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E-Learning and Information and Communication Technologies in Postsecondary Education of Students with Disabilities: Where We Are and Where We're Going?¹

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Abstract

We discuss the accessibility of popular e-learning and information and communication technologies (ICT) currently used in postsecondary education and highlight emerging trends. These include recent developments in the use of digital textbooks and note taking as well as the evolution of e-learning, including open source materials, mobile learning, MOOCs, and wearable technologies.. We also note that a trend worth watching is personalizing accessibility via the cloud. Increasing use of universal design principles - in particular, ensuring the accessibility of technologies at the inception of development, is recommended.

Turn of the Century to Date

Specialized assistive technology. In the 2000s, the medical model has been losing ground and the social model has been gaining strength in North American postsecondary education. This includes the migration of universal design concepts from the realm of products and buildings to e-learning and postsecondary education.

Another key development was enforcement of the "Section 508" legislation, which, while not specifically relevant to postsecondary education per se, became a point of reference, requiring U.S. federal government agencies to acquire or develop only accessible ICTs. It made no sense for mainstream software and hardware developers to produce two versions – an accessible version for the government and an inaccessible version for everyone else.

A key finding of a recent study by the Adaptech Research Network is that mainstream IT specialists on campus know very little about the technological needs of students with disabilities, underscoring the need for access technologists. This research also showed that while many students' access needs are being reasonably well met, there

¹ A fuller version of this document is soon to be published in the Journal of Postsecondary Education and Disability. Details of Adaptech Research Network's studies can be found on the Adaptech Research Network web page at <http://www.adaptech.org/en/publications>

is one key exception: training on how to use needed specialized technologies. Typically, training is one of the responsibilities taken on or given to those whose role involves supporting access technology on college and university campuses. It was also during the 2000s that the Access Technology Higher Education Network (ATHEN), along with the IT Accessibility Constituent Group of EDUCAUSE, came into being, raising the profile of those who support technology accessibility in higher education.

In all of the Adaptech Research Network's investigations students noted the high cost of specialized assistive technologies. But they also told us about low-cost alternatives. This prompted us to compile, starting in 1999, a list of free and/or inexpensive hardware and software alternatives that might be useful for students with diverse disabilities. This list continues to be updated. It now includes not only PC and Mac products but also Apple and Android apps (Adaptech Research Network - <http://www.adaptech.org/en/downloads>)

E-learning. Most instructors use some form of e-learning in their courses. This includes PowerPoint and Prezi, podcasts, videos, clickers (hand-held hardware or mobile device to respond to multiple choice questions in class, which are then tallied in real time), simulations, blogs, digital textbooks, and Web conferencing. But unless the course is held in a computer lab, many students with disabilities cannot use needed specialized technologies to access these. Students can experience difficulties even in classrooms equipped with a computer for each student (or, more recently, a tablet) because the specialized hardware/software they need is located on computers in specialized adaptive technology labs, rather than in the locations where students need these. Although site licenses are usually available, it is only when specialized technologies began being available on USB flash drives that some students were able to take their technologies to class. Wi-Fi, portable and mobile computing have also been helpful, but only if instructors upload their teaching materials in accessible formats and allow students to access these on their own devices.

Faculty often make online materials available on a course web site or a course/learning management system which allows students to interact with learning materials outside the classroom. But material used "on-the-fly" inside the classroom can pose access challenges.

College libraries with paper journals are becoming extinct as libraries increasingly move toward both digital journals and e-books which can be read online or downloaded and borrowed for the usual number of days. The accessibility of these e-documents varies. This trend notwithstanding, unless or until paper-based publications disappear completely from library shelves, colleges and universities must also continue seeking ways to address the need for timely access to print material. This was recently demonstrated by the 2013 settlement agreement involving UC Berkeley's library, which underscored that this need is still very much a reality. Fortunately, technology exists to convert print material into electronic formats.

"Active learning" has also become popular; this can include interactive white boards (e.g., SMART board) and study pods where students teach each other. Efforts are ongoing to make these accessible.

While some of the larger vendors that support and promote e-learning in higher education, such as Desire2Learn and Blackboard, as well as open source organizations,

such as Moodle, have been putting efforts toward making their learning platforms accessible, much work still remains. WebAIM's Cyndi Rowland highlights legal action taken against a number of US colleges and universities concerning the inaccessibility of their learning technology. Likely as a reaction to such complaints, in 2011 the United States Departments of Education and Justice provided written guidance on the use of emerging technology and institutions' obligations to students with a broad range of disabilities.

In mid-2014, universal design is a mainstream concept championed by offices which provide disability-related supports on campus. Its use in e-learning, however, is usually more by happenstance than intention. Social media are also increasingly used in academe. How accessible these are to students with different disabilities varies

The largest proportion of postsecondary students own a smartphone or a tablet. These have different levels of built-in features meant to provide accessibility.

Future Trends In E-Learning and Accessibility

We expect that many of the current approaches to e-learning will continue into the next decade. This includes the use of tablets and other mobile technologies, digital textbooks, and active learning applications as well as the use of videos, clickers, etc. But there are also many relatively new exciting technologies and approaches on the horizon.

Mobile learning and cloud computing. The traditional model of using software installed in one computer is rapidly changing with the advent of cloud computing. It allows the use of software "in the cloud" (essentially a metaphor for the Internet) anywhere, anytime, as long as the student has Internet access. No need to install software. Mobile devices are a natural platform for Web-based e-learning. Mobile learning devices include laptops, notebooks, smartphones and tablets. The concern for students with disabilities relates to the accessibility of the course / learning management systems used to deliver the learning materials as well as of the software and the learning materials themselves. Nevertheless, mobile learning allows students to replace printed materials with digital content delivered on students' own portable devices which are, presumably, accessible to them.

MOOCs (Massive Open Online Courses). MOOCs are online courses aimed to reach a great number (usually thousands) of students via the web. Most are free courses provided by universities and private providers. An issue with MOOCs is low completion rate. As we are writing this article, conversation around accessibility of MOOCs is nascent. According to Butler (2012), "The responsibility to ensure MOOC content is accessible will likely be divided between the platform providers and the partner institutions."

Wearable technologies. The purpose of wearable devices is to create constant portable, and mainly hands-free digital access. An example that could benefit people with disabilities in the future is Google Glass.

Digital textbooks. Digital textbooks (e-textbooks or e-texts) often serve as the main text for a class, be it traditional or online. The biggest advantage of these is their convenience, as many can be used with multiple portable devices such as laptops, notebooks, tablets, e-readers (dedicated devices for text reading) or smartphones. Other advantages include cost. If these are not simply electronic versions of the paper product,

digital textbooks can provide more up-to-date material than paper books, which can take a year or two to get to print. How digital textbooks are prepared and presented to students determines their accessibility and usability. Epub books are mostly accessible. But academic book publishers tend to use their own proprietary formats. Although most of these have, at least, limited accessibility to students with print and motor impairments, there are important issues related to usability.

YouTube as a learning platform. Here, users can upload and view mainly brief videos. In recent years it has become a useful e-learning tool, as instructors can create playlists, with selected videos on a specific topic and share it with their students. In addition, students can search YouTube for concepts they did not understand in class. YouTube videos can be especially helpful to visual learners, including students with learning disabilities. But there are issues related to hearing and visual impairments. For now, most YouTube videos are neither video described nor captioned.

Note taking. A variety of digital pens can be used to handwrite notes to upload to a computer. Some can also synchronize this with audio from a lecture. Tapping the audio enabled digital the pen anywhere on text written with the pen plays back the audio recorded while the text was being written. An iPad/iPhone app that costs under \$3.00 (Notability) will simply record all activity – be it writing or typing – on the tablet and synchronize it with speech, which it also records. Audio notes can also be taken using the built-in functionality of smartphones and tablets without the need for a separate recorder. While offices for students with disabilities often require students to sign a form to assure the confidentiality of the lecture, many students without disabilities simply use their portable devices to record both audio and video.

Another form of note taking – and paper writing as well - involves dictation software, both on a regular computer as well as on a mobile device. Although accuracy is not perfect, it has much improved over the past 20 years and we expect accuracy to continue to improve, making this a useful productivity tool.

On a related note, the idea that the professor can use voice recognition during a lecture where video, audio and text are simultaneously recorded and uploaded to a large screen as the professor is speaking has been around for 20 years (cf. Liberated Learning Consortium). A variety of problems have made this universal design endeavor a work in progress.

Many universities and colleges already provide lecture recording, especially in large classes, including video as well as audio capture, which is stored on the course web site. This, too, illustrates universal design principles and allows students to review material covered in class at their own pace. We suggest that, in future, such recording be made widely available and that these be enriched with captioning and with automatic generation of sign language animations. We also believe that technology which allows students to view – and save - material presented by the professor, in class on a multimedia projector or on an interactive whiteboard, on their own computer or mobile device via Bluetooth, Wi-Fi or other similar technology, should be made widely available.

Open educational resources are freely available, openly licensed software documents and media that are useful for teaching and learning. Open source software

makes it simpler to make modifications to be compliant to accessibility standards, as the source code is open and can be modified by any programmer. Communities of practice comprised of volunteers with expertise are available to help with accessibility issues. But there are no guarantees!

Future Trends in Technology Useful to Students With Disabilities

As mentioned earlier, built-in features in smartphones and tablets, along with a range of free or inexpensive software solutions are important and are expected to continue to evolve. YouTube and Vimeo continue to mature their captioning solutions. 3D printing is on the horizon in higher education, and may have potential for producing tactile objects useful for students with visual impairments. Finally, work to overhaul the Americans with Disabilities Act to more explicitly include the Internet will have a significant impact on technology, accessibility and postsecondary students with disabilities.

A trend worth watching is personalizing accessibility via the cloud. Here, the idea is that students with disabilities would gain the ability to use technology, such as a library terminal, that is able to provide accessible features personalized to their individualized needs without having to worry about the availability of specific adaptive technologies, such as a screen reader. The Global Public Inclusive Infrastructure is leading this effort. As for the Internet of Things... we'll see.

Conclusion

Trends such as mobile learning, open educational resources, MOOCs, gamification, and wearable technology offer exciting possibilities. However, lacking are substantive conversations on making learning experiences involving such technologies accessible and inclusive of all students, including those with disabilities. Failure to begin having such conversations and taking action today may well result in introducing a host of new digital barriers to postsecondary education. We expect that technology in education will evolve and increase in its use faster than in years past.