Fichten, C. S., Havel, A., Tremblay, M., & Arcuri, R. (2023). The cart before the horse: Accessibility practice comes before accessibility research. In J. Madaus & L. Lyman (Eds.), *Handbook of higher education and disability* (pp.323-337). Elgar Publishing. http://dx.doi.org/10.13140/RG.2.2.17709.77288

24. The cart before the horse: accessibility practice comes before accessibility research[1]

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The technology landscape is transforming for post-secondary students and for access professionals in post-secondary education as the features and use of assistive technology are swiftly changing. Here we review the impact of changes in the: (1) nature of students' disabilities/impairments, (2) cost of assistive technologies, (3) practices of the tech giants such as Microsoft, Adobe, Google, Apple, and Android, (4) emergence of artificial intelligence in post-secondary education, (5) lessons learned from the COVID-19 pandemic, and (6) problems with research that does not reflect the new technological developments nor the characteristics of today's post-secondary students with disabilities. In Québec, Canada's second largest province, the language of instruction for the majority of post-secondary students is French. Thus, there are issues related to the availability and usability of French language-based technologies.

CHANGES IN THE NATURE OF STUDENTS' DISABILITIES/ IMPAIRMENTS

Twenty years ago, the most commonly reported disabilities in post-secondary education were mobility, visual, and hearing impairments. In Québec (Canada) only 1645 students were registered to receive disability-related services from their four-year college (Tremblay et al., 2003). In 2020, using the same methodology, over 10 times the number of students were reported (i.e., 19,296) and the most commonly reported disabilities were attention deficit hyperactivity disorder (ADHD), mental health issues, and specific learning disorders (Gagné & Bussières, 2021). Indeed, as shown in Table 24.1, in one of our recent studies of Canadian two- and four-year college students (Fichten et al., 2022a) the most common disabilities/impairments reported by post-secondary students were mental health-related disabilities, ADHD, specific learning disorders, and chronic medical conditions with 50 percent of students reporting more than one disability.

Table 24.1 Disabilities/impairments reported by Canadian post-secondary students

Disabilities/Impairments of 121 Students	Number of students
Mental health difficulties/psychological disorder	79
Attention deficit hyperactivity disorder (ADHD)	39
Learning disability (LD)	32
Chronic medical/health problem	22
Neurological disorder	11
Visual impairment (NOT adequately corrected by wearing glasses or contact lenses)	7
Hard of hearing/hearing impairment	7
Speech/communication impairment	6
Limited mobility: use of a cane/crutch/walker	5
Limited use of hands/arms	4
Limited mobility: wheelchair/scooter user	3
Autism spectrum disorder	2
Totally blind	1
d/Deaf	0

LOW RATES OF STUDENT SELF-DISCLOSURE

When students are asked to self-identify, in accordance with the methodology suggested by the Association on Higher Education and Disability (2012) and by Banerjee et al. (2020), data show that less than half of the students with disabilities register for disability services from their post-secondary institution (Canadian University Survey Consortium, 2020; Fichten et al., 2018a; 2019a). Students with non-visible disabilities are less likely to register for disability services than those with more visible disabilities. For example, of a random sample of 1387 Canadian junior/community college students, 239 (17 percent) self-reported a disability (Fichten et al., 2018a). Of those students, only 44 percent indicated that they had registered with their institution for disability services and 56 percent had not. Similarly, in another study of 284 Canadian post-secondary social science students, 75 self-reported a disability. Again, fewer than half (41 percent) of the students with disabilities had registered to receive disability-related accommodations from their institution (Fichten et al., 2019a). In a series of studies by the Canadian University Survey Consortium (2019, 2020, 2021) between 20 percent and 25 percent of students indicated having registered for services for students with disabilities. Historically, post-secondary service providers for students with disabilities cited difficulties associated with accessing costly learning evaluations, and shame/unwillingness on the part of students to identify as having special needs as the reasons behind why fewer students asked for services (Squires et al., 2018). Today, it would seem that the increasing accessibility of readily available tech may have a role to play here.

A greater openness to inclusive education is bringing about a dramatic change in digital learning environments, allowing more students with disabilities to go without self-disclosure. Some assistive technologies traditionally reserved for students with

disabilities are now available to all students. For example, in the early 2000s Antidote (n.d.), a Quebec-developed grammar correction software, was offered as an accommodation only to students with specific learning disorders registered with disability services. Now, in many cases, Antidote can be accessed by all students, regardless of a disability.

The implementation of inclusive approaches in education (e.g., Universal Design for Learning [CAST, 2018], Universal Design in Higher Education [Burgstahler, 2021]) is changing the context in which assistive technologies are used. Previously, expertise was restricted to the disability services team, but this is no longer the case. Design that follows universal design tenets, such as ensuring that product development is conducted in collaboration with individuals with disabilities from the outset can improve accessibility and usability (Martiniello et al., 2019). The rise of user experience (UX) design is bringing a huge change to digital environments in education. Thus, design of new technologies increasingly includes Canadian (e.g., Secrétariat du Conseil du trésor, n.d.) and American (e.g., Web Accessibility Initiative, 2022) accessibility standards. This paradigm shift is important and can be witnessed in all countries with stringent accessibility laws. The inclusion of accessibility features is a fundamental trend that will profoundly change the notion of disability itself, and the need to use designated services to acquire technologies that meet the accessibility needs of students with different disabilities.

The trend to inclusive education and low rates of registration with post-secondary disability services has significant implications for understanding the ubiquity and effectiveness of access technologies and mobile devices in post-secondary institutions. This is because most studies of technology use by students with disabilities are based on samples of students that are registered for disability services with their school (e.g., Blasey, 2020; Malcolm & Roll 2017a; 2017b). It is no longer mandatory to be enrolled in disability services to use assistive technologies since these are increasingly integrated into mainstream digital educational environments.

THE COST OF ASSISTIVE TECHNOLOGIES HAS GONE DOWN

Not only has the cost of assistive technologies decreased in virtually all domains (e.g., Dancing Dots, n.d.; Nuance, n.d.; Quillsoft, n.d.), but the mode of assistive technology acquisition has also changed. For example, instead of a one-time fee with periodic updates, technologies are now available for a yearly or monthly subscription, thus making the up-front cost more affordable. It is possible that such price reductions are also due to the principles of supply and demand. Many tools were once offered by only one provider (e.g., Jaws, Dragon). Now there are more competitors, including some that are free and/or open source (e.g., NVDA vs. Jaws).

Expanded access to assistive technologies to wider audiences has reduced the cost of developing these technologies. Indeed, according to Lazar et al. (2015), many assistive technologies originally aimed at users with disabilities have become popular

with the general public. Take the example of speech recognition, which was originally used by people with significant motor disabilities as it allowed them to write and operate their computers. Speech recognition is now used in a variety of contexts: for example, to execute a command on a phone while driving a car and to assist someone with poor handwriting to complete written work. Expanding the availability and use of assistive technologies such as audiobooks, word prediction, and dictation has increased demand and, consequently, the supply. Assistive technologies are, thus, becoming an appealing market for IT developers. This interest is accentuated by the fact that the American tech giants, Google, Apple, Adobe, Facebook, Amazon, YouTube, and Microsoft are becoming progressively more involved in ensuring accessibility. At the same time, new users for whom these technologies have not been specifically developed are emerging (e.g., second language learners, education systems around the world, making transcripts, reading text messages in the car).

PRACTICES OF TECH GIANTS TO INCORPORATE ACCESSIBILITY FEATURES

Microsoft has increasingly provided built-in accessibility features for its operating system (currently Windows 11) as well as for Microsoft 365 (formerly Office 365), which is frequently available free of charge to Canadian post-secondary faculty and students (e.g., HiED Tech Store, n.d.). Included are a variety of features such as text-to-speech, dictation (speech-to-text), word prediction, and magnification (see Microsoft, n.d.; Microsoft Accessibility, n.d.) that can serve as assistive aids for students with disabilities, and often obviate the need to purchase specialized assistive technologies. Similarly, Adobe Acrobat Pro, also frequently provided to Canadian post-secondary faculty and, sometimes, to students by their school, has a variety of built-in accessibility features such as text-to-speech, keyboard alternatives to a mouse, and high contrast (Adobe, n.d.). Moreover, Acrobat can conduct optical character recognition (OCR) of PDF image files. Both Microsoft 365 and Adobe Acrobat Pro have built-in accessibility checkers to enable faculty to easily prepare accessible documents.

Mobile devices, such as Apple and Android smartphones and tablets, also have many built-in accessibility features (Adaptech Research Network, n.d.). These are often similar to Mac and Windows features. Apple is acknowledged as one of the key digital providers to include accessibility features in their products. For example, since 2005 VoiceOver, a screen reader for blind users, has been included in Mac OS 10.4 and is now in all Apple products. Similarly, Google is advancing with several accessibility features built into their products and into the Chrome browser.

For a few years now, it appears that the big players have been competing in the field of accessibility. Making products more accessible, thereby increasing market share by about 15 percent to 20 percent, appeals not only to users with disabilities, but also to an aging population with growing accessibility needs. Accessibility

legislation has also increased in several countries, further driving the trend to offer accessibility features in mainstream technology (Ferri & Favalli, 2018).

The built-in accessibility features of the large technology companies are well aligned with new approaches to inclusive instruction. There are a variety of accessibility checkers that allow faculty to generate subtitles or transcripts for videos, or to create PDF documents in one click. These recent technologies foster new practices in the development of content that is more compatible with the technologies now available for most operating systems (e.g., iOS, Android, Mac OS, Windows, Linux). These are the important advances in the field of accessibility that will change the portrait of digital educational environments in the coming years.

MOBILE DEVICES

Virtually all post-secondary students, with or without disabilities, own a smartphone (Chmiliar & Anton, 2018; Seilhamer et al., 2018) and, as our research shows, both groups appreciate being allowed to use their personal technologies in class (Fichten et al., 2018b). Our research (Fichten et al., 2019b), as well as that of others (e.g., Chmiliar & Anton, 2017, 2018; Clouder et al., 2019), indicates that mobile technologies such as smartphones, tablets, and laptops with touch screens are used to do academic work, both in class and at home, especially by students with various disabilities.

A key feature of mobile devices that can promote academic success is portability. Most importantly, built-in assistive technology, as well as software and apps that work across devices and platforms, assure that many students with disabilities do not have to pay for additional advanced multi-function assistive technologies. For example, our study which investigated the integration of smartphones and tablets into the learning process found that students with disabilities use their mobile devices for all the same reasons as students without disabilities (Fichten et al., 2019b). However, students with disabilities also used the built-in features of mobile devices (e.g., changing font size, speech-to-text, word prediction) and apps as assistive aids. Students with some specific disabilities, such as visual impairments, also indicated using apps such as Seeing AI and Microsoft Lens.

While the use of mobile devices is restricted in an assessment context because of issues of cheating and academic integrity, they are increasingly used in a learning context. Learning platforms and educational websites have the capability of exchanging information and making it available for use on both a computer and a mobile device. This can be very convenient as a student can start a task on their mobile device and complete it on their computer. It opens the possibility for the use of a multitude of learning strategies as well. Facilitating the coordinated use of computers and mobile devices can improve the accessibility experience of all students, but especially those with disabilities. Consider the example of the person with reduced mobility who may not be able to transport a laptop but can easily carry their smartphone or tablet.

The growth and subsequent reliance on technology due to COVID-19 resulted in a unique opportunity to explore the dual role – general use and assistive technology – that mobile technologies such as smartphones and tablets can play in the learning environment. In a study of 121 college and university students with disabilities and 51 students without disabilities, who indicated using either a smartphone or a tablet to do schoolwork, we found smartphones were more popular than tablets for both groups of students (Fichten et al., 2022a). Apple devices were preferred to Android devices by both groups.

Mobile devices, such as smartphones and tablets, are increasingly being used for schoolwork by all students – with and without disabilities. Portability, increased built-in accessibility features, as well as free and relatively inexpensive accessibility-related apps, make these devices the 'go to' choice for post-secondary students.

Apps for Students with ADHD

Because of the large number of students with ADHD (Gagné & Bussières, 2021; Green & Rabiner, 2012) and because they also have especially poor academic outcomes (Advokat et al., 2011; Budd et al., 2016; Green & Rabiner, 2012) we examined mobile tools that might help this group of students to complete schoolwork. To achieve this we conducted a series of studies.

- Study 1. We compiled a list of mobile apps that were recommended by experts for post-secondary students with ADHD to complete schoolwork (Fichten et al., 2020). The list was based on 23 journal articles or items in Google and Google Scholar published between the years 2017 and 2020. We also checked the past three years of ADDitude Magazine, as well as websites and Facebook groups. In Table 24.2, we present an annotated listing of the 20 schoolwork-related apps mentioned by at least two sources and available in the Apple App Store and/or the Google Play Store (Fichten et al., 2022b).
- Study 2. Next we used an online LimeSurvey to ask 35 students with ADHD and 74 students without disabilities whether they used any of the 20 recommended apps, and if yes, which of them were helpful (Fichten et al., 2022b). Both groups of students were familiar with Asana, Dragon Anywhere, Dropbox, Due, Evernote, Forest, Google Calendar, IFTT, Pomodoro Timer, Quizlet, Read&Write, and Microsoft To Do/Wunderlist. This study showed that one of the largest groups of students with disabilities on campus, students with ADHD, and students without disabilities used the same apps and found many of them helpful.

THE EMERGENCE OF ARTIFICIAL INTELLIGENCE (AI)

Students with various disabilities, the instructors who teach them, and the professionals who provide access services to them all agree that the hundreds of AI-based apps

Table 24.2 Twenty schoolwork-related apps available in the Apple App Store and/or the Google Play Store

App	Brief Description
Asana	Helps set goals and track progress using a Gantt chart
Dragon Anywhere	Dictation app for writing documents
Dropbox	Online file hosting that stores all files in the same place, across all devices
Due	'Auto Snooze' automatically reschedules overdue reminders as repeat reminders
Evernote	Task management and note taking that keeps all notes in one place
Focus@Will	Focusing music subscription service; customizes music for different activities
Forest	Growing a virtual tree; helps to set one's smartphone for specific distraction-free time periods
Freedom	Focusing, distraction management app; blocks websites, apps, etc. for specific time periods
Google Calendar	Web-based calendar and reminder that integrates with Gmail
IFTTT (If This Then That)	Connects apps, services, and devices to automate tasks
Microsoft To Do/ Wunderlist	Task management app with a daily planner; breaks tasks down into simple steps
Mindnode 5	Mind-mapping brainstorming tool; users can add visual tags to track progress
Pomodoro Timer	Focusing app; sets study and break times
Quizlet	Study app that uses flashcards and games to facilitate learning
Read&Write	Provides text-to-speech, word prediction, and other literacy tools
Remember the Milk	Reminders by email, text, and Twitter; works across all devices
RescueTime	Time management app that tracks time spent on apps, websites, and specific documents
Time Timer	Visual countdown timer; helps notice time remaining for a task
Todoist	Prioritizes tasks, sets daily and weekly goals, rewards for completion
Voice Dream Reader	Provides text-to-speech reading aloud with synchronized highlighting

are beneficial (Martiniello et al., 2020). In fact, popular AI includes scheduling apps, dictation, image and facial recognition, text-to-speech, and text summarization, as well as captioning and translation.

AI is also included in the development of products that support the well-being of students. For example, two Canadian colleges in Quebec collaborated with Optania (n.d.) to develop a mental health AI chatbot, Ali, that utilizes the French language. Ali is a caring conversational robot that serves as a gateway for referral to college psychosocial services and asks the student questions and responds accordingly based on their answers. Optania (n.d.) also developed ISA, a predictive AI platform that manages and analyses data related to the success of college students. It provides a real-time student profile and allows for the rapid identification of students at risk of failure and academic difficulties.

Using a scoping review of the scientific and grey literatures, we conducted an examination of AI-based technologies that could assist students with disabilities complete schoolwork (Fichten et al., 2021a). The review showed the articles and posts on Google.com, such as testimonials about the advantages of new products, the features of various technologies, and first-person accounts are very different from what can be found on Google Scholar and other scientific websites, where most articles are based on the development process of new products and their usability,

with small sample sizes and little current applicability. The one realm where there is some relevant scientific literature relates to intelligent virtual assistant apps, including Alexa, Siri, and Google Assistant. This is an important development because it reflects how the use of AI apps plays out in the hands of real users.

Intelligent Virtual Assistants

We completed an examination regarding how Canadian two-year and four-year college students with (n=121) and without disabilities (n=51) use Siri, Google Assistant, and Alexa to do schoolwork (Fichten et al., 2021a). Findings show that students did not use virtual assistants frequently to do schoolwork (between 2 percent for Alexa and 15 percent for Google Assistant). Again, there were few differences between students with and without disabilities. The main uses of virtual assistants were for calendar alerts, internet research, and the dictionary function. Input modalities were mainly voice for Google Assistant and half voice and half keyboard for Siri. For Alexa, students communicated through Amazon Echo. Students used more Apple than Android devices and more smartphones than tablets. Overall, we concluded that the hype about the potential of virtual assistants has not yet been realized. Once these virtual assistants acquire additional capabilities they will be of considerably greater benefit for students both with and without disabilities.

LESSONS LEARNED FROM REMOTE TEACHING AND LEARNING DURING THE COVID-19 PANDEMIC

The COVID-19 pandemic resulted in an explosion in the use of a variety of technologies. This includes videoconferencing tools, real-time video streaming of course lectures, cloud storage, and increased use of digital collaboration.

Videoconferencing

The COVID-19 pandemic resulted in an upsurge of videoconferencing, first for emergency remote teaching and subsequently for a myriad of other tasks, including communication among students, colleagues, and family members. In Canada, Zoom and Microsoft Teams are currently the most popular videoconferencing tools for post-secondary education, although there are others being used as well (e.g., WebEx, Slack) (Fichten et al., 2021b). In their English language versions, both Microsoft Teams and Zoom have live captioning and transcription features. Teams can provide captions in numerous languages with some adjustments and setting changes (Aberystwyth University, 2021) and the less frequently used Google Meet will shortly follow suit (Schroeder, 2021). These major technological advances in captioning have been noticeable since the beginning of the pandemic and are most likely where the big digital players have put their greatest efforts to be more accessible. Many Canadian colleges and universities provide free Microsoft subscriptions to

their students and faculty. Free Zoom versions have also been made available. Both Zoom and Teams work on virtually all platforms; a feature that students consider important.

Microsoft, Google, and YouTube now provide automatic captions in multiple languages. Thus, while the French language version of Microsoft 365 (both Teams and PowerPoint), Google Meet, and YouTube offer automatic live captioning, the French language version of Zoom did not during the 2022 spring semester although it is expected that this capability will shortly be added (Zoom Support, 2022). There has always been a lag between the release of English and French versions of digital products. This may help explain the difference in the usage of technology, including the adoption of assistive technologies, between English and French speaking post-secondary students in Canada.

Microsoft 365 recently incorporated numerous AI features. Given the importance of Microsoft in the technology market, its move to be more accessible is having a major impact on available technology, especially in education. Microsoft tools are interesting because of their collaboration features using OneDrive. These became vital during the COVID-19 pandemic for students with disabilities because of their accessibility features, such as speech-to-text, text-to-speech, live automatic captioning, and transcriptions.

For faculty use there are live captions in Zoom, Teams, and in PowerPoint. Also, most Microsoft 365 products have accessibility checkers. The availability of assistive technologies integrated into the operating system is similar in French and in English. Microsoft's influence in the technology market has put some pressure on other companies to offer more inclusive and accessible solutions. Other large tech companies, such as Adobe and Google are also incorporating accessibility-related AI into their suites (Bayern, 2019; Potoroaca, 2020).

Real-time video streaming of course lectures has made education accessible to students who are unable to attend classes in person due to various chronic illnesses and disabilities. During the COVID-19 pandemic real-time video streaming through platforms such as Zoom and Microsoft Teams has become the norm for many students. The Kubi Telepresence Robot is an interactive remote-controlled robot that runs alongside the institution's preferred videoconferencing software and is designed to hold an Apple or Android tablet during live video streaming (Kubi, n.d.). It differs from traditional room scale installed equipment because it allows a student user to look around the classroom and interact with a teacher, a small group, or an individual student without being physically present. The student can decide what they see by remotely controlling the camera installed in the tablet to pan 300 degrees and tilt 90 degrees. The Kubi Robot is a mainstream information and computer technology tool, but its potential as assistive technology is self-evident. However, there are issues that need to be addressed related to informed consent and privacy for those in the classroom, as well as the logistics of setting up and securing the equipment in the teaching space.

It is reasonable to expect a radical transformation of the assistive technology market. We will most likely see a decrease in specialized software offerings in favour

of solutions that integrate accessibility features. Although specialized assistive technologies will always be necessary (e.g., refreshable braille displays), this major transformation of the technology market will open up opportunities to create more accessible and inclusive digital educational environments.

Collaboration Tools

Collaboration tools for students have also become popular with the onset of the COVID-19 pandemic. Google Docs also has many accessibility features (Google Support, n.d.; Michigan State University, n.d.). Although Google Docs is more commonly used to collaborate, Microsoft Word can also be used (Microsoft Support, n.d.-a), especially when combined with Microsoft OneDrive (Microsoft Support, n.d.-b). Nevertheless, our findings show Discord as the most likely to be used by students to collaborate with each other (Fichten et al., 2022b).

RESEARCH ISSUES

The technology landscape is changing for Canadian post-secondary students with disabilities. However, the focus of research studies does not reflect this new technological perspective, nor the characteristics of today's post-secondary students with disabilities.

One issue that needs to be addressed is the selection of research participants. Over half of students with disabilities do not register for disability services from their institution, yet that is where research participants have traditionally been recruited. To get a representative sample there needs to be a broader recruitment strategy to find both registered and non-registered students. Categorization of disabilities must also be carefully considered as many students have more than one disability and students with different disabilities may respond in unique ways to the technology made available to them. In recent studies few differences were found between students with and without disabilities. Rather than put into question the relevance of disability as a variable, it is worthwhile to continue exploring the differences and similarities of students with and without disabilities. The intersectionality of disability with such variables as gender, race, socio-economic class, and language should also be considered.

Another question has to do with the types of technology researched. Originally, disability-related research focused on adaptive technology but clearly this is no longer sufficient as students with disabilities are increasingly accessing general use technologies, including with mobile devices. Tech giants such as Microsoft, Adobe, Google, Apple, and Android have been incorporating powerful built-in accessibility features into their products. Other developers are following suit by also exploiting AI. Clearly, if research on technologies for students with disabilities is to remain relevant, it should go beyond adaptive technology and incorporate mainstream digital

tools, including mobile technology such as smartphones, apps using AI and even browser extensions.

The greater openness to inclusive pedagogy is also bringing about a dramatic change in the digital learning environment and the way technology is being used in and out of the classroom. In applying a universal design model, intentionally or unintentionally, some assistive technologies that were traditionally reserved for students with disabilities are now available to all students. Part of this transformation was brought about by the COVID-19 pandemic and the necessity to move to online teaching and learning. Regardless of the reason, research could be conducted to better understand the effective use of technology in instruction, both for students with and without disabilities. As well as continuing the research on the impact of the pandemic on technology, and vice versa, the role of technology in Universal Design for Learning and other forms of inclusive education should be further studied.

Research is of limited value if findings are not efficiently communicated to key stakeholders. Students, with and without disabilities, disability service providers, faculty, and administrators want more information about what technologies exist that have proven beneficial, and how they can best be implemented. As well, developers could benefit from feedback from users so they can continue to make their products universally accessible. Therefore, it should be the responsibility of researchers to disseminate both the results of their studies and their implications.

CONCLUSION

We began this chapter with the premise that accessibility practice sometimes comes before accessibility research. Although we were able to describe several studies, it is obvious that many questions, including what impact research has on policy and practice, remain unanswered. What is encouraging is that the field of technology as it relates to students with disabilities is not standing still but continues to advance. One day research may catch up and the horse will finally get in front of the cart! Only then will accessibility practice be based on a firm scientific foundation. Is this likely to happen, considering the rapid pace at which technology is changing?

NOTE

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