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Building Curriculum for Instructors to Address OER Accessibility as STEM Librarians

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Abstract

In 2021, the Arthur Lakes Library at the Colorado School of Mines (Mines) developed the Accessibility Course for Education (ACE) to provide training on accessible course content for faculty creating Open Educational Resources (OER). The ACE curriculum includes an introduction to accessibility, best practices for designing various types of resources, and learning activities that help participants begin using their new skills. As a STEM institution, the course heavily focuses on accessibility related issues in STEM disciplines, such as mathematical equations, tables, graphs, and diagrams. This paper discusses the development of the ACE course curriculum and lessons learned while supporting accessible OER development in STEM disciplines. The paper concludes with areas for future development of the course, including expansion of STEM related content and incorporation of participant feedback to continue improving the course.

Introduction

Mines has been funded by the Colorado Department of Higher Education (CDHE) to build and sustain an Open Educational Resources (OER) development initiative on campus. The grant funding includes statutory requirements to make all materials created accessible and compliant with the Americans with Disabilities Act (ADA). Accessibility in OER aligns well with the purpose of OER, making access to educational resources more equitable. Nevertheless, buy-in for accessibility implementation poses a challenge. To better encourage and support accessible OER creation, the authors developed an open course that trains instructors on making their course materials more accessible. This training, called the Accessibility Course for Education (ACE), aims to equip instructors with introductory level skills and knowledge about accessibility best practices. This open course builds on accessibility guidelines, resources, and training from other institutions, including the California Community Colleges[1] and Pennsylvania State University.[2]

With the support of $118,000 of grant funding, the Arthur Lakes Library at Mines has facilitated a successful OER program that is now saving students approximately $620,000 annually.[3] Despite this success in student cost savings, the OER created under this program were not necessarily made accessible, which is essential for making educational resources equitable. The grant administrators' limited expertise and staff availability made it necessary to deploy a novel approach to address accessibility of materials. With the help of two graduate student fellows, ACE was built and launched.

This paper discusses the development of the STEM-focused portions of the ACE course curriculum, lessons learned while supporting accessible OER development in STEM disciplines and areas for future growth of the course. First, the paper discusses models used for and struggles in designing the course. Lessons learned include accessibility challenges inherent to STEM resources, lack of librarian competency in this area and special issues with STEM tools like LaTeX. The paper concludes with areas for future development of the course, including expansion of STEM-related content and incorporation of participant feedback to continue improving the course.

Literature review

Scientific literacy impacts politics, medical decisions, and countless other aspects of life. Mahadeo Sukhai, a visually impaired biophysicist, notes, "basic numeracy and scientific literacy are required the world over for full participation in society."[4] The United Nations' Universal Declaration on Human Rights specifies that education is a basic human right as is sharing in "scientific advancement and its benefits."[5] This 70-year-old declaration serves as the basis for the OER movement[6] and has been reaffirmed in recent years with the 2018 Berlin Declaration on the Human Right to Science in Education.[7] Under these declarations, the global population of people living with disabilities, around 15 percent or over 1 billion people and growing,[8] is entitled to equal access to science education as a basic human right.

Beyond human rights, a diverse STEM workforce is well understood to bolster scientific progress by providing diverse and unique perspectives.[9–11] According to the federal Interagency Working Group on STEM, accessibility in STEM fields should not be viewed as the "right thing to do" but rather as a valuable strategy to increase the talent and diversity of practitioners in the field.[12] Poor representation of disabilities in STEM has been identified as a significant barrier to successful navigation of higher education for students with disabilities.[4] Students with disabilities enter STEM fields in postsecondary education at about the same rate as the general population, yet their completion rates are lower.[13] According to the University of New Hampshire, 16.1 percent of people with disabilities between 25-34 attain a bachelor's or higher degree compared to 39.2 percent of people without disabilities in the same age range, a gap in achievement exceeding 23 percent.[14] Though the gap in achievement has remained relatively consistent between 2008 and 2019, due to population-wide increases in educational attainment over that same time, the proportion of people with disabilities achieving a bachelor's or higher has increased more than 64 percent.[14] With greater emphasis on inclusion, diversity, and changing demographics in higher education, instructors must create educational resources which accommodate and promote this change.

STEM resources pose unique challenges to accessibility. Maps, diagrams, and graphs are difficult to make accessible as they rely heavily on visual perception.[4] Practical components of STEM education, like labs and field work, also pose significant challenges to accommodation as

they often require observations that may not be perceptible to all students and frequently lack accessibility options for physical lab spaces and equipment.[4,15–17] To address the growing population of students with disabilities entering institutions of higher education, instructors must address challenges endemic to STEM resources. Explicit recommendations from instructors, a lack of access to STEM coursework, and poor accessibility of resources deter students with disabilities from considering STEM disciplines even prior to entering post-secondary education.[15,18–20] A lack of accessibility awareness among instructors is frequently considered the source of this problem.[4,15]

There is significant literature on strategies to effectively accommodate students with disabilities in a variety of academic fields including STEM disciplines.[15,18,21,22] Though many accessibility trainings exist, there are gaps in the literature with regards to effective strategies to train instructors on accessible OER creation.[23] Further, there are gaps in available accessibility trainings on resources specific to STEM disciplines. This case study seeks to fill such gaps.

Course overview

During the first year of the program (2019-2020) the campus OER Steering Committee recognized that many of the OER created did not meet the accessibility requirements for the state grant. The Committee also did not have the staff capacity to properly engage with faculty on campus about OER in general. To address this second issue, the OER@ Mines Champions course was developed, but the curriculum only briefly touched on accessibility[24]. Neither the Steering Committee nor the faculty creating OER had the expertise or time to ensure resources were accessible and ADA compliant. As a response to this need, and building on the success of the Champions course, additional funding was requested during the third grant cycle (2021-2022) to build an open accessibility course with special focus on challenges in STEM resources.

Through iterative design, a course was rapidly developed which equipped faculty with the skills and resources needed to create accessible and compliant OER materials for their courses. The Accessibility Course for Education (ACE) aims to 1) increase the knowledge of accessible design practices, and 2) to encourage conversations around accessibility. The course provides introductory modules on general accessibility topics and basic design principles. It also includes self-directed modules on specific issues for various types of resources or platforms, such as videos, Canvas pages, or equations. Each self-directed module includes an introduction to accessibility concerns for that type of content, methods to check resources, learning activities, and a short quiz to check understanding. Based on participant feedback, content was indexed according to which resource formats instructors wanted to use or for which disabilities they wanted to remediate course content. Participants could learn about resources to support students with a spectrum of visual, auditory, physical and cognitive accommodation needs.

The course curriculum relies heavily on previously existing materials from the California Community Colleges Accessibility Center[1] and Pennsylvania State University's guide, *Accessibility and Usability at Penn State,*[2] as well as feedback from stakeholders across campus. The target audience for the course is faculty at Mines creating OER, however it is open to the entire campus and to educators across the state to participate. The course is now also published as an OER in Canvas Commons, enabling adoption beyond Mines.[25]

ACE provides extensive information on accessibility issues found in STEM materials and addresses the specific challenges such materials pose for accessibility accommodation and remediation. Topics covered in the curriculum include proper color contrast, keyboard navigation, and multiple means of communication, such as including alternative text descriptions for graphs, maps, and figures. Additionally, ACE provides recommendations for audiovisual content; specifically, that instructors create visual representations of vocal information and vocal representations of visual information and avoid using flashing visuals or loud, unexpected, noises. The course also provides a robust set of math accessibility guides, which include recommendations and tools.

Significant feedback from the campus' teaching and learning center, disability support services, and faculty guided the course creators to develop a three-part structure for ACE. The three sections include:

1. An introduction to accessibility and Universal Design for Learning (UDL) and their context in higher education. This section is designed to provide participants with a basic understanding of needs for various disabilities and to encourage empathy.
2. Guides for various educational resource types commonly used in STEM education. Examples of guides include documents, tables, HTML, videos, and equations. This section is designed to provide guidance on putting UDL principles into practice.
3. Self-directed practice modules for various resource types. This section is designed to provide participants with opportunities to self-evaluate their knowledge.

To best support Mines faculty, the OER Steering Committee limited ACE coverage to tools that are free or licensed by Mines. For instance, while MathType is commonly used to input accessible equations into documents, it requires a license which Mines does not currently have. To bypass this, the OER Steering Committee decided to explore the full capabilities of EquatIO, a lightweight but powerful equation editor which the university licenses. Within ACE, exploration of this tool included the numerous input options ranging from handwritten text to an built-in equation editor and output options including images with alternative text, spoken text, and MathML. ACE also provides guidance on EquatIO's integration with Canvas, and Canvas' accessible equation editor.

MathML is a markup language, like XML, specifically designed for mathematical equations and compatible with screen readers. MathJax is a JavaScript library compatible with MathML, LaTeX and ASCIIMath markup. To provide participants with an opportunity to test their skills with equations, the course developers created a MathML document with MathJax, as well as one without MathJax to allow users to see how equations displayed in different browsers. Participants learned MathML allows screen readers to access equations and MathJax allows MathML to properly display in all browsers. The practice exercise instructions encourage participants to try using NonVisual Desktop Access (NVDA), a free screen reader, in documents with equations to see if this open-source software can properly handle what is on the page.

Lessons learned

The biggest success of ACE was the growth of OER accessibility awareness on campus. Through the course, the number of accessibility advocates and the level of expertise on campus increased. In addition, the process of developing and delivering the course enhanced the OER Steering Committee's expertise as the administrators of the institutional grant program. Prior to ACE, the Steering Committee lacked expertise and knowledge of accessibility standards and best practices in STEM. To adequately support ACE, the Committee needed to fully comprehend the accessibility toolkits they adapted and how these solutions work. This need translated to a considerable amount of time spent learning these tools, so the course facilitators were comfortable enough to be able to support discussion among participants. Fortunately, participants have also helped to inform the course developers' gaps in knowledge through their own exploration. For example, several participants investigated the accessibility options for LaTeX. Although these resources were frequently limited in functionality, this insight will help guide revisions of ACE prior to the launch of additional cohorts in summer 2022.

Additionally, ACE is itself an accessible OER[25] with STEM components. This project was reliant on adapting existing OER. As such, the course provided the course facilitators with firsthand experience of the value that open resources bring to education and strengthened their resolve for supporting open education. The creation of ACE provided many opportunities to improve the facilitators' understanding of STEM accessibility in the context of OER. As a result of this effort, the library's ability to support accessible OER creation in STEM disciplines has improved substantially.

Another success was the inclusion and participation of colleagues from other institutions of higher education across the state. Their perspectives broaden the Committee's understanding of accessibility needs. Although Mines is a STEM-focused institution, ACE aims to meet instructor needs across departments and the participation of non-STEM departments and institutions helped to ensure the course met these goals. ACE also served as a valuable exercise in building inter-institutional accessibility awareness and opening lines of communication between OER and

accessibility advocates around Colorado. Feedback received from participants will help guide the future direction of ACE as well as the OER program at Mines.

Despite numerous successes, course development faced challenges. OER Steering Committee members lacked expertise on accessibility in STEM, which proved to be the greatest challenge of developing ACE. To overcome this, the group relied on existing open coursework, faculty expertise, and feedback to revise and add content to the course to best suit the needs of Mines' STEM-focused community. Course facilitators needed to learn about accessibility topics and tools, in addition to navigating the limited accessibility options for many types of STEM resources. For example, content related to LaTeX is essential, but few accessibility resources related to this format exist. Complex maps, graphs, and diagrams also lack adequate automated means of accessibility implementation, making remediation a daunting task for resource creators. The best support ACE can provide for visual resources is recommendations and tools to facilitate adequate contrast and instructions for implementing alternative text descriptions. The primary focus of the course was digital resource accessibility, but accessibility of physical resources became a recurring topic of concern among course participants. We aim to better explore this topic prior to facilitating the next cohort in summer 2022.

Another challenge encountered during the course development was the ephemeral nature of technological tools. Prior to initial course enrollment, many of the materials adapted for ACE needed to be rewritten to include up-to-date information, graphics, wording, and links. Updating content is expected to pose a continued challenge to maintaining this resource. For the next CDHE OER grant funding cycle, the campus OER Steering Committee requested a graduate student assistant with the explicit purpose of supporting ACE. With this continued support, the course will stay current and relevant to instructors at Mines and beyond. Adoption and adaption of ACE elsewhere will further sustain currency of content.

The instructors solicited feedback, before, during and after the course to better understand what was and was not working with regards to content and course design. This feedback is currently being evaluated and will be incorporated into future facilitated sessions and iterations of ACE as uploaded to Canvas Commons.

Conclusion

The development of the ACE course, especially the STEM-focused components, has contributed greatly to Mines' local knowledge and expertise about accessibility and specific issues associated with STEM tools and resources. The OER Steering Committee will continue to explore the literature and rely on participant feedback to modify ACE to meet the evolving needs of Mines and Colorado teaching communities. Awareness of accessibility issues is growing, especially in STEM, and new progress is being made all the time to support students and instructors. ACE is a

living resource, which the Committee intends to update and modify as the course continues to be facilitated.

Our examination of the efficacy of this course relates exclusively to self-reported increases in knowledge of accessibility. Future areas of study might include an examination of resources produced by instructors who have completed ACE to evaluate how lessons learned were applied. The work produced by ACE participants in their respective fields can contribute greatly to OER accessibility and help to alleviate lingering issues across STEM disciplines and beyond.

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