*n*=4) wanted to receive a better guidance on the ATP. They wanted help defining tangible goals that needed to be met and help with becoming familiar with the ATP group partners' organizations. This desire may be due to unfamiliarity with how to do research: "There is an expectation that students are placed with their ATP partners and should understand the process of developing an accessibility design problem. . .many students may not have a lot of experience with this process" (P22, 2019).

Relatedly, it was clear that some participants (*n*=7) could benefit from getting help staying on track with the ATP. Participants struggled to prioritize the ATP over other commitments; they experienced delays with the ATP and did not accomplish as much as they had originally planned. As such, having guidance, either from faculty or having an ATP leader, can help students to work as a group (vs. working to meet an individual timeline).

Lastly, participants (*n*=6) wanted to have more opportunities to interact with others, including University B and C students and persons with disabilities: "more opportunities to interact with [persons with disabilities] and discuss their challenges and the solutions that they employ in their lives" (P14, 2018) and "get a better idea of what it's like being in [persons with disabilities'] shoes" (P20, 2019).

## 5 DISCUSSION AND CONCLUSION

To our RQ1, "has READi achieved its five objectives?" we have some confidence to say "yes, it has" based on the observation that each student in our study has gained at least one learning outcome that we have identified. These learning outcomes directly map onto each objective: students understood fundamental principles of inclusive design (which aligns with objective 1), interacted with diverse people, which resulted in their appreciation of multidisciplinary effort (objective 2), showed increased empathy towards persons with disabilities and an optimistic mindset towards a disability (objective 3), and viewed accessibility from multiple perspectives (i.e., cultural, social, and legislative perspectives) (objective 4), and many students (18 out of 22) planned on continuously learning about accessibility (objective 5). Eleven students explicitly said READi has met its objectives in their reflection, which boosts our confidence about the effectiveness of READi.

Our results regarding student learning outcomes confirm what prior studies have found [8, 11, 16]. This replication of results gives us additional confidence that READi is an equally effective pedagogical approach to teach accessibility as other forms of accessibility education interventions. We also found another learning outcome not reported in prior studies: enhanced professional skills, which are core skills valued in industry [14]. Participating in programs like READi with experiential learning components can equip students with accessibility knowledge *and* professional skills.

In our analysis, it is difficult to tease out the effect of individual training components on student learning outcomes since not all students made a connection between their perceived learning outcomes and each component. However, we can hypothesize that one component, sometimes in collaboration with other components, had greater impact on the development of particular skills and knowledge than others. For instance, students may have become more empathetic from participating in the ATP and the course (vs. the Symposium) since they had more interaction opportunities with the persons with disabilities in the former. Similarly, the course may have had greater impact on establishing students' knowledge on inclusive design over the Retreat, which provides more opportunity for social interaction and activities.

To our RQ2, "how can READi improve to support student learning?" some students said there needs to be a better guidance, especially with the ATP. This makes sense given the wicked problem nature of the ATP and wicked problems is associated with uncertainty about solution to problem [4]. However, it is our view that sometimes the experience in the uncertainty is what is needed, as many real-world accessibility issues are wicked. Computing educators can help graduate students embrace uncertainty, for instance, by having frequent group discussions about the nature of wicked problems. We analyzed student reflections from 2017 and we have revised the program each year. Our readers should interpret our results on program improvements with this in mind.

There are several limitations in our initial assessment. First, we analyzed 22 students' overall program reflection, which translates to 39% of a total program student population since 2017 (22 out of 56 students). While we analyzed all available portfolios, our results may reflect the experience of a limited number of students. Second, we are uncertain about the long-term effect of the program; other computing educators can consider conducing a longitudinal study. Third, we recognize the limitation related to establishing the validity of our findings. Involving multiple coders in thematic analysis can reduce the impact of individual biases, especially when one's thematic analysis includes numeric information [10]. We advise other researchers to adopt more rigorous validity techniques.

Despite the limitations, we hope that our work inspires computing educators who wish to adopt community-engaged and interdisciplinary pedagogy to teach accessibility to STEM graduate students.

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