



Building Capacity to Increase the Participation of People with Disabilities in Computing

Proceedings of an *AccessComputing*
Capacity Building Institute

December 5 – 7, 2016
Seattle, Washington



Proceedings of the December 2016 AccessComputing Capacity Building Institute (CBI)

The *Alliance for Access to Computing Careers (AccessComputing)* coordinates multiple activities to increase the participation of people with disabilities, including veterans, in computing and information technology (IT) postsecondary education and career fields. *AccessComputing* is led by the Department of Computer Science and Engineering, the Information School, and the DO-IT (Disabilities, Opportunities, Internetworking, and Technology) Center at the University of Washington (UW) and is funded by the Computer and Information Science and Education (CISE) program of the National Science Foundation (grant #CNS-1042260, CNS-1539179).

This publication shares the proceedings of Building Capacity to Increase the Participation of People with Disabilities in Computing, an *AccessComputing*-sponsored CBI that was held December 5 – 7, 2016 in Seattle, WA. The content may be useful for people who

- were participants in the CBI,
- are people with disabilities interested in computing fields,
- are computing educators,
- are disability service and career service providers in higher education,
- are motivated to engage in an electronic community to discuss these issues, and/or
- have promising practices to share with others.

About **AccessComputing**

AccessComputing works to increase the participation of people with disabilities in computing and IT fields. Institutional and organizational partners apply evidence-based practices to

- increase the number of students with disabilities successfully pursuing degrees and careers in computing fields;
- increase the capacity of postsecondary computing departments to fully include students with disabilities in computing courses and programs;
- increase the capacity of employers to recruit and retain employees with disabilities in computing-related employment;
- encourage computing educators to teach about accessibility and universal design in the computing curriculum;
- create a nationwide resource to help students with disabilities pursue computing fields; and
- help computing educators and employers, professional organizations, and other stakeholders develop more inclusive programs and share effective practices nationwide.

AccessComputing institutional partners are Auburn University, Carnegie Mellon, Clemson University, Cornell Tech, DePaul University, Gallaudet University, Georgia Institute of Technology, Haverford College, Indiana University-Purdue University Indianapolis, Landmark College, National Technical Institute for the Deaf, New Mexico State University, North Carolina State University, Northwestern University, Old Dominion University, Portland State University, Rochester Institute of Technology, Texas A&M University, Towson University, University of Alabama, University of California Irvine, University of California Santa Cruz, University of Colorado Boulder, University of Iowa, University of Maine, University of Maryland, University of Maryland Baltimore County, University of Nevada Las Vegas, University of Nevada Reno, University of Portland, University of Puerto Rico Rio Piedras, University of Washington, and Washington State University.

AccessComputing organizational partners are the Alliance for Students with Disabilities in Science, Technology, Engineering, and Mathematics (AccessSTEM); the Anita Borg Institute; the Center for Minorities and People with Disabilities in Information Technology (CMD-IT); the Computer Science Teachers Association (CSTA); the Computing Alliance of Hispanic-Serving Institutions (CAHSI); the Computing Research Association (CRA); Expanding Computing Education Pathways (ECEP); the Institute for African-American Mentoring in Computing Sciences (iAAMCS); Into the Loop; the National Center for Women and Information Technology (NCWIT); the National Girls for Collaborative Project (NGCP); and the STARS Computing Corps.

AccessComputing industry partners are companies that are working to make the technical workplace more welcoming and accessible to computing professionals with disabilities. Companies learn about strategies that can be successful in recruiting and retaining employees with disabilities. Industry partners include Lawrence Livermore National Labs, Microsoft, Yahoo!, and Salesforce.

AccessComputing engages with project partners by

- conducting CBIs focused on increasing the participation of students with disabilities in computing and IT academic programs and careers,
- sharing the results of the CBIs with other institutions and individuals who serve students with disabilities,
- providing an electronic forum to continue discussion of issues for students, including veterans, with disabilities and increase services and supports for these students, and
- extending resources to other programs and promising practices via an online searchable Knowledge Base.



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About the CBI

Its focus was on making classes, departments, and organizations more welcoming and accessible to students with disabilities and encouraging educators to include accessibility in the computing curriculum. This CBI was a hands-on, project-oriented workshop, where participants created resources to share with colleagues and students.

Attendees included computing faculty members and graduate students, computing students and professionals with disabilities, disability services professionals, and industry professionals from across the country. Sessions shared information on broader subjects such as accommodations and universal design, IT accessibility, and the experiences of individuals with disabilities, as well as presentations on specific outreach activities, strategies for making courses welcoming, and methods for teaching accessibility.

The CBI also facilitated discussions between participants. The CBI provided a forum for discussing access challenges, sharing expertise and successful practices, developing collaborations, creating resources, and identifying systemic change initiatives relevant to the meeting's goals.

Topics discussed included

- the experiences of computing students with disabilities,
- challenges in increasing the participation of students with disabilities in computing,
- strategies to increase accessibility content in computing curriculum, and
- best practices for making departments welcoming and accessible to students with disabilities.

The agenda for the CBI and summaries of the presentations, panels, and working group discussions are provided on the following pages.



CBI Agenda

Monday, December 5

7 – 9 Networking Reception

Tuesday, December 6

8 – 9 Breakfast and Networking

9 – 9:30 Welcome and Introductions
Richard Ladner, Sheryl Burgstahler, Amy Ko, and Jacob Wobbrock,
University of Washington

9:30 – 9:45 Video – Leading the Way: Computing Students and Professionals with Disabilities

9:45 – 10:20 People with Disabilities in Computing
Richard Ladner

10:20 – 11 Accommodations and Universal Design
Sheryl Burgstahler

11:15 – 12:15 Panel of Computing Students with Disabilities
Panelists: Cameron Cassidy, Vincent Martin, Jessie Zhang, and Anna Marie Golden

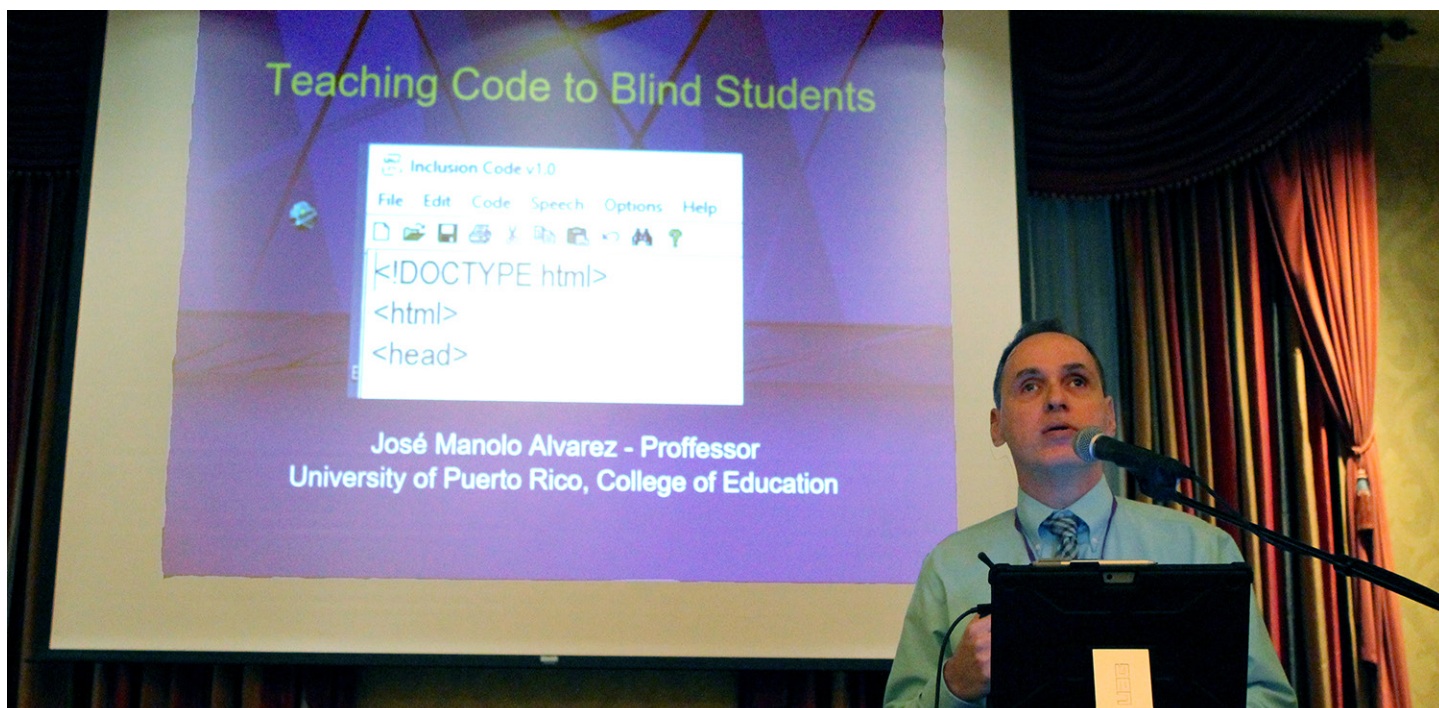
Moderator: Brianna Blaser, UW

- 12:15 – 1:00 Discussion During Lunch
At your table, share your institutions' challenges in increasing the participation of students with disabilities in computing.
- 1:15 – 1:45 Report Out
- 1:45 – 3:15 Short Presentations – Teaching about Accessibility
- Teach Access – Matt May, Adobe
 - “The Accessibility Lecture”: Should We Teach Accessibility as a Standalone Topic or Integrate Disability Throughout the Course? – Shiri Azenkot, Cornell University
 - How Designing for Users With and Without Disabilities Shapes Student Design Thinking – Kristen Shinohara, UW
 - UW Accessibility Capstone Course – Anat Caspi, UW
 - Improving a Web Accessibility Class Curriculum – Anna Marie Golden, UW
- 3:35 – 4:45 Presentation and Discussion: How can we include topics of accessibility in the computing curriculum?
Amy J. Ko, UW
- 4:45 – 5:00 Preview of Dinner Tonight and Tomorrow's Topics
Complete Daily Feedback Form
Pose for Group Picture
- 6 – 7:30 pm Dinner
Discussion: What can be done to make computing classes and departments more accessible to students with disabilities?

Wednesday, December 7

- 8 – 9 Breakfast and Networking
- 9 – 9:15 Daily Overview
- 9:15 – 10 Discussion in Small Groups to Develop Solutions
Considering the barriers that were discussed yesterday over lunch and dinner, identify concrete, actionable solutions that institutions might implement to overcome these barriers. Develop prototypes of these solutions.
- 10 – 10:30 Report Out
Share the solutions that you developed this morning. How can these plans be further developed? How can we encourage institutions to adopt these sorts of plans?

10:45 – 12	<p>Short Presentations – Working with Students with Disabilities</p> <ul style="list-style-type: none"> • Including Students with Disabilities in Summer Programs – Sarah Lee, Mississippi State University • Multi-Modal Lecturing Helps All to Learn – Vincent Martin, Georgia Tech • Teaching Coding to Blind Students – Jose Alvarez, University of Puerto Rico • Accessible Presentations – Kyle Rector, University of Iowa • Runestone Interactive – Jeff Rick, Georgia Tech
12 – 1	<p>Resource Production & Lunch: Individually or in groups, develop resources related to our discussions. This could include</p> <ul style="list-style-type: none"> • potential promising practices, Q&A's, or case studies for our knowledge base; • a 1 to 2 page handout about teaching accessibility; or • modules related to teaching accessibility.
1 – 1:30	Report Out
1:30 – 2:45	Continue Development of Resources
2:45 – 3:30	<p>IT Accessibility: What Your Institutions Are Doing, and How You Can Help</p> <p>Terrill Thompson, UW</p>
3:30 – 4	<i>AccessComputing</i> Resources
4 – 4:30	<p>Discussion: How can we continue to work together to promote the participation of people with disabilities in computing and the inclusion of information related to disability, accessibility, and universal design in the computing curriculum?</p> <p>Evaluation</p>



Presentation Summaries

People with Disabilities in Computing

Presenter: Richard Ladner

Computing fields need more people with disabilities because their expertise and perspectives spark innovation. By increasing access to include more people with disabilities in postsecondary and workplace settings, we allow a substantial group—15 percent of the world’s population—the ability to participate and create these innovations. Though there are many people with disabilities already succeeding in computing education and careers, these numbers are still much lower than their representation in the general population.

The World Health Organization defines disability not as a health problem, but by an individual’s ability to interact with the environment and the social barriers that prevent these individuals from fully participating in society. While K-12 education in the US has made great strides in including people with disabilities, only ten percent of college students and four percent of graduate students have disabilities.

Innovations that allow access to people with disabilities often become technology utilized by the wider population. Examples of this include personal texting, speech recognition, and video chat. Personal texting and picture phone were both originally created in the 1960’s for deaf people to communicate over distances; speech recognition was originally created for people who could not type easily. Many people now use these technologies daily (e.g., iOS’s Siri). Disability and technology innovation are intertwined, and more mainstream technology products have accessibility features built-in.

Barriers to access can be attitudinal as well as physical. Throughout the years, people with disabilities have been excluded, institutionalized, and eventually accommodated, which is still a reactive approach. We encourage a universal design mindset, a proactive approach that considers the needs of all people with varying levels of abilities from the beginning stages of design. This can include having multiple options so each student can learn and interact in the method that works best for them, as well as information technology that works with a wide range of assistive technologies.

Accessibility should be taught in all computing classes. Within the computing industry, there is demand for this knowledge and the innovation results from being proactive with regards to accessibility. Many companies are now requiring their employees to know accessibility principles and best practices. ABET, which sets the standards for engineering departments, now includes accessibility in their criteria.

To learn more about teaching accessibility, visit teachaccess.org. To learn more about various students with disabilities already studying and working in the computing field, visit the ChooseComputing profiles at www.uw.edu/accesscomputing/resources/choosecomputing/profiles.

Accommodations and Universal Design

Presenter: Sheryl Burgstahler

Ability exists on a continuum, where all individuals are more or less able to see, hear, walk, read print, communicate verbally, tune out distractions, learn, or manage their health. In K-12 education in the United States, every child is ensured a free, appropriate education in as integrated of a setting as possible. However, in postsecondary education, students must meet whatever course or program requirements apply and are offered reasonable accommodations as needed.

Accommodations and universal design (UD) are two approaches to access for people with disabilities. Both approaches contribute to the success of students with disabilities in computing classes. Accommodations are a reactive process, providing access for a specific student and arise from a medical model of disability. Students might be provided with extra time on tests, books in alternate formats, note takers, sign language interpreters, or other adjustments.

In contrast, UD is a proactive process rooted in a social justice approach to disability and is beneficial to all students. UD is designing products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. A UD approach can benefit people who face challenges related to socioeconomic status, race, culture, gender, age, language, or ability.

UD of instruction is an attitude that values diversity, equity, and inclusion. It can be implemented incrementally, focuses on benefits to all students, promotes good teaching practice, does not lower academic standards, and minimizes the need for accommodations. UD can be applied to all aspects of instruction, including class climate, interactions, physical environments and products, delivery methods, information resources and technology, feedback, and assessment. Examples include the following:

- Arranging seating so that everyone has a clear line of sight.
- Avoiding stigmatizing a student by drawing undue attention to a difference.

- Using large, bold fonts with high contrast on uncluttered overhead displays and speak aloud all content.
- Providing multiple ways to gain and demonstrate knowledge.
- Avoiding unnecessary jargon; defining terms.
- Providing scaffolding tools (e.g., outlines).
- Providing materials in accessible formats.
- Providing corrective opportunities.
- Testing in the same manner in which you teach.
- Minimizing time constraints as appropriate.
- Designing websites to include text alternatives for graphics, present context via text and visuals, include captions and transcripts for all video and audio content, ensure that all content and navigation can be reached with the keyboard alone, and spell out acronyms.

Educators who effectively apply UD and provide accommodations level the playing field for students with disabilities and make instruction welcoming to, accessible to, and usable by all students. They minimize, but do not eliminate, the need for accommodations.

Presentation and Discussion: How Can We Include Topics of Accessibility in the Computing Curriculum?

Presenter: Amy J. Ko, UW

When we talk about curricular change, it can start with an instructor changing how they teach a course. However, this change doesn't just happen out of nowhere—it comes from faculty members thinking about what to teach their students and finding better ways to educate. There are many barriers to change, including curriculum that doesn't need updating, faculty not having enough time, no room for more topics in the class, no room for more classes in the curriculum, or instructors who don't have the expertise to teach a particular topic, like accessibility.

We hired three lecturers to teach Information 343: Client-Side Web Development, and I asked them to rework the existing curriculum to include accessibility. In order to do this, we trained these lecturers on web accessibility, and asked them to think of how they could include the information in their courses. Ultimately, one instructor realized they could redesign the lesson that covered markup to include information about web accessibility. This not only incorporated the information, but also served to make the lesson on markup more compelling. This instructor committed to teaching the new markup lesson over the summer. In order to encourage him, I checked in on a regular basis. This new lesson worked well and was engaging for students. Other instructors implemented this content subsequently. As a result, a year later we have trained 200 web developers who now know web accessibility basics.

Now, it isn't always this easy to include accessibility topics within course curriculum. We had several things working in our favor:

- The iSchool has a strong culture of continuous improvement in learning outcomes and student engagement in the iSchool.
- We had a team of instructors already in the habit of improving their instruction every quarter reinforced these values.
- We focused on reaching out to lecturers whose only job was teaching and whose course load was structured to account for course improvement efforts.

- I was incentivized by my (funded) participation in *AccessComputing* to champion this change.
- The instructor creatively identified a weak part of the course material that could be improved with accessibility content.
- We modified content rather than adding new content.
- We identified an existing, required, well-liked course rather than proposing a new course.
- Accessibility is already taught in other courses throughout the undergraduate and graduate curricula, so it wasn't viewed as a "new" topic.
- The instructors already had exposure to content from their professional experiences as software developers.
- Having an in-house accessibility expert made it easy to do a quick training, giving the instructors confidence in the material.

You can facilitate change by identifying a champion (whether this is you or someone else in your department), surveying your landscape for incentives and capacity for change, creating sufficient incentives and capacity, finding the person most motivated to change and manage their change, and repeating these steps as necessary. There should also be some long term thought to including accessibility, and adding scheduled time to check that the efforts put forward are not forgotten or waylaid.

I asked participants "How can we include topics of accessibility in the computing curriculum, and what are ways to incentivize and motivate faculty to include accessibility?" Their responses included the following:

- Some people know about accessibility and some people don't—and if a professor doesn't know anything about accessibility, they won't teach it. Raising awareness and providing resources can mitigate this potential barrier.
- Looking at specific courses and making small changes to include accessibility in them.
- Bringing awareness to how accessibility is newly included in ABET accreditation standards may help to motivate faculty.
- Engaging tenure-track faculty who have the most power for encouraging curricular change.
- With more computing jobs requiring accessibility, motivate faculty by showcasing what companies are looking for and the tools students need to be successful in computing careers.

IT Accessibility: What Your Institutions Are Doing, and How You Can Help

Presenter: Terrill Thompson, UW

There are barriers at each step along the way of making IT accessible in computing courses. EDUCAUSE is a national organization focused on accessible IT within postsecondary education. This last year, I led a poster discussion that focused on students with disabilities sharing their experiences related to IT accessibility. Students shared their issues including inaccessible web-based programs, programs inaccessible to screen readers, inaccessible productivity tools, uncaptioned videos, and a variety of other problems. In higher education, if many of our programs, services, and activities are inaccessible due to these IT issues, it makes it monumentally harder for these students to succeed.

Each institution has tens or hundreds of thousands of web pages, digital documents, videos, and software applications that are inaccessible. For web pages, each page should follow WCAG 2.0 Level

AA success criteria as well as Accessible Rich Internet Applications (ARIA), which provide a more interactive look at accessibility; however, very few web developers actually consider these when designing their webpages.

For documents, the tagged PDF has been around since 2001 with Adobe Acrobat 5.0, which makes it possible for a document to communicate the structure happening within the text (e.g., headings, alt text). However, making accessible PDFs can be difficult and most authors don't know many accessibility techniques.

For videos, captions are extremely important for some people to access the information. While automatic speech recognition has improved, there are still many problems with relying on them to have the correct transcription. Furthermore, captioning has other benefits, including a searchable, interactive transcript, usability in quiet areas, and greater ease of access for non-native speakers of English. Videos may also need audio description for people with visual impairments.

Lastly, software is a wide topic with a lot of tricky issues. A growing number of institutions are adding accessibility requirements to their purchasing agreements, which push software developers to create more accessible products.

There are many civil rights complaints and lawsuits that have targeted postsecondary institutions regarding the accessibility of their IT. Their resolutions have brought to light five major points to address:

1. Conduct an audit of the accessibility of IT and develop a corrective action strategy to address problems identified in the audit.
2. Set institutional standards related to accessible technology.
3. Provide training and education about accessibility to anyone on campus who is responsible for creating or procuring IT as well as those responsible for creating content.
4. Institute procedures for addressing accessibility as a requirement with the procurement process.
5. Provide and publicize a mechanism by which students, faculty, and staff can report accessibility issues on campus.

How can you help? Work at any level (state, institutional, college, departmental, or personal) to enact policies and procedures around creating accessible websites, documents, videos, and software. Consider research opportunities that address any of the problems described here. For more resources, visit www.uw.edu/accessibility.

Short Presentations: Teaching About Accessibility

Teach Access

Presenter: Matt May, Adobe

Accessibility is not commonly taught in the undergraduate computing curriculum. The problem is three-fold:

1. There is too little accessibility talent in the pool, meaning that companies are left to train their own accessibility team.
2. There is not a clear demand for accessibility talent in job descriptions, so few individuals study it in sufficient depth.
3. There is a need for better, more uniform accessibility training.

All engineers, product testers, computer programmers need to be trained in accessibility in a uniform way, and companies need to be hiring for those specific accessibility requirements.

To help address this problem, a group of us have formed Teach Access, which currently has 29 partners, from education, industry, and the accessibility field. Teach Access's first project was adding accessibility to job descriptions. Nine organizations committed to doing this and you can find sample language from their job descriptions on the Teach Access website. Our second project is a tutorial that provides basic accessibility training for developers and designers.

Our industry needs a lot of people who know a few things about accessibility and a few people that know a lot about accessibility. The former can be accomplished by including general accessibility and inclusive design training as part of general computing curricula. The latter can be accomplished by developing a standardized, advanced curriculum for teaching accessibility and inclusive design. What can industry offer to academia that will help cultivate more people who are interested and invested in accessibility? Teach Access is creating a plan, which includes qualified speakers to talk about accessibility, partnership opportunities (including internships, research projects, and fellowships), and learning tools and videos on accessibility.

To learn more about Teach Access and how to get involved, visit teachaccess.org, or email mattmay@adobe.com.

“The Accessibility Lecture”: Should We Teach Accessibility as a Standalone Topic or Integrate Disability Throughout the Course?

Presenter: Shiri Azenkot, Cornell University

I teach a class on interaction techniques (e.g., text entry and scroll bars). When designing this course, I had to consider constraints (time, curriculum requirements, and expectations) and how my course might compare to similar courses across institutions. Would I include accessibility into this course with an “Accessibility Lecture,” where I cover everything about accessibility in one short lecture or by integrating disability throughout the course?

An “accessibility lecture” might cover things like the definition and examples of disability, models of disability, the importance of accessibility, and interaction techniques for people with disabilities. Instead of covering the same topics on accessibility in a short amount of time, I integrated assistive technology and accessibility into multiple lectures as a part of the ongoing discussion. I included readings throughout the semester that discussed interaction techniques for people with disabilities and assistive technology. Furthermore, I tried to encourage my students to think about their biases they have based on perceived disability, age, race, gender, location, and a variety of other situations or statuses.

By incorporating disability throughout the course, accessibility becomes normalized and not marginalized. Disability also becomes included in context, and not just as a specialized subject, and means that students have more exposure to accessibility and disability-related issues. That being said, there are also advantages to a stand-alone “accessibility lecture.” It allows more time for framing the topic, drawing from disability studies, and motivating the importance of accessibility. This sort of lecture could also address other disability-related issues beyond interaction techniques. A combination of both approaches can enhance the content of a course.

How Designing for Users With and Without Disabilities Shapes Student Design Thinking

Presenter: Kristen Shinohara, UW

Despite the popularity of teaching design thinking, most technologies are not made to be accessible out-of-the-box. When students design, projects do not cover accessibility unless accessibility was directly included in the course syllabus and direction. Technology is often either designed for disability or ignores accessibility.

We came to ask how we could teach design thinking to incorporate accessibility in the design process and include accessible design as a key part of design thinking rather than a “special topic.” We taught an undergraduate course where students each designed in groups for expert users who had sensory disabilities. Students often came into this project with their own preconceived perceptions. By working on a project with a person with a disability, students soon changed their perceptions and confronted their biases. Furthermore, students discovered that many prototypes are inherently inaccessible and can not be used for user testing with individuals with disabilities.

Most students learned that designing with accessibility in mind was not as hard as they had thought, and most students felt very interested in including accessibility in all of their future projects, as well as designing for a wider range of user.

For more information, consult Shinohara, K., Bennett, C.L. and Wobbrock, J.O. (2016). How designing for users with and without disabilities shapes student design thinking. *Proceedings of the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '16)*. Reno, Nevada (October 24-26, 2016). New York: ACM Press. ACM Digital Library.

UW Accessibility Capstone Course

Presenter: Anat Caspi, UW

All computer science and engineering students at the University of Washington are required to take a capstone course. Along with that capstone come certain expectations, including writing and documentation processes that must be in place.

The course provides students with exposure, engagement, and participation and interaction:

- **Exposure** to the engineering, design, economic and social challenges facing designers, engineers, researchers, entrepreneurs, clinicians, older adults, and individuals with disabilities in the design, development, and use of accessible technology
- **Engagement** in a team-based project experience that exercises collaborative working skills and applies an engineering design process to tackle difficulties experienced by individuals with disabilities and older adults
- **Participation and Interaction** with users of accessibility features and assistive technology in the local community along with health care professionals, coaches, and caregivers.

It also gives students more opportunities to

- think critically about the complex relationship between technology and diverse abilities;

- communicate effectively about diverse abilities and about design process through interviews with Need Experts, in-class discussions, report writing, project presentations and media production; and
- apply design and engineering skills to create technology solutions that increase independence and improve quality of life for people of all abilities.

Improving a Web Accessibility Class Curriculum

Presenter: Anna Marie Golden, UW

I teach a web accessibility class at Bellevue College. The first time I taught the class I questioned the curriculum's focus. The class meets three times for three hours per session. The second session was all about legal cases. I thought we were doing students a disservice with this focus because when they go on a job interview, they won't be asked about specific legal cases; they will be asked about creating accessible web content.

When I presented this material to my class, I told them I didn't expect them to remember all of the cases. I told them the important thing to note is that this has been a really long process and we still aren't there yet. When thinking about all of the cases, the thing to keep in mind is what the outcomes were. I told them to think about the issues and how the courts resolved them.

After I taught the class for the first time I went to administrators at Bellevue College and asked them about revising the curriculum. I told them the current curriculum is doing students a disservice because the focus should be on how to create accessible content and not all about legal cases. They were receptive to my ideas and I received the okay to revise the curriculum.

I also wasn't enthused about the curriculum material for the first class session. It included empathy-building exercises. I questioned the authenticity these exercises would bring but in reading student evaluations after the class had ended, I learned students actually liked this exercise and appreciated what they had learned from it. Therefore I found value in the exercises and decided to continue with them.

So the next time I teach the course, the second session will be different. Instead of spending the full time discussing legal cases, we are actually going to talk about the things students can do to create accessible web content. These are the skills they need to ensure they are creating accessible websites.

Short Presentations: Working with Students with Disabilities

Including Students with Disabilities in Summer Programs

Presenter: Sarah Lee, Mississippi State University

Bulldog Bytes is a K-12 summer outreach program based at Mississippi State University. Through hands-on learning and industry speakers, students demonstrate knowledge of cybersecurity vulnerabilities, cybercrime, and how attention to safe online behavior is crucial to their personal safety. Last summer we had over 80 participants and a sizeable support team, including near-peers and college-age mentors, and utilized a wide variety of programming tools.

We've hosted interns with disabilities through the *AccessComputing* program. By hiring students with disabilities, we've provided opportunities for computing majors with disabilities and we've seen increased student confidence and relationship building among both the participants with disabilities and those without. Students saw people from underrepresented group in leadership positions, which helps encourage others from underrepresented groups to apply and succeed in challenging programs. Interns reported increased confidence from serving in a leadership position and learning more about conducting outreach activities.

Multi-Modal Lecturing Helps All to Learn

Presenter: Vincent Martin, Georgia Tech

People with disabilities all perceive information differently, depending on when they were born and when they developed their disability. People sense and perceive the world in multiple ways; while we are often taught there are only five senses, there are actually 12 to 15 senses. Learning can involve all of these senses.

Learning styles are different methods that people learn; the three main methods described are visual, auditory, and kinesthetic. However, people can learn to learn in a variety of ways. For example, people who think they learn only visually can actually be shown how to learn auditorily through multi-modal exercises.

All classes should use multi-modal learning because you never know how someone is engaging with the materials. Regardless of a person's disability or where he or she lies on the spectrum of ability, multi-modal lecturing is an example of an application of universal design.

Teaching Coding to Blind Students

Presenter: Jose Alvarez, University of Puerto Rico

Most individuals who are blind access their computer with a screen reader for output and a keyboard for input. To program, they use coding editors, such as text editors or graphical user interfaces (GUIs). In order to be accessible to individuals who are blind, these applications need to work with a screen reader as well as work solely with keyboard commands. Unfortunately, this is not the case with many applications.

To be successful in computing, individuals who are blind, like individuals who are sighted, need to develop computational thinking skills. Applications and games that are designed to do this are often inaccessible to blind students as well. Video games are usually graphic, but it is possible for them to be designed to be accessible auditorily. Games can be designed so that a screen reader can read movements in the game and cue the player to what is happening. I have designed games that include an accessible blackjack game, math-based baseball, and an accessible driving game.

Accessible applications should be the norm for all educational topics to help students learn and stay engaged. Learn more at www.fundacionmanolonet.org.

Accessible Presentations

Presenter: Kyle Rector, University of Iowa

Making presentations accessible is important in multiple settings – including in the classroom and at conferences. The first thing you should do to make your presentation accessible is to submit slides a few days in advance in an accessible format to allow those who need them to view the slides beforehand. For the actual presentation itself, slides should be made with a high contrast color scheme and use more than just color to communicate information. Furthermore, text should be kept brief so viewers don't get lost in reading bullets rather than listening to the speaker. One exception to this could be an entire quote; in that case the entire quote should be read out loud.

Graphics should be kept simple so viewers aren't trying to figure out the meaning of the graphic. I recommend simple graphics that are black and white from *thenounproject.com*. Furthermore, all images should be verbally described and have a purpose within the presentation. Avoid using animations as much as possible, and all videos incorporated into presentation should have captions and verbal description.

Make sure to speak clearly when presenting. Everyone in the room needs to understand what you're saying, including interpreters, captioners, and people who may not speak English as a first language. Speak in a proper cadence, face the audience, speak loudly, and use understandable words. A version of this presentation can be found on YouTube at www.youtube.com/watch?v=L9TxxhGv91kc.

Runestone Interactive

Presenter: Jeff Rick, Georgia Tech

Runestone Interactive is an open source e-book project focused on computer science education. It supports authors with an open source, cross-platform toolkit, mark-up text authoring, and the ability to compile locally before transferring to a server. It supports students with interactive content and immediate feedback, and it supports faculty by providing tools for managing courses, tracking student performance, and providing free hosting.

The program integrates a variety of supports, including the ability to code in a browser and a tool called CodeLens that shows how code is executed. There are also the Parsons Problems, which are puzzles that allows students to drag and drop blocks of code to successfully solve a problem.

Runestone Interactive has 71,000 users, more than 730 courses run, with 240 current running courses. Over 20,000 users access these courses each day. There are 12 completely open-source books available on the site.

In the future, there will be more sophisticated administrator tools, more accessible content and platform use, and more content. To get started with your own course, visit the site at runestoneinteractive.org, or get involved by becoming a part of the community and working on the platform itself.



Panel Presentation Summary

Panel of Computing Students with Disabilities

Panelists: Lourdes Morales, Cameron Cassidy, Vincent Martin, Jessie Zhang, and Anna Marie Golden

Moderator: Brianna Blaser, UW

What kind of accommodations have you used, and how have they changed over your education?

- Due to my visual impairment, in class I use a camera that can zoom in on things on the board and slides. I also ask for materials in advance and electronic books so I can use access the material on my computer.
- I use every device and computer you can imagine, and I often like to go above and beyond what is expected. So, as an individual who is blind, I often run into accessibility problems and troubleshoot as the problems come along.
- Because of my mobility impairment, I needed accessible furniture, like a very ergonomic chair, or a specific table. I also have a thumb and wrist injury, so writing can take longer, which means I need extra time on exams.
- I am deaf, so I use an frequency modulation (FM) System, which is basically a microphone I give the professor that connects directly to a headphone in my ear. I also use Computer Aided Real-Time Transcription (CART), so I can read in real time what others are saying around me. I need captioned videos as well.

How do you communicate with faculty about your needs, and how do you want faculty to communicate with you?

- I email the faculty member at the beginning of the quarter to bring up my accommodations and discuss what works best for me.
- The disability services office often tells faculty about my accommodations, but I like to make sure I bring it up with each faculty member personally. I also like to bring up discretion about my disability—I've had professors call me out for being the reason we can't do something or we don't have more time on an exam.
- I set a personal meeting with my faculty members and discuss what my disability really means. Then I can ask to look at the syllabus ahead of time so we can look at what documents I might need made accessible or what we may need to do to make something accessible.
- I agree, it's important to meet with the professor and talk about the accommodations needed. For me, I like when other students see my accommodations and learn about different ways of learning and different disabilities.

What challenges have you faced as a student with a disability?

- The student lounge for my program was up a long staircase that I couldn't climb very easily. This space was also used as meeting space, and my student group had to scramble to find another place to meet. By talking with my professor, he found us another space in the building next door that was still conveniently located and worked for all of us.
- I was the first blind student at my school. This meant I have had a lot of barriers to overcome. I've met with a lot of people during my time, and even had to file Office of Civil Rights complaints to try and make the program more accessible for me. Many of these barriers they wouldn't fully fix or change, and it can be a constant battle to get what I need to learn in these classes.
- In my design class, we had video tutorials that didn't have captions. I had to scramble to get those captioned in time to allow me to keep up with the material.

What advice would you give faculty members for working with students with disabilities?

- If you see a student struggling or having an issue, ask that student if there is something wrong—recognize there may be other issues or someone may need an accommodation. You can refer students to a variety of resources on campus that might be useful, including tutoring or writing centers, in addition to the disability services office.
- Be a part of the solution. Try to see how you can do something, and try looking at a variety of solutions.
- Open up your mind to differences and how others can learn and communicate differently.
- Be approachable; however, understand that a student with a disability may not want your help or may not need an accommodation you think would work better for them.

I have a hard time understanding one of my blind students and how he sees programming. What advice would you give to faculty in ways to get rid of their built-in biases?

- Most of my professors are happy to try to work with me on my disability, and I also try to show professors how I've solved problems before or how others have taken on the barrier. The biggest problem is usually about accessible documents—I would suggest to professors to find resources on campus to make their PDFs and other documents accessible.
- Each person with a disability is different—be open to dialogue and working through an issue.

Do you prefer professors to approach you proactively about accessibility, or would you rather approach the professor?

- I always use my accommodation letter as a starting point to discussing disability with professors. I'd rather bring it up with a faculty member myself, because I know more about what I need. That being said, it can be nice if a professor approaches me, since that ensures me they are very willing to work together.
- I've never had a professor reach out to me, and it would mean a lot if a professor did; however, I do think it is ultimately on students to approach professor to advocate for themselves.
- Because I have a service animal, it can make it obvious that I have a disability. However, I did have one student halfway through a quarter ask me what my guide dog was for, and I had to tell them I was blind.

Incoming freshman often have a harder time with self-advocacy—how can faculty help students learn to speak up and advocate for their accommodations and disabilities?

- When I was in high school, I joined the *DO-IT Scholars* program, which taught me the advocacy skills to get accommodations for myself and learn to navigate the differences in college from high school.
- Ultimately, learning to advocate for myself was a part of growing up, gaining confidence, and learning what worked best for me.
- I think mentors are very important. I mentor other students with disabilities and teach them the skills needed to succeed in college.
- A cultural change around accessibility would really help students be more confident in advocating for themselves. If incoming freshmen were taught how to advocate for themselves and told that professors would be approachable. If professors show they are friendly and welcoming, this will make students feel more comfortable about reaching out when needed.
- As a faculty member, verbally tell your class that they are welcome to come and talk to you about accommodations or any other needs.
- At *AccessComputing* and *DO-IT*, we offer workshops where we bring in both students and faculty to role play these discussions in groups, which allows faculty to give feedback to students, allows students to learn from watching their peers frame the discussion, and allows students to talk with faculty about how to be welcoming to students with disabilities.

What are your experiences with libraries and informal learning environments, and how do your accommodations work in those settings?

- At my college, we have a place with a computer lab and space where students can come in and get help with their classwork. A lot of this requires self-advocacy in talking about what you need and what they can do for you.
- A makerspace can be really inaccessible, and I often had to have a partner help me in that environments.
- Now that libraries have lots of resources online, I have fewer issues with getting accessible versions of documents and books. I have someone who works in the disability services office who will make accessible PDFs for me. I have to start my research early and make sure I have time to get accessible PDFs.

Do you think faculty should be trained on more forms of technology, and what do you want your fellow students to know about your accessible technology?

- I think it can be less efficient for every faculty member to learn each specific piece of technology instead of one expert who is my go-between; however, it can be really nice for the professor to understand the difficulty and challenges with inaccessible materials.
- I personally like to show people my technology and teach others what options are out there, especially when faculty and other students in my classroom are the ones who are going to design future technology.
- It's frustrating when educators don't understand technology. I had one person on staff who told me to get Dragon Naturally Speaking and use it to record all of my professors. That staff member didn't understand that Dragon Naturally Speaking worked and how it has to be trained to a specific person's voice.
- I often have other classmates talk to me about my technology, and I'm happy to speak to them, especially about how CART works.



Discussion Summaries

At your table, share your institutions' challenges in increasing the participation of students with disabilities in computing.

- Often the only interaction between disability services and professors is a letter sent out about a student's accommodations, and there isn't any more connection between the professor and student. If professors could be more engaged in the accommodation process, they may be more welcoming to students with disabilities.
- Buildings are inaccessible and don't have ramps or elevators. This not only makes it hard for students with disabilities to access classes, but it sends a message about how welcoming an environment is for students with disabilities.
- Instructors don't receive much or any training in how to work with students, especially students with disabilities. There should be more resources for professors to learn how to understand universal design and accessibility.
- Online courses often include inaccessible websites or media, making it hard for students who are blind or who are deaf to engage with the material or with other students.
- There is a lack of championship of accessibility and inclusion.
- Young people with disabilities are often not targeted for computer programming, so by the time they reach college, they are not interested or confident in their computing abilities.
- Departments are intimidated from trying to be more accessible by the perceived cost. Showcasing what can be done for little or no money and how some of these costs are just perceived could make a difference.
- Departmental websites and marketing materials can be inaccessible, which keeps students from even learning the information about a program, let alone feeling welcomed into that program.
- Students with disabilities can often be missed from targeted recruiting methods.

- Professors have applications and software tools they like to use that aren't accessible. Professors argue it is their academic freedom to use the software they deem best for teaching, but this is at odds with access.
- Academics can often ignore advice that doesn't come from PhDs, which may impact how well faculty work with the disability services office on their campus.
- Open source books and resources are not always accessible, but they can be a cheaper option for lower income students.
- Classrooms are rarely set up with accessibility in mind, making it hard for faculty to seem welcoming to students.
- Materials—PDFs, programming languages, software, videos, etc—are often inaccessible, and getting all of these up to a fully inclusive level can be difficult and labor intensive.
- People with disabilities often don't have role models within the department. If we hire more faculty with disabilities, it improves the culture of inclusion and makes accessibility more of a priority.
- Accessibility can often just be seen as an obligation, not an inclusionary practice.
- Disability should be addressed in the same way other underrepresented groups are—if disability can be added to the same efforts that are put into getting more women into computing, the numbers will go up.

How can we include topics of accessibility in computing curriculum?

- Summer can be a good time to start changing curriculum, since faculty usually have more time then and schedules aren't as tight.
- If department heads would promote accessibility, faculty will start to follow suit and make it a priority.
- We should strategically choose the classes where accessibility can go into already existing curriculum.
- Accessibility can be added to portfolio projects.
- Faculty need some professional development on the topic – this should include information about accessibility in the ABET requirements, as well as in job descriptions.
- If we can hire more accessibility specialists, they can work with faculty to change curriculum.
- Staff with an interest should be made into accessibility champions to prioritize it in departments.
- Incentivize accessibility by making it a requirement of professors' jobs. It could be considered in tenure and promotion.
- Faculty need specialized training and workshops on accessibility in order to be able to teach about it.
- Bring more people with disabilities into classes and the department to show faculty what is at stake and to gather more input from people with disabilities themselves.
- Accessibility should be included in all introductory classes, so all students are exposed to it.
- Faculty are often overloaded with other expectations and priorities, making it very hard to push new material or curriculum changes on their workload.
- Incentivize adding accessibility to the curriculum with an award or recognition.

What can be done to make computing classes and departments more accessible to students with disabilities?

- Add accessibility to the Consortium for Student Retention Data Exchange (CSRDE), an association of two-year and four-year institutions dedicated to achieving student success through collaboratively sharing data, knowledge, and innovation.
- Reach out to *AccessComputing* to apply for opportunities for outreach to students with disabilities, whether on panels or going out to classrooms. To learn more, email accesscomp@uw.edu.
- Get faculty on board with teaching in a more accessible manner.
- Bring back the philosophy of computers as a means of access; promote diversity in all aspects of computing.
- Acknowledge the cost of not making classes accessible compared to the cost to make it accessible—lawsuits are often a bigger target on costs than proactive accessibility.
- Rewrite policies and admissions criteria to be more inclusive.
- Be more proactive about accessibility, instead of merely striving for compliance.

Considering the barriers that were discussed, what solutions might institutions implement to overcome these? How can these plans be further developed? How can we encourage institutions to adopt these sorts of plans?

- A website should be created with information about what faculty should do when they have a student with a disability in their class, including the reasoning behind it, accommodation information, accessibility options, and other pertinent information.
- If people with disabilities aren't applying for a program, what does that say about a program being welcoming and accessible? And if students with disabilities are applying, why aren't they getting in? Let's look at the application process, marketing materials, and acceptance process, fix any problems or biases, and accessibility wording and inclusion.
- A lot of solutions to these barriers can also fix problems found in other aspects of a program, like issues for English as a second language students or students with different backgrounds. Taking a holistic look at inclusion could benefit many populations.
- Tools can be provided that allow for multiple means for communication between a student and faculty, such as being able to text a faculty member a question during class instead of speaking out loud. Other options can include online discussions or more options for office hours that allow students to communicate and learn.
- Workshops could be offered to faculty that trains them for accessibility issues, as well as information on disabilities, accommodations, and other topics. Requiring faculty to participate in these workshops could help to ensure that they reach a broad group.
- Student evaluations should include a question about accessibility so faculty can hear how accessible their class is and make changes accordingly.
- If accessibility is a priority to the dean of college and department heads, other faculty will follow suit if their job can be affected.
- If accessibility is included in course descriptions, then faculty will have to incorporate it into materials.
- If faculty are allowed less restraints on their time, they would be able to evaluate their teaching and curricula more.

- Questions focused around accessibility should be included in faculty hiring so that new faculty coming on board will realize it is an integral part of the job and see that it is part of the institution's values.
- If we apply for an *AccessComputing* minigrant, we can host an event that brings faculty closer to people with disabilities.
- Presentations on accessibility and inclusion should be given at more computing conferences.
- More studies should be done on disability and inclusion in computing departments. This data could be shown to faculty for why we are stressing the importance of accessibility.
- More accessible technology could be purchased by the department to make sure equipment costs aren't a barrier to student participation.
- We could have a lightweight certification for departments to receive that try to design universally and be welcoming to people with disabilities.

How can we continue to work together to promote the participation of people with disabilities in computing and the inclusion of information related to disability, accessibility, and universal design in the computing curriculum?

- Writing up a 2-page guide on how to include accessibility and disability topics in our computing courses.
- Creating a course on accessibility that can be shared to other institutions.
- Talking to faculty about accessible web design and other accessible products.
- Addressing the undergraduate curriculum committee to bring to light the accessibility requirements in the Accreditation Board for Engineering and Technology (ABET) as well as the job descriptions listed by Teach Access to encourage accessibility being taught in classes.
- Submitting a proposal on a special topics course or capstone on accessibility.
- Making sure the individuals who produce videos create accessible captioned videos so all students and faculty can utilize these resources.
- Encouraging the use of more accessible programming languages, including Quorum (quorumlanguage.com).
- Looking at our program to see how we can broaden our accessibility and work with other companies and programs to improve these efforts across the board.
- Sharing individual experiences and efforts over email lists to find solutions.
- Reaching out to *AccessComputing* to find students for internships and research experiences.



CBI Participants

Stakeholder groups represented in the CBI included

- student service leaders and administrators,
- faculty members,
- students, and
- professional organizations.

The following individuals participated in the CBI.

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Resources

The *AccessComputing* website (www.uw.edu/accesscomputing) contains

- information about project goals,
- the application of evidence-based practices toward project deliverables,
- resources for students with disabilities,
- educational materials for postsecondary faculty and staff,
- information about partners and collaborators, and
- program applications.

AccessComputing maintains a searchable database of frequently asked questions, case studies, and promising practices related to how educators and employers can fully include students with disabilities in computing activities. The Knowledge Base can be accessed by following the “Search Knowledge Base” link on the *AccessComputing* website.

The Knowledge Base is an excellent resource for ideas that can be implemented in engineering programs in order to better serve students with disabilities. In particular, the promising practices articles serve to spread the word about practices that show evidence of increasing the participation and success of people with disabilities in computing.

Examples of Knowledge Base case studies, promising practices, and questions include

- How can I make my computing department more accessible to students with disabilities?
- What adaptive technology is typically provided to students with disabilities on postsecondary campuses?
- What are specific computer applications that can assist students with learning disabilities?
- Are there any web-based tutorials on accessibility?

- How can principles of universal design be used to construct a computer lab?
- Are there scientific and graphing calculators that can be used by students who are blind?

Individuals and organizations are encouraged to propose questions and answers, case studies, and promising practices. Contributions and suggestions can be sent to accesscomp@uw.edu.

For more information on *AccessComputing*, universal design, and accessible computing and IT education, review the following websites and brochures:

- To find more information on universal design, visit the Center for Universal Design website at www.uw.edu/doit/programs/center-universal-design-education/overview.
- To learn more about and get involved with *AccessComputing*, visit www.uw.edu/accesscomputing.
- For resources specifically designed for faculty, consult *The Faculty Room* at www.uw.edu/doit/programs/accesscollege/faculty-room/overview.
- To discover how to become an industry partner, learn more at www.uw.edu/accesscomputing/about/industry-partners.



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