The ALT Text | Accessible Learning with Technology

CRITICAL ANALYSES

Summer 2024

Edited by Rob Power, EdD

Chapter contributions from participants in
EDUC5507G: Accessible Learning with Technology

CRITICAL ANALYSES: SUMMER 2024

The ALT Text

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Accessible Learning with Technology
Critical Analyses: Summer 2024

ROB POWER

POWER LEARNING SOLUTIONS

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CRITICAL ANALYSES OF ACCESSIBILITY ISSUES AND POTENTIAL SOLUTIONS

The following chapters have been contributed as major assignments by participants in some of my instructional design and educational technology courses. Each chapter has been peer-reviewed, including feedback on general accessibility using accessibility audit checklists developed by course participants.

A Note About the Critical Analyses Chapters

ROB POWER

The following chapters will represent contributions by participants from some of my instructional design and educational technology courses. Each interactive chapter is submitted as a major course assignment. It is then "blind" peer-reviewed by classmates, including through the use of checklists and rubrics for accessibility developed as one of their course activities. The range of sub-themes and the number of chapters that follow in this "living text" will expand and evolve, as new chapters are submitted during subsequent course offerings.

Implementing the eBook Chapter Assignment

The following is a generalized version of the instructions provided to students in my courses for the three stages of this assignment. Feel free to adopt and adapt as necessary if you plan to implement a similar project with your own students!

eBook Chapter Assignment: Part 1 (Draft Chapter)

Overview

You will prepare a research paper that identifies an Accessibility issue for teaching and learning in a K12, higher education, or workplace training context, and that proposes proposed solutions to that issue through the integration of instructional design strategies and potential digital teaching and learning resources.

Your paper should be approximately 2000-2500 words, and should be formatted according to APA v7 guidelines, and should also adhere to formatting guidelines for document accessibility.

View [full assignment part 1 instructions with assessment rubric]

eBook Chapter Assignment: Part 2 (Audit Report)

Overview

Utilizing rubrics that will be developed as a class activity during Week 8 (see the Developing an Audit Checklist chapter), you will “audit” one of your classmate’s paper submissions from eBook Assignment Part 1 (Draft Chapter), before publication of that paper as part of a fully-accessible, open-access eBook project.

You will prepare an “audit report” (max 1000 words) that follows APA v7 guidelines, as well as general document accessibility guidelines, that:

- Describes the criteria used to evaluate or audit digital resources, such as the group presentation sites, and the rationale for those criteria.
- Discusses the auditing process, and the findings of the auditing process.
- Makes recommendations for reducing or mitigating potential accessibility issues such as those found through the group presentation auditing process, and in a general context for anyone creating their own digital teaching and learning resources.

View full assignment part 2 instructions with assessment rubric

eBook Chapter Assignment: Part 3 (Final Publication)

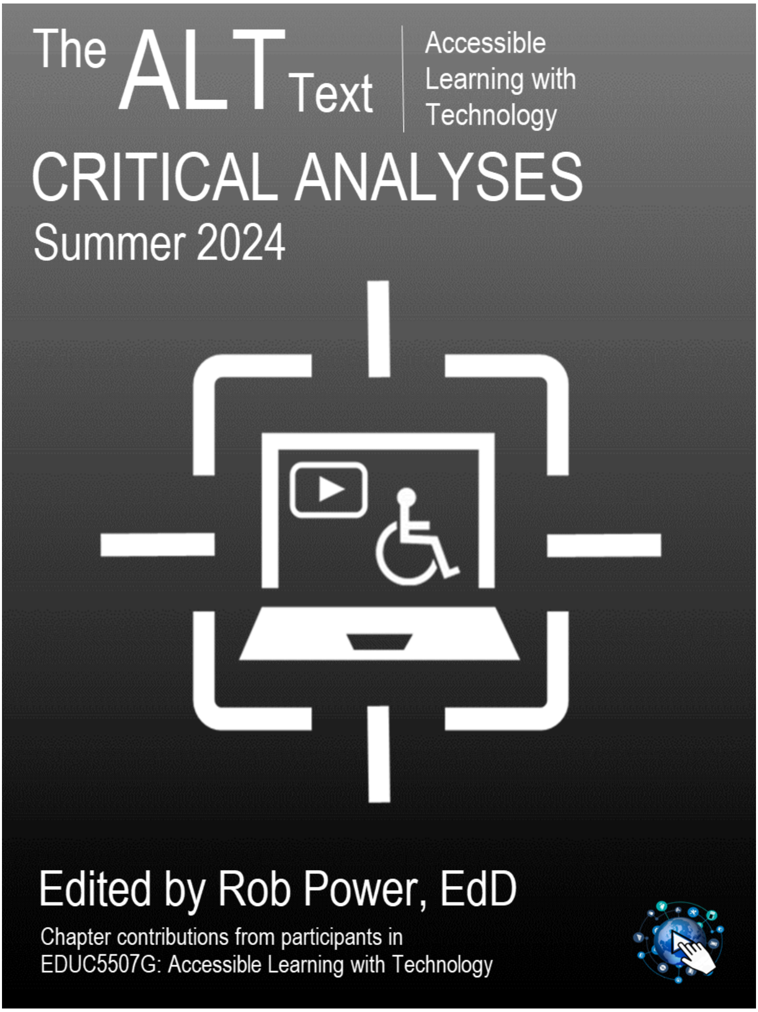
Overview

For this assignment, you will use the feedback received from your instructor for your draft eBook chapter submission, as well as the "audit report" submitted by one of your classmates, to complete edits and revisions to your major paper, and submit it for inclusion in a fully-accessible, open-access eBook project. You will submit your polished version of your paper to the eBook Assignment Part 3 drop box in the course. Your instructor will provide details on the publication platform in class.

View full assignment part 3 instructions with assessment rubric.

SUMMER 2024

Chapter contributions by participants in EDUC5507G: Accessible Learning with Technology during the Spring/Summer 2024 term at Ontario Tech University



APPS AND TOOLS FOR PROMOTING ACCESSIBILITY

Minimizing Barriers to Document Accessibility - SensusAccess: A Self-Service Tool

KAYLA CHARBONNEAU

Introduction

Screen readers are indispensable assistive technologies that empower individuals who are blind to interact with computers effectively. According to Momotaz et al. (2023), these tools audibly narrate visual content displayed on screens and offer alternative navigation options like keyboard shortcuts, thus removing the need for a mouse. Critical to their functionality is the use of alternative text, and manually inputted descriptions of images and graphics. This feature is pivotal in enabling blind users to access and understand visual information that would otherwise be inaccessible. By converting visual elements into meaningful auditory descriptions, screen readers ensure equitable access to digital content, effectively bridging the accessibility gap.

Momotaz et al. highlight that screen readers are crucial in enhancing independence and productivity for blind individuals in various domains, including education, employment, and daily life. These tools facilitate reading and navigation and enable users to interact with complex applications and websites independently. Moreover, they contribute significantly to inclusivity by allowing blind users to participate more fully in digital communication and information-sharing platforms. Screen readers represent a transformative technology that empowers individuals who are blind by providing them with the tools necessary to navigate and engage with the digital world on par with their sighted counterparts. Through alternative text and audible narration, screen readers make digital content accessible and comprehensible, thereby promoting equal opportunities and enhancing the overall quality of life for blind users.

Not All File Types are Created Equal

For screen readers to effectively narrate text displayed on a screen, the content must be formatted using a digital language that these assistive technologies can interpret. Hypertext Markup Language (HTML) stands out as the format of choice for accessibility (Teaching and Learning, n.d.). HTML's structured nature inherently supports compatibility with screen readers, requiring minimal additional effort to ensure files are readable. This structured format also enhances navigation capabilities through the use of keyboard shortcuts, providing a more efficient browsing experience for visually impaired individuals. Furthermore, HTML's native application as a web browser ensures consistent and reliable rendering of content across different devices and platforms, maintaining accessibility standards universally.

PDF files, or Portable Document Format, are widely used in education but vary in their accessibility. According to Teaching and Learning (n.d.), there are three types of PDFs: unstructured, structured, and tagged. Among these, only tagged PDFs are optimized for accessibility. Tagged PDFs include markers in their code that enable screen readers and other assistive technologies to accurately narrate the text and navigate the document (Accessible PDF, 2019). However, creating accessible tagged PDFs requires careful tagging to ensure that all content, including headings, images, and tables, is correctly identified and described. This meticulous tagging process is crucial for ensuring that PDF documents are accessible to individuals who rely on assistive technologies for reading and comprehension.

Microsoft Word (2024) is a ubiquitous file format in education, yet its accessibility for visually impaired users poses significant challenges. Despite features like Styles for structuring content, which are often overlooked (Teaching and Learning, n.d.), Word's underlying coding does not integrate seamlessly with screen readers. Unlike HTML, which is structured for accessibility, Word's formatting can impede screen readers from effectively interpreting and narrating text. While authors can add alternative text to graphics in Word, this information is not accessible to screen readers within the Word application itself, limiting the utility of .docx files for visually impaired students and educators.

Guidelines and Regulations

Regulating accessibility in higher education is crucial for ensuring that all students have equal opportunities to pursue and excel in their academic endeavors, regardless of their physical or cognitive abilities. Accessibility regulations not only uphold principles of equity and inclusivity but also foster a supportive environment where every individual can fully participate and benefit from educational experiences (VanderMolen, 2023). Accessibility policies ensure that campuses, facilities, and digital platforms are designed and maintained to accommodate diverse needs. By adhering to these standards, institutions eliminate barriers that could otherwise hinder students with disabilities from accessing educational resources and participating in activities on an equal basis with their peers.

Accessibility for Ontarians with Disabilities Act

The Accessibility for Ontarians with Disabilities Act (AODA) of 2005 is a crucial piece of legislation in Ontario. Its primary goal is to achieve accessibility for individuals with disabilities by setting standards and regulations that organizations and businesses must follow (accessiBe, 2024). The AODA outlines specific requirements and timelines for making various aspects of society accessible, including customer service, employment, information and communication, transportation, and built environments.

By establishing these standards, the AODA aims to create a barrier-free Ontario, where people of all abilities can participate fully in all aspects of life. It mandates that organizations implement measures to identify, remove, and prevent barriers to accessibility. The AODA is not only about physical accessibility but also encompasses digital accessibility, ensuring that websites, software, and digital content are usable by everyone, including those with disabilities. This includes ensuring that information is available in accessible formats, and setting the World Wide Web Consortium's (W3C, 2022) Web Content Accessibility Guidelines (WCAG) 2.0 Level AA as its minimum requirements.

Web Content Accessibility Guidelines

WCAG 2.0, or the Web Content Accessibility Guidelines 2.0, consists of four guiding principles that serve as the foundation for creating accessible web content. These principles are perceivable, operable, understandable, and robust (W3C, 2022). Perceivable means that information and user interface components must be presented in a way that users can perceive. This means providing alternatives for non-text content (such as images, audio, and video) and ensuring content is distinguishable (e.g., sufficient color contrast). Operable means that user interface components and navigation functionality must be operable. Users should be able to navigate and interact with the website using various input modalities (e.g., keyboard, mouse, touch) and sufficient time should be provided for users to read and use content. Understandable: involves making content readable and predictable, using clear language and consistent navigation, and providing assistance with errors and input validation. Finally, robust means that content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. This means using technologies that are compatible with current and future user agents, ensuring content remains accessible as technologies evolve. These principles form the basis for the detailed guidelines and success criteria outlined in WCAG 2.0, which are essential for developers, designers, and content creators to follow when aiming to make their web content accessible to people with disabilities.

SensusAccess

SensusAccess
alternate media made easy

Achieving comprehensive accessibility in educational materials requires institutions and educators to adhere to WCAG guidelines and legal standards such as the AODA. Implementing tools like SensusAccess (2023) in post-secondary settings is crucial for overcoming barriers posed by inaccessible document formats, and ensuring compatibility with screen readers and other assistive technologies. By leveraging SensusAccess, institutions can transform various document types into accessible formats, thereby fostering an inclusive learning environment. This approach enables students with disabilities to access course materials effectively, promoting equal educational opportunities for all learners, regardless of their abilities. SensusAccess plays a pivotal role in enhancing accessibility by facilitating the conversion of documents into formats that support diverse needs, ultimately supporting a more equitable educational experience.

Capabilities

SensusAccess (2023) is a specialized document remediation service tailored for educational institutions. It automates the conversion of documents across various file types, including audiobooks, e-books, digital Braille, digital large-print, and BeeLine Reader formats. The service addresses inaccessible document formats such as image-only PDFs, JPG images, Microsoft PowerPoint presentations, and LaTeX projects, transforming them into more accessible formats that facilitate easier navigation and comprehension. Moreover, SensusAccess offers language translation capabilities, allowing documents to be converted from one language to another, further enhancing accessibility for multilingual students and educators alike. By providing these functionalities, SensusAccess supports universities in creating an inclusive learning environment where all individuals, regardless of their abilities or linguistic backgrounds, can access educational materials effectively. This comprehensive approach not only promotes accessibility compliance but also improves the overall accessibility and usability of educational resources, contributing to a more equitable educational experience for diverse student populations.

Examples of Successful Integration

One institution that has successfully implemented SensusAccess is McMaster University (Accessibility Hub, 2024). Their Accessibility Hub, affiliated with Library Accessibility Services, boasts an easy avenue for alternate media. This resource provides a straightforward process for converting documents into alternate formats, making resources more accessible to students with disabilities. SensusAccess plays a crucial role by allowing users to convert documents into formats such as audio, Braille, and digital text, thereby supporting diverse learning needs within the university community. McMaster's use of this important tool is a testament to its commitment to accessibility and inclusivity in education. Other institutions that have integrated SensusAccess, such as Wilfrid Laurier University (Thomas, 2023), Toronto Metropolitan University (Toronto Metropolitan University Libraries, 2022), and Harvard University (Harvard University, n.d.), have similarly embraced the tool's capabilities to enhance accessibility and inclusivity in their educational environments. These institutions' adoption of SensusAccess underscores its effectiveness in facilitating compliance with accessibility standards and improving the educational experience for students with disabilities.

Limitations

As detailed in McMaster University's SensusAccess guide (Accessibility Hub, 2024), the effectiveness of converting documents from one format to another hinges significantly on the quality of the original document. High-quality scanning is crucial as it directly impacts the accuracy of data transfer during the conversion process. Documents that are poorly scanned or lack sufficient resolution or clarity are prone to recognition errors (Thomas, 2023) when converted into alternative formats.

Moreover, documents with poor contrast levels or conversion of files containing complex elements like mathematical symbols to text formats pose additional challenges. These factors can impede the accurate interpretation and conversion of content, potentially affecting the comprehensibility of the document for users relying on assistive technologies. Being that it is an automated tool, SensusAccess is not always accurate and may produce errors (Thomas, 2023).

Finally, testimonials about the use of SensusAccess from the perspective of the student and the instructor are lacking. Further research should be done to explore the user experience and flesh out any challenges that may arise. These may vary from challenges related to first-time use or large-scale use.

Conclusion

The integration of assistive technologies like tools such as SensusAccess plays a pivotal role in advancing accessibility standards in educational settings. Screen readers make educational content accessible to students, faculty, and university staff, but only so long as those documents can be transcribed by the screen reading program. SensusAccess is vital to supporting the use of screen readers by stakeholders with various visual disabilities. SensusAccess also aids in the adherence to legal frameworks such as the Accessibility for Ontarians with Disabilities Act and international standards like WCAG 2.0, which provide essential guidelines for fostering inclusive educational environments.

SensusAccess exemplifies a proactive approach to accessibility, automating the conversion of documents into accessible formats such as audiobooks, Braille, and digital text. Its capabilities extend beyond basic conversion, offering language translation and support for diverse file types, thereby catering to the varied needs of a multicultural and multi-ability student body. Successful implementations of SensusAccess at institutions like McMaster University highlight its role in facilitating compliance with accessibility standards and enhancing the educational experience for students with disabilities. Despite its benefits, challenges such as document quality and processing accuracy underscore the ongoing need for quality control and user awareness.

The continued advancement and integration of assistive technologies and accessibility tools are essential for realizing inclusive educational environments. By embracing these technologies and adhering to established standards, educational institutions can ensure that every student, regardless of ability, can fully participate in and benefit from educational opportunities. Through collaboration, innovation, and commitment to accessibility, post-secondary institutions can collectively foster a more inclusive society where diversity is celebrated and barriers are dismantled.

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Audio Computers - The Way Forward

BROOKE WITKOWSKI

Abstract

This chapter reviews how audio computers can help learners of various ages and abilities inside and outside the classroom by decreasing background noise, increasing sound clarity, reducing sensory overload, and translating speech without using a handheld device. There is no current or existing research for audio computers because the first company, IYO, will release the first of its kind in late 2024/early 2025. Therefore, this chapter aims to connect previous research on hearing aids and hearing impairment to learning and how the audio computer could aid students in hearing with fewer distractions and translating languages. Solutions for barriers to accessibility that audio computers could present for learners will also be proposed.

Key Words

Additional languages, audio computers, hearing loss, hearing impairment, IYO One, tinnitus,

Introduction

Released in May 2024, Rugolo's TED Talk, Welcome to the World of Audio Computers (2024), was viewed 167-thousand times by July 2024. The new technology described by Rugolo has been hyped as the next most significant breakthrough since the first iPhone was released.

Watch TED (2024, May 8). *Welcome to the World of Audio Computers | Jason Rugolo | TED*. [Video]. (13:04 mins)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=315#oembed-1

Personalized audio computers will allow people to have individualized and humanized voice interactions for all aspects of life, such as education, work, fitness, and customized coaching and assistance. Hearing is a significant concern as, according to the Government of Canada (2024), the inability to communicate effectively due to hearing loss can lead to smaller social circles and feelings of loneliness. For young people, even minor hearing impairments can affect their school performance, language skills, and emotional development. In adults, hearing loss is connected to higher levels of anxiety and depression, as well as lower income and fewer job prospects. The ability to hear is a vital component of all aspects of life.

Hearing Impairments

Hearing loss is becoming a more expansive issue than ever before. According to the WHO (2024), over 1.5 billion individuals worldwide (almost 20% of the global population) experience hearing loss, with 430 million of them having severe hearing impairment. By 2050, the number of people with severe hearing loss will exceed 700 million. Also, a systematic review published in the open-access journal BMJ Public Health suggests that video gamers, which may include 3 billion people globally, may be at risk of permanent hearing loss or tinnitus, characterized by continuous ringing or buzzing in the ears (Dillard et al., 2024). Therefore, we must take proactive measures to combat the increasing number of people with hearing impairments.

Audio computers could help people with hearing loss for various reasons: constant exposure to loud noise, age, and genetic mutations. The device could also help people who do not fit into this category and suffer from noise sensitivities in general, tinnitus, or people with Down Syndrome. They could also be more accessible by users because they remove the physical barrier of holding a handheld device. It can also translate speech into the desired language to remove a language barrier. Since this device has yet to be released, no research exists. However, using audio computers could be promising and should be further studied.

Context of Using Audio Computers

Although my profession focuses on Language Instruction for Newcomers (LINC) in adult education, this device could benefit everyone, regardless of gender, race, age, and socioeconomic status, in educational and real-world scenarios. However, LINC consists of adult learners who sometimes come from war-torn countries and may have had limited medical access. Also, hearing loss becomes more prevalent with age (WHO, 2024). Adult learners usually enter the classroom to learn and improve their English here in Canada. Since many newcomers sponsor family members as part of the government’s plan to reunite family members and help “the world’s most vulnerable populations through refugee resettlement” (Immigration, Refugees and Citizenship Canada, 2023), it is vital that adults can hear and understand in the classroom and places such as the doctor’s office, schools for their children, job interviews, housing agencies, and other vital components of settlement. Audio computers could help people of all ages not only hear the other person’s words but also translate speech into any desired language so that they can access vital services as landed immigrants. There could be many benefits to ease newcomers’ transition to life in a new country if audio computers are accessible.

Audio Computer- Potential Solution?

In the 21st century, various technical handheld devices have swept the market. However, what separates this new gadget is that it is a hands-free personalized device, unlike the recently released Humane AI Pin and the Rabbit R1, which were failures (Data Monsters, 2024). Rugolo (2024) hopes that with the audio computer, people can leave them in their pockets or at home. The audio computer uses natural language that is intuitive and personalized for the user with access to the internet and AI. As the founder emphasizes, people are no longer giving commands to a voice assistant but interacting with how two people might communicate naturally. It can also allow the users to adjust the ambient sounds or background noise in their location, giving them choices in their soundscape. Rugolo (2024) and his company have worked in psychoacoustics for six years, building a giant audio structure resembling the Star Trek holodeck to create a "virtual auditory space" for users. These wearable earbuds will be available in the fall of 2024, and they will be a game changer for all people, including individuals with hearing, learning, and language impairments, and offer immediate AI-generated language translation.

Background Noise

In Rugolo's Ted Talk (TED, 2024), he demonstrates how audio computers can isolate speech and remove background or any other noises. If a person without an identified disability could benefit from eliminating background noise from their hearing, what about people with a hearing impairment**?** A study by Brännström et al. (2018) discovered that background noise from multiple speakers makes it harder for children with normal hearing to understand and remember information; therefore, the multi-talker babble noise of other students in a classroom can interfere with practical learning. Seemingly, if background noise can interfere with learners who do not have a disability, what about learners who do? We will now look at how audio computers can help people who identify with a disability in a learning environment.

Learners with Hearing Impairments

Even though the masses of people do not identify as someone with a hearing impairment, we should look to find help for those who do. According to IYO's LinkedIn post after the Ted Talk, others were delighted with this new device. Dr. Ram Nileshwar states the following:

As an audiologist, helping my patients hear and understand speech better for 44 years, would be a dream come true for the millions of individuals struggling to communicate better in challenging listening environments. I certainly hope there would be options for this technology to be used without voice prompts, possibly with touch-initiated actions and/or via an app on a smartphone. Can't wait to see the delight on the face of the hard-of-hearing individual communicate better with little to no effort!" (Nileshwar, 2024).

The Center for Devices and Radiological Health states that hearing aids can not restore hearing like corrective eyewear but work by amplifying sounds, even the ones we do not want to hear, like background noise. This is because when using hearing aids, the brain needs to relearn which sounds to prioritize and which to disregard (Claso, 2021). However, in Rugolo's Ted Talk, he asks "Q," the AI-voice assistant, to "...enhance the sound that is right in front of me?" (10:23). Once the sounds are enhanced, Rugolo (2024) asks "Q" again to turn the sound of the baby crying down. Then the baby is no longer heard at all (10:32). This is consistent with the study done by Browning et al. (2019) when comparing OMNI, which picks up sounds from all directions equally, the fully adaptive directional hearing aids enhanced speech recognition in consistent background noise for children with hearing loss, even if they were not facing the speaker. Therefore, I hypothesize that if children and learners can hear relevant speech around them instead of background noise, they could have a more optimal learning experience and reduced cognitive load. If people could hear better with or without background noise, there could be a reduction in the number of people diagnosed with dementia, too. According to a systematic review by Yu et al. (2024), adult-onset hearing loss is often treatable with hearing aids, which may also help reduce the risk of dementia. One reason might be that the less input the brain has to decipher, the better. Humans need a delicate balance of input and output of relevant communication and speech in the brain for optimal cognitive ability.

Tinnitus

Tinnitus is another form of hearing impairment. However, the ear ringing or humming is self-produced instead of an external noise. As documented in recent research analyzing approximately 50 years of data, tinnitus, often called a ringing in the ears, could impact around 750 million globally, nearly 10% of the population. According to a systematic review by *JAMA Neurology*, severe tinnitus affects adults and children equally (Jarach et al., 2022). As a result, people of all ages suffer from tinnitus, and the audio computer may be able to remove the ringing in their ears so that they can concentrate on the world around them, not the sound in their ears. However, no research exists on this topic now, but it should be an area of consideration in the future.

Another benefit of using audio computers and the technology used to make them is that they reduce the effort or cognitive load to hear and understand a person. A study by Beechy et al. (2019) suggests that participants with hearing loss managed effective communication regardless of their background noise level or hearing impairment. However, current speech assessments have strengths but do not consider how people interact during conversations or the impact of motivation and engagement. A person with a hearing impairment could begin to lack the motivation to engage in classroom activities if more effort is required to interact with classmates. A later study by Beech et al. (2020) found that effort is crucial for understanding how noise and hearing impairment affect communication. It goes beyond speech perception, encompassing interactive conversations where speakers adjust to maintain effective communication despite challenges. This dynamic concept shows how individuals adapt their energy to meet others' needs, revealing its significance in assessing the impact of adverse conditions on hearing and the experiences of those with hearing impairments in daily life. With the assistive technology of audio computers, learners could expend their energies on creative and productive work rather than expending it solely on communicating with others.

Language Barrier

Another helpful feature of the audio computer is isolating sounds and translating speech simultaneously. In Rugolo's Ted Talk (2024), one of the people speaks in Spanish, and the listener asks for the speech to be translated into English (10:46) with the background noise already removed. The IYO One translates his words without delay and with his voice. For learners who struggle with language daily, this could be revolutionary. A study by Goldschagg et al. (2023) discovered that noise affects both English First Language Learners (EL1) and English Second Language (EL2) learners, but EL2 learners experience more disruption from noise. Not only does the audio computer eliminate background noise to increase audibility, but since it can translate speech, it could also provide access to health services for the learner and their children. A review of 152 children with ASD revealed that those with English-speaking parents were more likely to have social skills and communication goals in their IEPs and received more direct service hours from state disability programs. This suggests that language barriers may hinder non-English-speaking parents from accessing necessary healthcare services for their children with ASD (St. Amant et al., 2017). If a parent of a child with a learning disability could have access to instant translation, they may be able to access more resources for them and their child.

Hands-Free vs. Hand-Held Devices

This chapter advocates the need for audio computers for all people. However, one might wonder why we already have these features, such as text-to-speech, translation, voice commands, AI assistants, etc., on our mobile devices. The reason why audio computers are more accessible is that it enables the user to free their hands. For example, say a service dog guides a student in a wheelchair to the entrance to a building. This person needs to push the wheelchair button to enter the building. They already have one hand on the leash, another possibly on the controls or wheel of the chair; how would they then have access to push the buttons on their phone? This scenario also excludes the possibility that they had no motor coordination issues. Therefore, hands-free devices could provide more accessibility features that would benefit everyone regardless of disability, but further discovery and research are needed.

Barriers to Audio Computers

Although the audio computer seems to have many benefits, it also has its challenges. The release date is the fall of 2024, so the

IYO One could be delayed even further, which would further research and studies on the device's practicality. The device costs $600 US and requires a subscription service or cellular plan. This would be a steep barrier for many users**.** Based on a report by Statistics Canada (2023), one in four Canadians cannot cover an unexpected $500 expense, highlighting financial vulnerability, which also increases among racialized population groups. However, the most significant barrier is that it cannot be a one-size-fits-all solution, especially for people with sensory issues, as it seems quite bulky for the ear. We also do not know the effects of having a device continuously connected to Wi-Fi in an individual's ear as there is yet to be research on this topic. However, in Pall's (2018) study, seven adverse effects are consistently associated with Wi-Fi and other EMF exposures. Further research is needed in this area.

Instructional Strategies

Although an array of strategies is optimal for learning, incorporating the five design strategies is always helpful. Firstly, as an instructor in adult education, I would conduct a needs analysis and ask the learners about their learning style preferences and if they require additional support. However, it is essential to note that since one out of five to one out of ten (WHO,2024) people will have a hearing disability, a person(s) with this impairment will most likely be in a classroom. Therefore, it would be best to plan for this scenario in advance by, for example, telling all students to ask their audio computer to remove the background noise (construction, air conditioning vent, etc.) while in class for a more optimal experience. One then includes this in the design of writing in the lesson plan, as well as the instructions an instructor would give students during a task, writing on the plan, “Remind students to turn off background noise on their audio computer while different groups are talking to reduce multi-talker babble.” In the development phase, the instructor would advise students that they are about to practice pronunciation and may need to isolate the partner’s speech during the practice dialogue. During the implementation phase, the instructor could walk around or join different breakout rooms, inquire about their soundscape, and offer suggestions for audio quality depending on the task. Lastly, during the evaluation, instructors could receive feedback from their learners on what they discovered, tips for tweaking their soundscape, and discuss how it aids their auditory quality and comprehension of the task. It could be viable for many learners to wear audio computers in the future.

Conclusion

As noted throughout this chapter, no existing research on this topic exists. However, the IYO One could become the norm in a majority of classrooms throughout the world, just as laptops, cellphones, and tablets are. Future researchers would look at content comprehension, the correlation between brain activity and hearing, and how immediate and accurate speech translation increases income using audio computers inside and outside the classroom. Some possible adverse effects to research could include Wi-Fi in the ear, overdependence on the audio computer, and the psychological effects of being “wired” for 16 hours of the day. Concludingly, the IYO One could be the way forward, and hand-held devices could be a way of the past.

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Revolutionizing Testing: The Impact of Computer Adaptive Testing on Accessibility and Equity in Education

ROMAN NAGHSHI

Introduction

Context/Background to the Research

Traditional testing environments often fail to accommodate the diverse needs of students, leading to significant accessibility challenges. These challenges include issues faced by students with learning disabilities, those from different cultural backgrounds, and individuals with physical impairments. Additionally, traditional tests often induce high levels of stress and anxiety, further impacting student performance negatively (Heissel et al., 2019, p. 47). The disparity in academic achievement between students with and without disabilities highlights the urgent need for more inclusive and adaptive testing methods (Newman et al., 2011, p. 48).

Topic Clarification

This research focuses on Computer Adaptive Testing (CAT) as a potential solution to address the accessibility issues inherent in traditional testing environments. CAT dynamically adjusts the difficulty of test questions in real-time based on the test taker's performance, offering a personalized assessment experience. This method aims to provide a more accurate measure of a student's knowledge and skills, catering to their unique needs and reducing the barriers associated with traditional testing formats (Weiss, 2011, p. 10-11).

Thesis

The central thesis of this research is that Computer Adaptive Testing (CAT) significantly enhances accessibility and equity in educational assessments by providing a tailored testing experience that accommodates diverse learning needs, reduces test-related stress, and maintains academic rigor.

Road Map

This essay will first explore the various accessibility issues prevalent in traditional testing environments, highlighting their impact on student performance and outcomes. Next, it will delve into how CAT addresses these issues through its adaptive nature, multimodal support, and strategies for maintaining academic rigor (Sireci & Zenisky, 2006, p. 329).

Following this, the discussion will cover the challenges and limitations of implementing CAT and propose mitigation strategies to overcome these hurdles. Finally, the essay will look ahead to future directions and innovations in CAT, emphasizing the potential for integrating advanced technologies to further enhance its effectiveness and inclusivity.

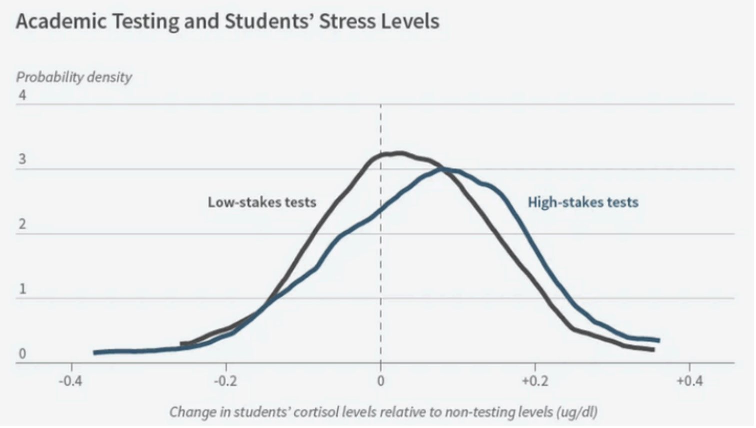
Accessibility Issues in Traditional Testing

Traditional testing environments often fail to address the diverse accessibility needs of students, leading to significant challenges for many. Students with learning disabilities, for example, may struggle with the standardized format of traditional tests that do not accommodate their specific needs, such as extended time or alternative formats. Those from different ethnic backgrounds might encounter cultural biases in test questions, which can disadvantage them if the content is not reflective of their experiences and knowledge. Diverse learning preferences also pose a challenge, as traditional tests typically cater to a narrow range of skills, such as rote memorization and written expression, rather than incorporating various ways of demonstrating understanding.

Physical disabilities add another layer of complexity, as students with mobility impairments or visual and hearing impairments may face difficulties in accessing test materials or environments designed without their needs in mind. Additionally, stress and anxiety are pervasive issues, exacerbated by high-stakes testing. The traditional testing format often amplifies these issues, leading to increased cortisol levels, a stress hormone, during high-stakes exams as compared to low-stakes ones, as demonstrated in a study involving students from a charter school network in New Orleans (Heissel et al., 2019). This heightened stress can impair cognitive function, negatively impacting performance and outcomes (see Figure 1).

Figure 1

Changes in students' cortisol levels during low-stakes and high-stakes tests.

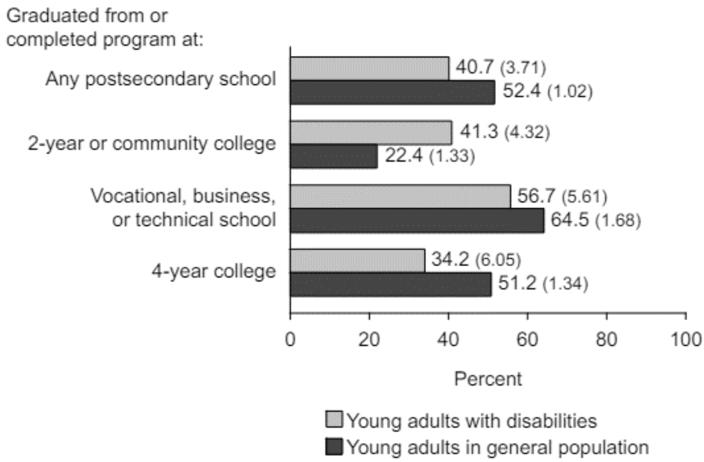


Note. Changes in students' cortisol levels during low-stakes (internal school tests) and high-stakes (statewide standardized tests) testing weeks relative to non-testing weeks. The probability density on the y-axis shows the distribution of these cortisol changes among students, indicating significantly increased cortisol levels during high-stakes tests compared to low-stakes tests (Heissel et al., 2019).

The disparity in graduation and completion rates for students with disabilities (SWDs) further illustrates the impact of inadequate accessibility. At four-year colleges, the completion rate for SWDs is 34%, significantly lower than the 51% completion rate for their non-disabled peers. Across all postsecondary institutions, the completion rate for SWDs is 41% compared to 52% for non-disabled students (Newman et al., 2011, p. 47). This gap is often due to universities not providing the necessary accommodations and support, leading to higher dropout rates among SWDs (see Figure 2).

Figure 2

Completion rates of students with disabilities from current or most recently attended postsecondary school.



Note. Completion rates of students with disabilities from current or most recently attended postsecondary schools compared to their non-disabled peers (Newman et al., 2011, p. 48).

Traditional testing's impact on student performance extends beyond stress and accessibility issues. For instance, socioeconomic factors also play a significant role. Research indicates that cortical thickness, which correlates with academic achievement test scores, differs between higher- and lower-income students (Mackey et al., 2015). Lower-income students, defined as those from families earning less than $42,000 per year (Mackey et al., 2015, p. 5), show differences in brain regions related to vision and knowledge storage. These neuroanatomical disparities, influenced by environmental factors, further disadvantage lower-income students in traditional testing scenarios, exacerbating the income-achievement gap.

In summary, traditional testing environments are rife with accessibility issues that disproportionately affect students with disabilities, those from diverse backgrounds, and those experiencing high levels of stress and anxiety. These challenges contribute to lower performance and completion rates, highlighting the urgent need for more inclusive and adaptive testing methods that cater to the diverse needs of all students.

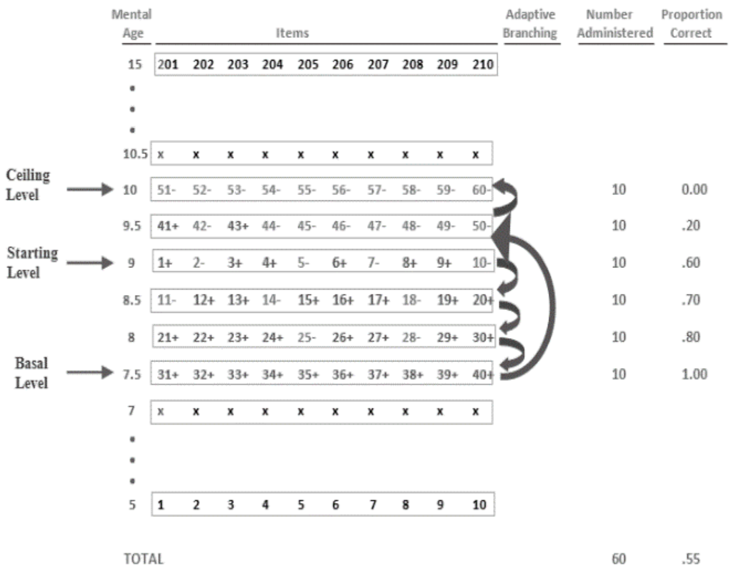
How CAT Addresses Accessibility Issues

Adaptive Nature of CAT

Computer Adaptive Testing (CAT) represents a significant advancement in the field of educational assessment by adapting to the test-taker's ability level in real-time. This dynamic approach means that the difficulty of each subsequent question is determined based on the student's performance on previous questions. For instance, if a student answers a question correctly, the next question will be more challenging. Conversely, if a student answers incorrectly, the subsequent question will be easier. This real-time adjustment helps to keep the student engaged and reduces the frustration that can arise from questions that are either too difficult or too easy (Weiss, 2011). This follows the Binet Adaptive Test created by Alfred Binet in 1905 (see Figure 3).

Figure 3

Schematic Representation of a Binet Adaptive Test



Note. This figure illustrates how a Binet Adaptive Test adjusts in real-time to a test-taker's ability by presenting items based on performance at different mental age levels. Starting at the designated level, the test increases difficulty with correct answers and decreases it with incorrect ones, represented by green arrows showing adaptive branching. Each mental age level has a set number of items, and performance is tracked by the proportion of correct answers. This adaptive mechanism ensures the test accurately gauges the test-taker's mental age and cognitive abilities by dynamically tailoring item difficulty to their responses.

By tailoring the difficulty of the questions to the individual's ability, CAT can provide a more accurate assessment of a student's knowledge and skills. Traditional fixed-form tests, where all students receive the same set of questions, often fail to capture the full range of a student's abilities. High-achieving students might find the test too easy and not fully demonstrate their knowledge while lower-achieving students might struggle and become discouraged. CAT, by contrast, creates a customized testing experience that can better pinpoint a student's true level of understanding and competency (Wainer, 2000, pg. 10-11).

Multimodal Support

One of the most promising aspects of CAT is its ability to incorporate multimodal support, which enhances accessibility for students with diverse learning needs. CAT can present questions using videos, images, audio, and other interactive elements, making the assessment more engaging and comprehensible (Sireci & Zenisky, 2006, p. 329). For example, a question could be presented through a short video clip, followed by a series of related questions. This not only aids in comprehension but also caters to students who might have difficulty with text-based questions. Additionally, audio support can be provided for students with visual impairments or reading difficulties, allowing them to hear the questions read aloud (Thurlow et al., 2010, p. 3). Furthermore, CAT can offer multiple methods for students to express their answers. Students could type their responses, speak them aloud using speech recognition technology or select answers through interactive touchscreen interfaces. This flexibility is particularly beneficial for students with physical disabilities, learning disabilities, or language barriers, ensuring that they can demonstrate their knowledge without being hindered by the format of the test.

Maintaining Academic Rigor

While CAT provides support and accommodations to enhance accessibility, it also maintains academic rigor by ensuring that the core content and difficulty of the questions remain challenging and appropriate for the test's objectives. CAT systems are designed to reframe questions or provide assistance without diluting the academic standards.

For example, if a student is struggling with a complex math problem, the CAT system might offer a simpler version of the problem that still assesses the same underlying concept. Alternatively, the system might provide hints or scaffolding, such as breaking the problem into smaller, more manageable steps. This approach helps students to engage with the material and develop their problem-solving skills without compromising the test's integrity. These adaptive strategies align with the general principles of maintaining academic rigor in adaptive testing.

A hypothetical scenario illustrating this process could involve a history exam where a student is asked to analyze the causes of a significant historical event. If the student struggles with the open-ended question, the CAT system might offer multiple-choice questions focusing on specific aspects of the event, gradually building up to the more complex analysis. This method ensures that the student remains challenged and engaged while receiving the necessary support to succeed. The use of innovative item formats, such as simulations and interactive tasks, supports this adaptive and supportive approach.

By integrating adaptability, multimodal support, and strategies to maintain academic rigor, CAT not only addresses accessibility issues but also enhances the overall quality and effectiveness of educational assessments. These features make

CAT a powerful tool for creating more equitable and accurate evaluations of student learning.

Discussion

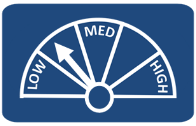
Challenges and Limitations of CAT

Despite the numerous benefits of Computer Adaptive Testing (CAT), several challenges and limitations need to be addressed for its successful implementation. One primary challenge is the technological infrastructure required for CAT. Implementing CAT necessitates reliable computer systems and internet connectivity, which might not be available in all educational institutions, especially in underfunded or rural areas. The digital divide can exacerbate existing educational inequalities (Thurlow et al., 2010, p. 2).

Another significant limitation is the potential for test security issues. As CAT delivers a unique set of questions to each test-taker, there is a need for a large item pool to ensure test integrity. Developing and maintaining this item pool can be resource-intensive. Additionally, the adaptive nature of CAT might make it easier for students to share specific test items, potentially compromising the test's fairness and validity.

There is also the challenge of ensuring the validity and reliability of CAT. The adaptive algorithm must be carefully calibrated to ensure that it accurately assesses a student's abilities without introducing biases. Any flaws in the algorithm can lead to inaccurate assessments and affect the validity of the test results (Wainer, 2000, p. 16).

Mitigation Strategies



To mitigate these challenges, several strategies can be employed. Investing in technological infrastructure is crucial. Educational institutions can seek funding and partnerships with technology companies to improve access to necessary hardware and software. Additionally, developing offline versions of CAT can help bridge the gap in areas with limited internet connectivity (Thurlow et al., 2010, p. 4).

To address security concerns, maintaining a robust and secure item pool is essential. This can be achieved by continually developing new test items and employing advanced encryption methods to protect test content. Regular training for educators and administrators on maintaining test security can also help minimize risks (Weiss, 2011).

Ensuring the validity and reliability of CAT requires ongoing research and calibration of the adaptive algorithms. This includes conducting pilot tests, gathering feedback from test-takers, and using statistical methods to identify and correct any biases. Collaborative efforts between psychometricians, educators, and technology experts are necessary to refine the testing process continually.

Future Directions and Innovations in CAT

Looking ahead, several exciting advancements and innovations in CAT technology hold the promise of further enhancing its effectiveness and accessibility. One such advancement is the integration of artificial intelligence (AI) and machine learning algorithms. Especially regarding the upcoming release of ChatGPT Edu (OpenAI, 2024). These technologies can provide more sophisticated adaptations, better predicting and responding to individual test-takers' needs in real time. Additionally, there is potential to explore how CAT can be integrated with other educational technologies, such as learning management systems (LMS), to create a seamless and comprehensive assessment experience.

Another promising direction is the development of more immersive and interactive testing environments. Virtual reality (VR) and augmented reality (AR) can create engaging, realistic scenarios for assessments, particularly in fields requiring practical skills. For example, medical students could use VR to perform virtual surgeries, providing a more accurate measure of their competencies (Zhu et al., 2014). This not only enhances the realism of the assessments but also allows for safe, controlled practice environments where students can hone their skills without the risk associated with real-life procedures.

Research is also underway to make CAT more inclusive. Advances in natural language processing (NLP) can help develop more accessible tests for students with disabilities. For instance, AI-driven speech recognition (Thurlow et al., 2010) can allow students to respond verbally to test questions, and NLP can ensure that the test content is understandable to students with diverse linguistic backgrounds.

Conclusion

The research asserts that Computer Adaptive Testing (CAT) significantly enhances accessibility and equity in educational assessments by providing a tailored testing experience that accommodates diverse learning needs, reduces test-related stress, and maintains academic rigor. The study first examined the various accessibility issues prevalent in traditional testing environments, such as difficulties faced by students with learning disabilities, cultural biases, and high levels of stress (Heissel et al., 2019). It highlighted how these issues negatively impact student performance and outcomes (Newman et al., 2011). Subsequently, the research explored how CAT addresses these challenges through its adaptive nature, multimodal support, and strategies for maintaining academic rigor (Weiss, 2011). The adaptive approach of CAT ensures that each test is tailored to the individual's ability level, while multimodal support accommodates different learning styles and needs (Sireci & Zenisky, 2011). The study also discussed the challenges and limitations of implementing CAT, proposing mitigation strategies to overcome these hurdles, and envisioned future directions for integrating advanced technologies to further enhance CAT's effectiveness and inclusivity.

CAT represents a significant advancement in educational assessments by creating more inclusive, engaging, and accurate evaluations of student learning. By addressing the diverse needs of students, it helps to level the playing field and promotes educational equity. The relevance of CAT is underscored by its ability to reduce the stress and anxiety associated with high-stakes testing, making the testing experience more positive and supportive for all students (Heissel et al., 2019). With the advent of generative AI and its transformative capabilities, there are abundant opportunities for further research and development in CAT. The power of generative AI can be harnessed to create even more sophisticated adaptive algorithms that provide real-time adjustments tailored to the needs of each test-taker. Efforts should be focused on integrating AI-driven technologies with CAT to develop more immersive and interactive testing environments.

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EARLY-CHILDHOOD AND K12 EDUCATION

Addressing Accessibility Issues in Early Childhood Education in Canada

INGI HONG

Introduction

Accessibility in early childhood education (ECE) is a pressing issue in Canada, with significant challenges surrounding the availability and quality of early learning centers and daycare facilities (Irwin & Lero, 2021). According to the Centers for Disease Control and Prevention (2023*a*), early diagnosis and suitable services for children and their families can significantly impact the lives of children with disabilities. However, due to high costs or limited availability in their area, many children cannot access the services or education they need.

Beyond the general shortage of early learning centers, only one in five Canadian child-care centres offer high-quality care for children with disabilities (Irwin & Lero, 2021). This raises concerns about the accessibility of services for children who need additional care and attention, such as appropriate early intervention. In addition, the Ontario Human Rights Commission (2022) published the executive summary of the Right to Read document, highlighting the importance of early screening and intervention in early literacy development, such as word-reading difficulties.

This paper will explore the accessibility issues in ECE, particularly focusing on the shortage of centers that meet quality standards for children with disabilities. It will also discuss the importance of early intervention and its effects on parents who have children with disabilities. Furthermore, this paper will review the benefits of integrating digital technology as a solution to mitigate current accessibility issues in early screening and intervention. By highlighting technology-assisted early intervention for young children and their parents to propose solutions for improving accessibility in early childhood education.

Current Accessibility Issues in ECE

Shortage of Early Learning Centers and Daycare Facilities

The general shortage of early learning centers and daycare facilities in Canada is a significant barrier to ECE accessibility. Nearly half of Canadian children under the age of five live in areas where there are more than three children competing for every available childcare spot (Macdonald, 2023). This shortage is exacerbated by regional disparities, with rural areas experiencing even more pronounced gaps in service availability compared to urban centers (Macdonald, 2023). The lack of sufficient childcare options forces many parents to rely on informal or unlicensed care, which may not meet the same safety and education standards as licensed facilities. It makes many parents unable to return to work or pursue further education due to the lack of available childcare, which affects the overall economy. The high demand for limited spots also drives up costs, making childcare unaffordable for many families. The federal and provincial governments have recognized this issue and have made commitments to increase the number of available childcare spaces, but progress has been slow.

High-Quality Centers for Children with Disabilities

In terms of accessibility in ECE, early learning centers and daycares should be able to provide adequate service to children who have disabilities. However, Irwin and Lero (2021) state that only 20% of Canadian childcare centers offer high-quality care for children with disabilities. In other words, 80 % of early learning centers often lack the necessary resources, such as trained staff and specialized equipment, to provide appropriate care and support (Irwin & Lero, 2021). Consequently, children with various physical, emotional, and behavioral disabilities, as well as those on the autism spectrum, are often rejected by centers that are either at capacity or do not have the required staff (Irwin & Lero, 2021).

Then, what is the high-quality care? It involves more than just meeting basic health and safety standards. It requires an inclusive environment where children can engage in activities that promote their cognitive, physical, and social development. Several key attributes characterize a high-quality early childhood education program worldwide. According to a group of experienced early childhood educators representing diverse international backgrounds, seven dimensions of quality have been identified by the Association for Childhood Education International (Jalongo et al., 2004). It includes "(1) philosophies and goals, (2) high-quality physical environments, (3) developmentally appropriate and effective pedagogy and curriculum, (4) attention to basic and special needs, (5) respect for families and communities, (6) professionally prepared teachers and staff, and (7) rigorous program evaluation" (Jalongo et al., 2004, p.143). Attention to both basic and special needs is essential to providing adequate services, such as early screening and interventions (Jalongo et al., 2004). Unfortunately, many centers are not equipped to provide such services, leading to disparities in educational outcomes for children with disabilities.

Early Intervention (EI)

Benefits of Early Intervention

The Centers for Disease Control and Prevention (2023*a*) emphasize that early diagnosis and appropriate services can make a significant difference in the lives of children with mental disorders, reducing the need for more intensive and costly interventions later. Early intervention (EI) encompasses services and support for infants and young children with developmental delays and disabilities, along with their families. It can greatly enhance a child's ability to acquire new skills, tackle challenges, and achieve success in school and life. For instance, children who receive EI services are more likely to achieve developmental milestones on time and have improved academic performance later in life (Centers for Disease Control and Prevention, 2023*b*). In addition, extensive research has demonstrated the success of various EI programs, leading to widespread recognition of their effectiveness as a preventative measure (Underwood, 2012) and better long-term outcomes for children with disabilities (Hall & Bierman, 2015).

In order to achieve a successful outcome, Meadan and Daczewitz (2015) suggest that EI practices prioritize families, grounded in evidence-based, active participation and training for parents, and service delivery in natural environments for children. EI impacts an individual child's development path and supports them by providing the appropriate therapy, such as speech therapy, physical therapy, and other interventions, depending on the specific needs of the child and family. Moreover, one of the most crucial aspects of EI is active family involvement, particularly given the young age of the children benefiting from these services. Family engagement is fundamental because parents and caregivers play a pivotal role in a child's development. Their consistent involvement can significantly amplify the positive outcomes of early intervention programs (Hall & Bierman, 2015).

Early intervention (EI) benefits to both children and parents. Parents of children with disabilities often face significant stress and uncertainty as they navigate the complexities of raising a child with special needs (Macdonald, 2023). EI programs can offer parents education and training on how to support their child's development effectively. These programs also provide parents with access to a network of professionals and other parents who can offer guidance and emotional support (Hall & Bierman, 2015).

Barriers and Challenges

Although early intervention significantly influences young children's development and overall life success, many children still lack access to these services, missing the vital period for their growth and development. To find solutions for accessibility issues, it is crucial to first identify the problems and barriers.

Underwoods (2012) highlights the lack of federal guidelines and funding for early intervention, as well as the absence of clear provincial legislation mandating these services. Consequently, defining and establishing early intervention services is challenging. As recommended, implementing EI services in natural environments like children's homes, daycares, and communities faces significant challenges (Meadan & Daczewitz, 2015). Many interventions, including those involving parents, often do not occur at home, primarily due to barriers such as long travel distances for EI providers, which are costly in terms of time and transportation. Additionally, challenges such as a shortage of trained providers, difficulties in maintaining program credibility, engaging parents, and accessibility barriers due to cost and location further hinder widespread implementation (Hall & Bierman, 2015; Meadan & Daczewitz, 2015).

Despite these challenges, it is essential to customize service delivery based on children's and families' unique needs and situations. Additionally, Underwoods (2012) suggests that there should be federal mandates and funding for early childhood programs due to their profound impact on children's development. To remove the barriers to access to EIs, we should explore technology-assisted intervention approaches to find practical solutions.

Accessibility and Technology

Researchers evaluate the effects of technology-based parenting interventions on both parents and children, and these interventions are delivered via web-based platforms, online discussion forums, mobile devices, and video teleconferencing (Hall & Bierman, 2015). Multiple case studies have observed positive outcomes such as increased parent knowledge, improved parenting skills, and reduced parenting stress (Kaplan et al., 2014). The same as any other theory and model, it cannot explain everything; technology-assisted or based interventions are no exception. However, since technology adds various and flexible approaches to traditional interventions, it could provide a complementary way to improve accessibility and convenience for diverse populations.

Web-Based Platforms & Online Discussion Forums

Web-based platforms and online discussion forums showed some positive outcomes in providing resources and specific parenting programs, leading to enhancements in child development knowledge and parenting confidence (Hall & Bierman, 2015). Even though the effectiveness of web-based interventions can vary, these platforms provide insight into valuable interactive features like online classes, discussion forums, and opportunities for parents to seek support from experts and peers (Hall & Bierman, 2015). This highlights the need for ongoing evaluation and improvement of online parenting programs to ensure they effectively support parents and enhance child outcomes. Some studies showed that access to online parent education programs and discussion forums can lead to decreased parenting stress and improved coping skills among participants (Kaplan et al., 2014). Additionally, several researchers have found that when a service provider is not physically present, parents tend to be more actively involved. Providing early intervention services remotely is a logical solution for addressing service gaps and lowering delivery costs (Meadan & Daczewitz, 2015).

Mobile Devices & Video Conferencing

Using mobile devices, including text messaging, phone calls, and email, for parenting interventions has resulted in improved parental engagement and positive changes in child behavior (Hall & Bierman, 2015). For instance, technology-assisted interventions enable active parental involvement by facilitating easy follow-ups through text, phone calls, and emails with EI providers and experts. Coaching and parent communication via videoconferencing also effectively promoted parent skill acquisition and reduced child behavior problems, especially among families facing various challenges (Meadan & Daczewitz, 2015). Consequently, this support makes weekly home visits or in-person meetings more effective for improving child behavior and outcomes (Hall & Bierman, 2015). The use of mobile devices and video conferencing provided additional support and guidance to parents, contributing to positive results in parent-reported knowledge, attitudes, and behavior compared to minimal intervention or support (Hall & Bierman, 2015; Meadan & Daczewitz, 2015).

The integration of technology-based parenting interventions facilitated continuous support and interaction between parents and professionals, bridging gaps in access to resources and expertise. These technologies offer a convenient and flexible means of delivering interventions, allowing for real-time feedback, guidance, and skill-building opportunities for parents. By combining the convenience of mobile devices with the interactive nature of video conferencing, interventions can be personalized and adapted to meet the specific needs of families, ultimately leading to improved parent engagement, enhanced parenting skills, and positive outcomes for both parents and children.

Conclusion

In conclusion, the accessibility challenges in Early Childhood Education (ECE) in Canada present significant barriers to quality education for children. The shortage of high-quality early learning centers and daycare facilities, especially for children with disabilities, stresses the urgent need for improved services and support mechanisms in the ECE sector. Despite government efforts to increase ECEs' wages to boost childcare workforces (Government of Ontario, 2023), however, the availability of childcare spaces, progress has been slow, leaving many families struggling to access suitable care for their children (Macdonald, 2023).

Early intervention (EI) plays a crucial role in supporting children with developmental delays and disabilities, offering them the opportunity to reach their full potential. However, barriers such as limited access to services, geographical disparities, and challenges in implementing interventions in natural environments pose obstacles to the effective delivery of early intervention programs.

The integration of technology in ECE, particularly through web-based platforms, online discussion forums, mobile devices, and video conferencing, offers invaluable insight into solutions which enhance accessibility and support for children and parents. These technology-assisted interventions showed positive outcomes in improving parental knowledge and skills, as well as reducing parenting stress, ultimately leading to better child outcomes.

Moving forward, it is essential to continue exploring innovative approaches, such as technology-assisted interventions, to overcome barriers and ensure equitable access to early intervention services in ECE. By combining the strengths of technology with evidence-based practices, we can create a more inclusive and supportive environment for children with disabilities and their families, ultimately fostering positive outcomes in both education and life.

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Accessibility Issues for Teaching and Learning in K12

RAAGAVI PARATHAN

Abstract

Accessibility issues in K-12 education encompass physical, digital, and cultural barriers that hinder equitable access to learning opportunities for all students. Physical barriers, such as inadequate facilities, challenge students with disabilities in navigating school environments. Digital accessibility gaps exclude students with visual or hearing impairments from fully engaging with educational content. Additionally, cultural and linguistic disparities impact students' ability to connect with instructional materials. This paper explores these challenges by analyzing legislative mandates, scholarly insights, and practical solutions, emphasizing the integration of Universal Design for Learning (UDL), accessible digital resources, and culturally responsive teaching practices to foster inclusive educational environments.

Introduction

Accessibility is fundamental to educational equity, ensuring that all students, regardless of their abilities or backgrounds, can fully participate and thrive in K-12 settings. However, numerous barriers persist that impede this inclusivity. Physical accessibility remains a prominent issue, with many schools lacking essential accommodations for students with physical disabilities, such as ramps and elevators. Meanwhile, the digital shift in education has introduced new challenges, as digital resources often lack necessary accessibility features, posing difficulties for students with sensory impairments. Moreover, cultural and linguistic disparities further complicate the educational landscape, affecting students' sense of belonging and engagement.

Legislative frameworks, such as the Accessibility for Ontarians with Disabilities Act (AODA, 2005), underscore the importance of addressing these accessibility gaps in educational settings. This legislation mandates that schools adhere to accessibility standards, yet implementation varies, leaving significant room for improvement. Scholarly research and educational insights highlight the critical need for proactive measures to enhance accessibility through UDL principles, accessible digital resources, and culturally responsive teaching practices.

Accessibility Issues in K-12 Education

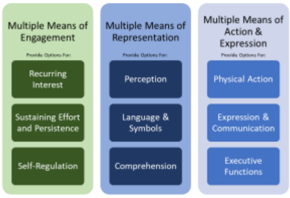
One of the most visible accessibility issues in K-12 education is the lack of physical accessibility in classrooms and school facilities. Many schools are not equipped with ramps, elevators, or other accommodations to support students with physical disabilities, such as wheelchair users. As a result, these students may need help navigating the physical environment, accessing classrooms, or participating in classroom activities. The Accessibility for Ontarians with Disabilities Act (AODA, 2005) in Ontario mandates that all public and private organizations, including schools, comply with accessibility standards. This includes providing accessible facilities such as ramps, elevators, and accessible washrooms.

According to Gasvoda (2023), inadequate physical accessibility in K-12 schools can severely impact students with disabilities. For instance, a school without ramps or elevators can prevent students who use wheelchairs from accessing upper floors or participating in activities held in inaccessible areas. Schools can address these issues by retrofitting existing buildings with accessibility features and ensuring new constructions comply with universal design principles. For example, installing ramps and elevators facilitates independent movement for students with physical disabilities, enhancing their overall educational experience (Gasvoda, 2023).

With the increasing use of technology in education, digital accessibility has become a significant concern. Many educational materials and digital resources used in K-12 classrooms are not designed with accessibility in mind. This poses significant barriers for students with visual or hearing impairments who may struggle to access and interact with digital content. Common issues include a need for alternative text for images, inaccessible PDF documents, and videos without captions or audio descriptions. Canada's accessibility laws, as summarized by Doyle (2021), emphasize the need for digital accessibility in educational settings. Schools must ensure that online platforms, educational websites, and digital resources are accessible to students with disabilities. Failure to comply can result in legal repercussions and hinder educational equity. The ECAR study (Gierdowski & Galanek, 2020) highlights common digital accessibility challenges such as inaccessible PDFs and videos without captions. These issues can significantly hinder students with visual or hearing impairments from accessing learning materials effectively. Implementing Universal Design for Learning (UDL) principles, as advocated by Meyer et al. (2014), ensures that digital content is designed to accommodate diverse learning needs. For example, providing alternative text for images and captioning videos allows students with disabilities to access and engage with digital content independently.

In addition to physical and digital barriers, there are challenges related to cultural and linguistic accessibility in K-12 education. Students from diverse cultural and linguistic backgrounds may need help understanding and engaging with instructional materials that do not reflect their cultural or linguistic backgrounds. This can lead to feelings of alienation and disengagement from the learning process. Stevens (2023) emphasizes the importance of culturally responsive teaching practices in K-12 education. For instance, using literature and instructional materials that reflect students' cultural backgrounds and experiences enhances their engagement and learning outcomes. In multicultural settings, providing educational materials in multiple languages supports students whose first language is not the language of instruction. This approach ensures that all students can comprehend and engage with instructional content effectively (Gasvoda, 2023). Nelson (2021) discusses the integration of diverse perspectives into curriculum development. For example, including historical events and literature from various cultural backgrounds helps students understand global perspectives and promotes inclusivity in the learning environment.

Proposed Solutions



UDL is an instructional design framework emphasizing flexibility and inclusivity in curriculum development and delivery. By incorporating UDL principles into lesson planning and resource development, educators can ensure that instructional materials are accessible to all students, regardless of their abilities or learning styles. UDL encourages using multiple means of representation, expression, and engagement to accommodate diverse learners. Educators can create lesson plans and resources that offer various ways to access content, such as simultaneously providing text, audio, and visual materials (Meyer et al., 2014). Implementing UDL principles allows for diverse assessment methods, such as allowing students to demonstrate knowledge through written, oral, or multimedia presentations (Nelson, 2021). Using digital tools that support UDL, such as interactive whiteboards or educational apps with customizable features, enhances engagement and accessibility for all learners (Rao, 2021).

To address digital accessibility issues, educators can prioritize selecting digital resources designed with accessibility features. This includes using platforms and tools that support screen reader compatibility, closed captioning, and alternative formats for content delivery. Additionally, educators can advocate for creating and adopting accessibility standards for digital educational materials to ensure they are accessible to all students. Educators can create lesson plans and resources that offer various ways to access content, such as simultaneously providing text, audio, and visual materials (Meyer et al., 2014). Implementing UDL principles allows for diverse assessment methods, such as allowing students to demonstrate knowledge through written, oral, or multimedia presentations (Nelson, 2021). Using digital tools that support UDL, such as interactive whiteboards or educational apps with customizable features, enhances engagement and accessibility for all learners (Rao, 2021).

Culturally responsive teaching practices involve recognizing and valuing all students' cultural backgrounds and experiences. Educators can create a more inclusive learning environment that resonates with diverse student populations by incorporating culturally relevant content and instructional materials into their teaching. This may include incorporating diverse perspectives into curriculum content, selecting literature and resources that reflect the experiences of different cultural groups, and fostering an inclusive classroom culture that celebrates diversity. Including literature, historical events, and cultural perspectives from diverse backgrounds enriches the curriculum and enhances students' understanding of different cultures (Stevens, 2023). Tailoring instructional strategies to reflect students' cultural identities and experiences fosters a sense of belonging and encourages active participation (Gasvoda, 2023). Collaborating with families and community members to integrate culturally relevant resources and practices into teaching promotes a holistic approach to cultural inclusivity (Bloom, 2024).

Integrating these solutions requires collaborative efforts among educators, administrators, and stakeholders. Providing ongoing training on UDL, digital accessibility standards, and culturally responsive teaching equips educators with the skills to implement these strategies effectively (Nelson, 2021). Advocating for policies prioritizing accessibility and cultural inclusivity in educational practices ensures sustained support and commitment at institutional levels (Doyle, 2021). Partnering with technology providers to develop and adopt educational tools that meet accessibility standards helps ensure that digital resources are accessible to all students (Gierdowski & Galanek, 2020). By implementing these proposed solutions, K-12 schools can create an inclusive learning environment where every student, regardless of their abilities, cultural background, or learning preferences, has equitable access to quality education and opportunities for academic success.

Integration of Instructional Design Strategies and Digital Resources

Educators should prioritize accessibility considerations during the lesson planning phase. This includes selecting inclusive instructional materials and digital resources that align with UDL principles. By planning, educators can proactively address accessibility issues and ensure that all students have equitable access to learning materials. According to Nelson (2021), educators can integrate UDL principles into lesson planning by selecting digital resources that provide multiple means of representation. For instance, educational software offering text-to-speech functionality supports students with reading difficulties, ensuring they can access content alongside their peers. The Accessibility for Ontarians with Disabilities Act (2005) mandates that schools in Ontario must consider accessibility needs in their planning phases, ensuring that physical and digital environments are inclusive.

For students with disabilities, educators may need to modify existing instructional materials to ensure accessibility. This may involve converting text-based content into alternative formats, such as audio recordings or tactile materials, or providing additional supports, such as visual aids or assistive technology tools and adapting instructional content for students with disabilities, such as converting textbooks into accessible digital formats. This adaptation supports diverse learning needs by providing materials that are compatible with assistive technologies like screen readers and refreshable braille displays (Gasvoda, 2023). The ECAR study identifies that many students with disabilities require customized content adaptations to engage effectively with digital resources, emphasizing the importance of tailored educational approaches (Gierdowski & Galanek, 2020).

Technology can play a significant role in supporting students with disabilities in the classroom. Educators can integrate assistive technologies and digital tools into their instruction to provide additional support for students with diverse learning needs. For example, screen reader software can assist students with visual impairments in accessing digital content, while speech-to-text software can support students with motor impairments in completing written assignments. Integrating assistive technologies in classrooms, such as speech recognition software for students with motor impairments. This technology enables these students to participate in activities that require written responses, promoting inclusive learning experiences (Power, 2023). Incorporating UDL into online learning platforms involves using interactive features that cater to diverse learning preferences, ensuring that digital resources accommodate varied student needs (Rao, 2021).

Ongoing training and support for educators are essential for effectively integrating instructional design strategies and digital resources into classroom instruction. Professional development opportunities should focus on increasing educators' knowledge and skills in inclusive teaching practices, accessibility standards, and the use of assistive technologies. By investing in professional development, schools can empower educators to create more inclusive learning environments and better support students with disabilities—the role of professional development in enhancing educators' ability to implement inclusive instructional design practices. Workshops on UDL and digital accessibility empower teachers to effectively utilize accessible digital resources and support students with disabilities (Stevens, 2023). Continuous learning and professional development are essential for educators to stay updated on accessibility laws and best practices, as highlighted in discussions on Canada's accessibility laws (Doyle, 2021).

Conclusion

Addressing accessibility issues in K-12 education requires a multifaceted approach that integrates legislative compliance, educational research, and practical solutions. By embracing Universal Design for Learning (UDL), educators can proactively design inclusive lesson plans and educational materials that cater to diverse learning needs. Prioritizing accessible digital resources ensures that technological advancements support, rather than hinder, students with disabilities. Furthermore, fostering culturally responsive teaching practices acknowledges and celebrates students' cultural backgrounds, enhancing their educational experiences.

Professional development is pivotal in empowering educators to implement these strategies effectively, fostering a supportive environment where every student can succeed. Collaboration among stakeholders, including educators, administrators, policymakers, and community members, drives systemic change and ensures sustained progress toward inclusive education. By prioritizing accessibility and embracing diversity, K-12 schools can create equitable opportunities for all students to learn, grow, and thrive.

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Digital Accessibility Barriers in K-8 Schools

TOUFAN ARIEB

Introduction

Digital Accessibility for students in schools K-12 is not a one-size-fits-all solution. Access to digital technology is often viewed through a technical lens, which, while not entirely unjustified, oversimplifies the challenges faced by stakeholders seeking meaningful improvements. Describing the current state of digital accessibility as merely a "situation" is inadequate, as evidence shows it is intricately linked to technological developments. Therefore, it is more accurate to see accessibility as a continuous and dynamic process rather than a static condition (Botelho, 2021). This means that the tools used to bridge the gap are evolving and changing, requiring new training and learning.

In Ontario schools from K-12, digital accessibility barriers can encompass various challenges that hinder access to digital content, platforms, and services for individuals with disabilities. Addressing these barriers requires a comprehensive approach that includes better training for educators, improved infrastructure and resources, clear policies and guidelines, and a commitment to inclusive education at all levels of the school system. Some specific barriers that I have identified as an Educator and Administrator for the Durham District School Board and from research are as follows:

Lack of Teacher Training & Insufficient Professional Development

Teachers often lack training in digital accessibility tools and practices. Professional development programs may not adequately cover how to use accessible technologies or design inclusive digital content. Currently, there are shortages in supply teachers, causing a halt in all professional development (Judge & Simms, 2009). In fact, since the COVID-19 pandemic, professional development has not been able to return to what it was prior to the pandemic due to insufficient coverage. As new technologies arise and the gaps in student learning widen, many educators are not fully aware of the accessibility needs of students with disabilities or how to address them through digital means.

Accessibility of Digital Content

Non-Compliant Educational Materials

Digital content, such as e-books, online assignments, and educational websites, may not meet accessibility standards. This includes issues like poor screen reader compatibility, lack of captions or transcriptions for audio/visual content, and poorly designed navigation structures (Rao & Meo, 2016). Examples of this are teacher pay teacher PDFs that are not properly made accessible or boom cards that are posted on a Google Classroom (n.d.) but not checked for accessibility.

Policy and Implementation Gaps

Lack of Clear Policies

Schools and districts may not have clear policies or guidelines on digital accessibility. Without a standardized approach, implementation can be inconsistent and ineffective (Seok et al., 2018). Currently, there is no policy that states that classroom material or even material that is being shared with families must comply with accessibility standards. In my experience, there is no standard of accessibility when it comes to classroom content creation. This poses a major issue that will be discussed further with differing perspectives.

Attitudinal Barriers

Resistance to Change

Some educators and administrators may be resistant to adopting new technologies or changing existing practices, which can hinder the implementation of accessible digital tools. There may also be misconceptions that digital accessibility is only necessary for a small number of students, leading to a lack of prioritization (Rao & Meo, 2016).

While the above-mentioned barriers highlight only a few of the challenges in accessing digital accessibility as it pertains to elementary schools, it is important to note that addressing both systemic issues and specific technical and attitudinal issues will help to break these barriers down slowly. In the following sections, I will focus on two main barriers I have experienced as an educator and what I see as barriers as a parent and school administrator. These are teacher training and accessibility to digital content. While attitudinal barriers and policy barriers are important, the tools I have researched are not within the scope of removing these barriers, and in fact, these barriers are larger ones that would need more careful thought and the voice of those mostly affected.

Addressing Key Issues

I will begin by discussing the issues more in-depth and then describe what tool would support dismantling these barriers.

Teacher Training Issues

Lack of teacher training is a significant barrier to digital accessibility in elementary schools. Without proper training, teachers may struggle to use and integrate accessible technology into their classrooms effectively. This can lead to inequitable access to curriculum and learning gaps for students with disabilities. As an educator myself, it was never brought to my attention how to ensure my teaching materials were fully accessible. While I would make sure my lessons were differentiated and that I used the principles of Universal Design for Learning, I don't think I was keeping in mind the digital aspect of this. Now, as a school administrator, I see the gaps for students with disabilities, and when trying to find indicators for where we can improve programming, it often falls on teacher-initiated accessibility and materials.

Many teacher college programs do not include sufficient training on digital accessibility and assistive technologies. The focus is usually IEP writing and lesson planning. This leaves new teachers unprepared to meet the diverse needs of students with disabilities. Once they are hired, it is unlikely they will get any training from the school board unless there is a student in their class with a need. Most of the school boards do provide after-hours training for teachers, and there are departments that are able to help facilitate this learning, but teachers need to make the time and reach out to access it. In my experience, this is not something that is done. I have also noticed that many special education resource teachers in school (SERT) do not get the sort of training they once received and that they need. With the advancement of technology and the ways it can support students with disabilities, it is crucial that teacher training happens right from the beginning in teachers' colleges. This training needs to be frequent and tailored to the specific needs of the student's classrooms.

Addressing Teacher Training Issues and Access to Accessible Resources

Here are some ways teachers can incorporate tools to provide digital accessibility and curriculum to all students. CAST (Center for Applied Special Technology) is an educational research and development organization that focuses on expanding learning opportunities for all individuals through Universal Design for Learning (UDL). Founded in 1984, CAST aims to address the barriers to learning that arise in traditional educational settings by developing innovative solutions that are flexible and accessible for all students, particularly those with disabilities (CAST, n.d. *a*). CAST developed the UDL Guidelines (CAST, 2018), a set of principles for curriculum development that provide all individuals with equal opportunities to learn. CAST provides technical assistance to schools, districts, and other educational organizations to help them implement UDL and create more inclusive learning environments. This assistance includes consulting services, project management, and support for systemic change initiatives. As a solution to the barrier mentioned here with teacher training, providing professional development from CAST to schools and, more specifically, to special education resource teachers would help bring more accessibility within the classroom.

CAST's tools include Book Builder (CAST, n.d. *b*), which allows teachers to create accessible books. It enables teachers to create, publish, and share digital books that are accessible to all learners. UDL Exchange is an online community where educators can create, share, and discover resources and lesson plans designed with UDL principles. CAST also offers a range of professional learning opportunities, including in-person workshops, online courses, and webinars focused on UDL implementation and other accessibility topics (CAST, n.d. *a*).

Another major barrier to digital accessibility that I have experienced in my education career, both as a teacher and as an instructional leader, is material that is used in the classroom that does not meet the accessibility standards. An example of this is many teachers pay for teacher resources, PDFs, or e-books. A solution, however, to this is providing a list of resources that are digitally accessible for students with disabilities. Tools like WAVE (Web Accessibility Evaluation Tool) (WebAIM, 2024) is a website Accessibility Checker that helps teachers evaluate the accessibility of web content and educational websites they use or create (Palani, 2022).

Using screen readers is a very common tool in education; extensions like Google Read and Write (TextHelp, 2024) help students overcome the barriers of reading challenges and access the curriculum without worrying about decoding the content. However, using this extension means the content you put on your Google Classroom (n.d.) for kids needs to be digitally accessible. In my experience as a classroom teacher, I never thought about this too much. In fact, if a student had difficulty with the read-and-write tool, I would just read it aloud. Not realizing the document or e-book was not digitally accessible. If I knew about the WAVE tool and how to utilize it to make my programming more accessible, that would be very helpful for me and my students.

In fact, the WAVE tool can help audit your virtual classrooms to ensure that photos, videos, navigation, and such are all accessible (Botelho, 2021). This can also help families who have needs at home and could benefit from digital accessibility to support their own kids at home.

Digital accessibility in K-12 schools is vital to providing equitable educational opportunities for all students, especially those with disabilities. Integrating tools like CAST's Universal Design for Learning (UDL) guidelines and the WAVE Web

Accessibility Evaluation Tool can significantly help overcome barriers such as lack of teacher training and content accessibility.

CAST's UDL framework offers principles and guidelines that support educators in designing flexible and inclusive learning environments. By focusing on multiple means of engagement, representation, and expression, UDL ensures that educational content is accessible and engaging for a diverse student population. Professional development and support from school boards to use these tools equip teachers with the necessary skills and knowledge to implement these guidelines effectively.

The WAVE tool is a resource for evaluating and enhancing the accessibility of digital content. Its user-friendly interface and comprehensive feedback enable teachers to identify and address accessibility issues, making sure that all students can navigate and benefit from online educational resources. WAVE's visual feedback and detailed explanations also serve as an educational tool, increasing teachers' understanding of web accessibility standards and practices.

By leveraging CAST and WAVE, schools can address barriers to inadequate teacher training and ensure that digital content meets high accessibility standards. Committing to digital accessibility in K-12 education is essential for fostering an inclusive learning environment.

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POST-SECONDARY AND WORKPLACE EDUCATION

Digital Accessibility: Barriers in Post-Secondary Education

SOWNTHY SENTHILCHELVAN

Introduction

As technology increasingly dominates our daily lives, our interaction with digital tools becomes more integral. Despite efforts to integrate digital technologies into educational frameworks, significant barriers to accessibility persist. A 2016 study revealed that 70% of major universities lacked the necessary assistive technologies for student use, even as learning environments transitioned to online platforms (Idaho Training Clearinghouse, n.d.). The number of students who have a disability has substantially increased over the years. Between the academic years 2009-2010 and 2019-2020, the number of registered students with disabilities increased by over 132% (Ontario Newsroom, 2021). Notably, in the 2019-2020 academic year, nearly 92,000 students registered with Offices for Students with Disabilities at publicly funded colleges and universities (Ontario Newsroom, 2021). With the lack of accessibility at a post-secondary education level, fewer students with disabilities are set up for success by the educational system. 16.4% of students with disabilities completed their post-secondary education compared to the

34.6% of students who do not have a disability (Idaho Training Clearinghouse, n.d.).

This chapter discusses various topics around accessibility, including the importance of digital accessibility barriers in post-secondary education and some common challenges students face. This chapter also takes a deeper dive into some proposed solutions to combat some of the barriers and how they can be used to provide more inclusive learning environments for all students.

Learning Management Systems (LMS)

A common challenge with digital accessibility in post-secondary education is the websites and LMS platforms universities use to teach students. According to UC Berkeley (UC Regents, 2024), digital accessibility can be described as using websites, tools, and various technologies designed and developed so that people with disabilities can use them. Websites and LMS platforms may not be fully accessible to students using screen readers or other assistive technologies. Assistive technology helps individuals with difficulty speaking, typing, writing, hearing, and seeing through software and equipment. Assistive technology is used to increase, maintain, and/or improve the functional capabilities of a person with a disability (Assistive Technology Industry Association, 2024). For example, Ontario Tech University uses Canvas (Instructure, 2024) as its main learning management system. Within the LMS, no screen reader is embedded into the software, which does not benefit students who require them to learn. This now forces students to have another screen reader application to get their content read aloud for them. The American Foundation for the Blind (AFB) stated in 2024 that screen reader prices vary from free to $1200 depending on the functionality of the screen reader. Screen readers are mainly for those who suffer from vision impairment to read text on the screen but can also be used by choice for those who travel or prefer to have text read aloud to them (AFB, 2024). When deciding which screen reader to purchase, some factors need to be considered, such as whether the screen reader application is compatible with the computer's operating system, whether it would work with other applications you intend to use it for, or whether it would work with a braille display (AFB, 2024). These are considerations that may be extensive for students with disabilities to think about while trying to navigate post-secondary education. With various universities using different LMS platforms, not embedding a screen reader application contributes to the barriers to digital accessibility for students.

Other associated challenges with LMS include poor usability, lack of access to content, and lack of integration (ExpertusONE, 2024). Recognizing these common issues associated with LMS, it becomes evident that a significant gap exists between students with disabilities and equitable access to post-secondary education. Idaho Training Clearinghouse (n.d) stated that a contributing factor to the disparity is the lack of adequate support systems for students with disabilities at post-secondary institutions. For example, without the provision of assistive learning technology, students with disabilities encounter significant obstacles in accessing distance learning programs and engaging in class discussions through LMS platforms (Idaho Training Clearinghouse, n.d).

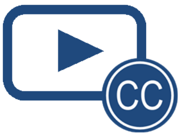
Accessibility Guidelines

As time progresses and technology evolves, current accessibility guidelines also possess limitations that hinder the widespread adoption and efficacy of digital accessibility solutions (Kulkarni, 2019). For instance, there seems to be insufficient comprehensive evidence on the effectiveness of accessibility standards and guidelines, as stated by Kulkarni (2019). The complexity of accessibility guidelines can hinder the design and development of accessible services (Kulkarni, 2019). Waller (2023) stated that even with accessibility guidelines, the information needed to execute a digital accessibility plan is unclear to most. The standards and guidelines for accessibility are mainly directed toward designers and developers of websites and platforms, which may not be easy for everyone to understand and use. As post-secondary education increasingly embraces digital learning platforms, many educators could find themselves working with LMS that they did not select. While accessibility guidelines and standards are typically formulated for web developers, post-secondary educators, as end-users, could lack the expertise to effectively incorporate these guidelines into their course content and delivery methods through the LMS without adequate training and resources. Recognizing the efforts of post-secondary education trying to be inclusive, it is apparent that the complexity of document and content formatting can be a significant obstacle. This issue is particularly pronounced without the necessary training to understand and implement accessibility guidelines effectively.

Non-Accessible Documents and PDFs

Educational materials such as PDFs, Word documents, and PowerPoint presentations may not be formatted properly for accessibility, making it difficult for screen readers to interpret. This issue creates another barrier to digital accessibility for students in post-secondary education. A limitation posed by digital accessibility is the lack of resources of staff and those working within institutions to understand the full scope of digital accessibility and functionality (Kulkarni, 2019). This is a statement I agree with myself, and the reason is that when working with Word (Microsoft, 2024*d*) and PowerPoint (Microsoft, 2024*c*), I was not expected to know nor was taught about the accessibility features of these applications until this course, where the professor took the time to show us accessibility features. According to the University of New Hampshire (UNH) (2024), PDFs are a common way of distributing documents, but it can be challenging to format them to make them accessible. This is because multiple layers must be added to the document, such as tags, which take time to formulate and apply to the document and input the content (UNH, 2024). Another digital accessibility barrier to inaccessible documents is that tables and charts are challenging to format to be fully accessible (UNH, 2024). My experience of attempting to format tables to be accessible was extremely difficult, even with the assistance of other supporting students. While post-secondary institutions emphasize content delivery, ensuring document accessibility could present significant challenges. This challenge could result in a substantial barrier for students with disabilities, who may struggle to access the same information as their peers.

Lack of Closed-Captions for Multimedia Content



Videos and audio recordings used in lectures or course materials frequently do not include captions or transcripts, which creates a barrier for students who are hard of hearing, preventing them from being able to engage with the content fully. Not only do those who are hard of hearing use captions, but others also use them. Pogue (2024) found that 34% of Americans have subtitles on at all times for many reasons, such as watching content in different accents and languages or for those who are hard of hearing. As an individual who suffers from partial hearing loss, I always have subtitles on so I do not miss anything in translation, and it becomes helpful when watching shows in different languages. At a post-secondary education level, instructors may include videos as a part of readings or post pre-recorded lectures without captions, which becomes inaccessible to some. Specific platforms like TikTok cannot recognize voice patterns and automatically automate text (Lerman, 2021). This becomes challenging and frustrating for those who want to engage with the video but can not due to the lack of accessibility. It is crucial to double-check which platforms are being provided to students to ensure the platform can automate speech-to-text or allow educators access to transcribe information.

Solutions to Address Accessibility Issues

Recognizing the barriers to digital accessibility is the first step toward addressing these challenges. Numerous solutions and resources are available to create a more inclusive learning environment for post-secondary education students. By leveraging these tools and best practices, institutions can enhance accessibility and ensure equal student access. This section will review various resources and potential proposals to combat digital accessibility.

Web Accessibility Evaluation Tools

As educators who are trying to become more involved in the learning process of digital accessibility, there are web accessibility evaluation tools that can be used to help the user make their content accessible. An example of this would be WAVE (WebAIM, 2024), a tool that helps individuals make their digital content accessible using a program that also follows Web Content Accessibility Guidelines (WCAG) but also facilitates human evaluation of digital content. WAVE is driven by a philosophy that emphasizes addressing known user-impact issues, facilitating human assessment, and fostering education on web accessibility.

From a post-secondary perspective, this can be a great tool that would provide extra support for instructors and staff when trying to teach content digitally, where they are working with resources that would help check for accessibility errors and how they can be improved to be accessible. Accessibility guidelines may be overwhelming for educators to understand when it is more directed toward developers and designers. Accessibility guidelines such as WCAG are embedded into WAVE, which can help detect errors or give pointers where accessibility can be improved. Not only does WAVE function from a technical point of view, but it also helps evaluate content from a human perspective, which would help make the content more relatable and accessible for students with disabilities.

Document Accessibility Tools

As previously discussed, educational materials, including PDFs, Word documents, and PowerPoint presentations, often lack proper accessibility formatting, therefore hindering screen reader interpretation. Software such as Adobe Acrobat Pro now offers tools for creating, editing, and verifying the accessibility of PDF documents (Adobe, 2024). Alongside software that can help make documents accessible, there are courses on LinkedIn for creating accessible PDFs and Word documents (Chelius, 2017). There are various levels of depth regarding the courses, so everyone can learn based on their comfort level.

With Word and PowerPoint applications, Microsoft Office developed an accessibility checker, now a built-in tool in Microsoft to check and improve the accessibility of documents (Microsoft, 2024*a*). Microsoft created a best practices table that discusses the issue, how to find it, why you must fix it, and how to fix it, along with step-by-step instructions on navigating the features (Microsoft, 2024*b*). There is even a feature within Word that can test your accessibility with an immersive reader so it can read your content aloud to better understand how accessible the document is (Microsoft, n.d).

Post-secondary institutions should include Adobe Acrobat Pro and Microsoft accessibility references for educators and students to download for free, so it helps set them up for success in digital accessibility. Free online resources such as LinkedIn learning courses (LinkedIn Corporation, 2024) would be an excellent opportunity for staff to complete the modules and be well-equipped with accessibility features. Post-secondary institutions should also consider embedding software like Adobe Acrobat Pro into their LMS. Hence, it is easier for students who use screen readers to access their materials without having external applications to screen read for them. It would also be an excellent opportunity to upload these tools onto the LMS so they can be accessible to all and could be used as a reference point.

Universal Design for Learning Tools (UDL)

According to the Center for Applied Special Technology (CAST), UDL aims to devise teaching methodologies that ensure equitable access to the classroom curriculum for all students, encompassing those with diverse learning needs, disabilities, and cultural backgrounds (CAST, 2001; Pace & Schwartz, 2008). In terms of education, UDL attempts to create a more flexible curriculum that is accessible to a wide group of students by providing various opportunities to learn (Pace & Schwartz, 2008). Using CAST guidelines for UDL helps provide a framework for designing educational environments that enable all learners to gain knowledge, skills, and enthusiasm for learning (Pace & Schwartz, 2008).

Typically, at the post-secondary level, the content delivery is the standardized professor lecturing the class, where the professor determines the objectives, outcomes, readings, and assignments. The professor focuses on the course's knowledge aspect, not necessarily on how the students can access the information (Pace & Schwartz, 2008). This creates a barrier to accessibility for students at the post-secondary level. This is where UDL can be used as a driving force to build the framework of accessible learning through various modes of teaching information. Digital learning is relatively new, and digital accessibility may have been taken for granted. However, with technological advancements, incorporating UDL into digital learning would help post-secondary education prioritize the students to make content accessible.

Conclusion

As technology becomes integral to our daily lives, our reliance on digital tools grows. Despite efforts to incorporate digital technologies into educational systems, barriers to digital accessibility remain. Key obstacles include LMS used by universities, which often lack compatibility with screen readers and distribute non-accessible documents and PDFs. Many educators are unfamiliar with formatting these materials to be accessible, resulting in a learning gap for students with disabilities. Additionally, the complexity of accessibility guidelines can hinder the design and development of accessible services. The lack of closed captions for multimedia content also presents challenges for students who are hard of hearing. To address these issues, solutions such as web accessibility evaluation tools, document accessibility tools, and universal design for learning principles have been proposed. Utilizing these resources and tools can help bridge the accessibility gap, ensuring all students have equitable access to post-secondary education.

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Evaluating Course Accessibility In Post-Secondary

CAROLINE NICHOL

Introduction

Many of the accessibility and inclusion barriers students face in higher education could be attributed to the legacy of discriminatory policies and practices, as well as the pervasive negative attitudes shown towards people who exhibit physical and cognitive differences outside normative social constructs. This ableist mindset has placed students with varying learning needs, physiological differences and socioeconomic barriers in a position of inferiority in academic settings. Human rights organizations and inclusion advocates have begun to rectify these issues by creating awareness and guidelines addressing the needs of students with physical, cognitive and social differences.

Watch What is Ableism? (United Nations Human Rights, 2020) to learn more about ableism. (2:30 minutes)

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To combat ableist ideologies in higher education, we must recognize the barriers people with disabilities and other intersecting marginalized identities face within our educational system. Barriers include issues associated with attitudinal (e.g. discriminatory behaviours, perceptions, and assumptions), organizational or systemic (e.g. unfair policies, procedures, and practices), architectural or physical (e.g. limitations to infrastructure design), information or communications (e.g., sensory or cognitive inconsiderations), and technological (e.g., lack of access and usability) barriers (Council of Ontario Universities, n.d.). Many of these barriers can be addressed through changes in existing policies and procedures in how schools operate and how the learning environment is conducted. However, many inclusive policies in Ontario schools failed to address systemic inequities in their districts and lacked substantial accountability measures to determine the effects of accessibility and inclusive policies for their communities (Rezai-Rashti et al., 2021).

The Ontario Human Rights Commission (OHRC) states that "inadequate training for educators" and "insufficient resources and supports in the classroom" are ongoing barriers for students in the educational system and stresses the importance of incorporating inclusive design strategies to combat those issues (OHRC, 2018). It is the role of the institution and educators to design and develop inclusive classrooms for their students. This can be done by (1) incorporating Universal Design for Learning (UDL) principles and Web Content Accessibility Guidelines (WCAG) practices, which can foster inclusive participation and academic success of all students, and (2) utilizing accessibility and inclusion evaluation instruments which can guide faculty in how they can better support a diverse group of learners, as well as stay accountable to diversity, equity and inclusion initiatives within an institution.

This analysis will outline some of the implementation challenges educators face in creating accessible learning environments and provide suggestions for a path forward.

Inclusive Design

Watch [Accessibility vs. Inclusive Design](#) (NNgroup, 2024) to learn more about the differences. (4:38 minutes)

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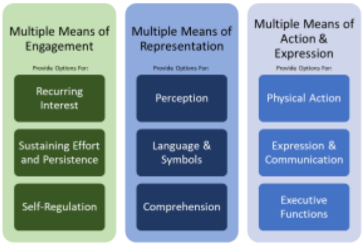
The goal of inclusive design is to remove obstacles that affect all students' well-being and academic success. In a 2022 report, the Postsecondary Education Standards Development Committee highlights equity, diversity and inclusion as core principles guiding educational institutions to develop standards and practices that address the intersectional identities of students with disabilities and create a more accessible learning environment by 2025 (King's Printer for Ontario, 2022). Accessibility and inclusion barriers are broad topics with many intersectional factors and potential solutions. Each post-secondary institution is a unique ecosystem comprised of administrators, stakeholders, support staff, educators, and students, and they all have a role to play in finding practical solutions that address these issues. As educators, we may not have control over the barriers our students face outside the classroom, but we do have a responsibility to remove them within the classroom. We do this by incorporating more inclusive theories and frameworks to redefine teaching practices that foster a more equitable learning environment to meet the needs of all learners, no matter their identities.

Frameworks such as Universal Design for Learning (UDL) and Web Content Accessibility Guidelines (WCAG) provide pedagogical and technical solutions for creating accessible learning environments and materials.

Universal Design for Learning (UDL)



The UDL Framework (adapted from CAST, 2018)

CAST (2018) developed the UDL framework as a tool for providing all students with equal opportunities and access to learning. This framework outlines strategies for developing flexible curricula that provide multiple means of representation, expression, and engagement so that students may have fewer barriers to learning (OHRC, 2018). For example,

- Representation: Providing learning materials and learning opportunities in multiple formats (e.g., text, visual, audio) that use appropriate language (i.e., cultural significance) can tailor the learning experience to best meet the needs of individual students.

- Expression: Providing flexibility in how students demonstrate their learning (e.g. compatibility with assistive technology, variety of technologies, personal goal setting and autonomy) can further support knowledge acquisition.
- Engagement: Providing opportunities for students to relate to the learning experience (e.g., building community, motivation, relevance and reflection) can foster engagement and application to the lived experience of the students.

To learn more about UDL, visit [The UDL Guidelines] on the CAST (2018) website.

Web Content Accessibility Guidelines (WCAG)

The World Wide Web Consortium (W3C) (2021) developed the WCAG technical standards to create global guidelines that ensure digital content accessibility for all digital technology users. The standards are categorized by four principles: Perceivable, Operable, Understandable and Robust.

- Perceivable: Information must be perceivable to all users and not limited to a specific sense (i.e., visual, auditory, kinesthetic).

- Operable: All users must be able to use and navigate content and not be limited to specific technologies.
- Understandable: Digital content must be consistent, reliable and clear.
- Robust: Digital content must be technically sound and compatible with other technologies.

To learn more about WCAG, visit Resources for Trainers and Educators on the W3C website.

Challenges and Solutions

Educators are responsible for meeting students' needs, so they may master the skills to be successful in their field of study and professional lives. However, how can this be accomplished if educators are not adequately supported and trained and also lack comprehensive guidelines for meeting inclusive standards? One significant shortcoming in our educational system is the lack of understanding of the accessibility and inclusive barriers students face and the lack of resources to provide practical solutions (Lomellini et al., 2022). Another corresponding shortcoming is the superficial nature of institutional policies and procedures, which do not comprehensively address accessibility and inclusion with plans of action and accountability measures (Fennelly-Atkinson et al., 2022; Pendergast, 2017; Rezai-Rashti et al., 2021). In conjunction, both shortcomings create a perpetual state of inaccessible and exclusionary practices that limit the academic success of many students.

To resolve these issues, the institution and its members should adopt a more critically inclusive praxis that acknowledges the existing gaps in inclusion and develop instruments to help facilitate inclusive learning experiences.

Evaluation Instruments

The Accessibility for Ontarians with Disabilities Act (AODA) advises that accessibility standards should be incorporated into colleges' and universities' quality assurance processes and program development projects (Kovac, 2023). These processes should invite feedback and perspectives from students and educators to continually assess the institution's determination and work towards eliminating barriers in the learning environment. Currently, there are no specific or universally accepted evaluation instruments that encompass all accessibility and inclusion guidelines for online course development. Baldwin and Ching (2021) reviewed seven online course design evaluation instruments popular in North America. They found 14 accessibility themes that, at varying levels, address principles of UDL, WCAG and accessibility human rights laws. They published a comprehensive Online Course Accessibility Checklist resource (Baldwin & Ching, n.d.) for evaluating online course design projects. Both Baldwin and Ching (2021) and Fennelly-Atkinson et al. (2022) caution that current accessibility checklists and evaluation instruments may not encompass all accessibility issues and guidelines necessary for online course development, and they may not address the additional accessibility protocols institutions may have in place to supplement these evaluation instruments. Much work is needed to redevelop these instruments for the specific needs of each institution and their demographical needs, taking a proactive approach to addressing accessibility issues (Pendergast, 2017). Institutions should tailor their training and development strategies to the specific technologies they utilize in their organization and move towards more comprehensive inclusion policies and procedures.

Review the list below for some of the commonly used technologies and their corresponding accessibility instruments used in postsecondary education.

LMS Accessibility Checkers

- BrightSpace (D2L) (D2L, 2024)
- Blackboard ULTRA (Anthology, 2022)
- Canvas (Instructure) (Instructure, 2024)

Adobe

- Accessible PDF’s (Adobe, 2023)

Microsoft Office

- Office Accessibility Checker (Microsoft, 2024)

Inclusive Praxis

> “Inclusive praxis refers to the process of using theory or experience-informed practices and reflection to intentionally design pedagogy and environments that enable full participation” (Warner et al., 2020, p. 244).

Educators and institutions may enhance their educational praxis by including Inclusive Design theories such as Culturally

Responsive Teachings, Multimodal Literacies, and UDL (Watts-Taffe, 2022) in combination with technical guidelines such as WCAG to create a more holistic approach to teaching a diverse group of learners. This perspective looks at accessibility and inclusion issues from an Inclusive Design umbrella with supporting theories and practices to create positive social change.

Visit Ontario's Ministry of Education website (King's Printer for Ontario, 2024) to learn more about Culturally Responsive and Relevant Pedagogy (CRRP).

To learn more about Multimodal Literacy, watch Developing a Critical Multimodal Literacies Pedagogical Framework | 2022 Literature Symposium from Foundation for Learning and Literacy (2022). (6:06 minutes)

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Conclusion

As educators and institutions navigate the evolving accessibility and inclusion landscape, we must stay cognizant of the continuous efforts needed to dismantle educational barriers for students of marginalized groups. In this analysis, we discussed why diversity, equity, and inclusion are essential when discussing accessibility in the classroom. Ableism and accessibility is a social issue that affects not only students with disabilities but also other marginalized groups. We also discuss the gaps in effective evaluation instruments and the importance of institutions tailoring these instruments to their specific communities' needs. Lastly, we discuss the importance of adopting a critically Inclusive praxis by combining inclusive pedagogies (Universal Design for Learning (UDL), Multimodal Literacies and Culturally Responsive Teachings) with technical accessibility standards (Web Content Accessibility Guidelines (WCAG)) to create a holistic and comprehensive approach to removing barriers for a diverse group of learners.

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Investigating Workplace Document Accessibility

CASIAH CAGAN

Introduction

In a time of digital convenience, electronic documentation has become standard. From public schools to higher education, government offices to nonprofits, a lot of information can only be accessed online. Applications such as DocuSign (2024) or Adobe Acrobat (2024) make it easier to create, sign, and send documents compared to hard copies that would need to be printed, hand-signed, scanned, and then faxed or emailed to the correct recipient. Despite these processing improvements, many organizations still distribute electronic documents that do not meet the accessibility needs of their target demographics. This failure is not intentional but due to poor training and weak connections with accessibility stakeholders.

I am currently employed at a university where a major part of my role includes digital document processing. For example, students will submit documents to change their full- or part-time student status, change their area of specialization within their degree, or their thesis supervisor. All documents in my workplace are in Portable Document Formats (PDFs) on the institution's website. Typically, the student is responsible for navigating the website to find the document for their needs.

If signatures are required, the student is also responsible for obtaining them and submitting the document to the correct department for processing. While it seems simple on paper, the process is confusing and time-consuming for students due to the lack of clarity on the process and a website that is difficult to navigate.

Framing the Problem

When first hired at my institution, I was asked to complete several training modules, including one for the Accessibility for Ontarians with Disabilities Act (AODA) (2005). However, as non-senior employees, we were only assigned basic levels of training. It explained what accessibility plans are, how to interact with or provide support to someone with a disability (i.e. "using the right words"), and general alternative communication methods. After completing this Accessibility and Technology course, I realize that this training should have covered more job-specific tasks rather than providing general information.

While one of my primary responsibilities in my job concerns document processing, I did not receive training on how to ensure documents are accessible. For example, I never knew that selecting "Print to PDF" on a document instead of saving directly as a PDF would remove all the formatting and tagging. I have used "Print to PDF" before because a document was not loading correctly, which unknowingly changed the accessibility. Similarly, I sometimes create letters for students in unique cases but was not trained to format the document for accessibility. In these cases, how do I know if a document sent to a student is accessible? Should documents be updated as standards and guidelines are updated? Who would I go to if I had a question about or needed assistance with accessibility?

Drawing from personal experience, this analysis will focus on accessible documentation for students within my institution. First, I will explain some of the web content accessibility principles that will help achieve optimal accessibility for our digital documents. Then, I will provide an overview of some existing document accessibility literature. Using the literature, I will propose solutions to the problem. Finally, I will discuss the implications of increased document accessibility for students and provide relevant resources for teaching and learning.

Accessibility Guidelines

Developed by the World Wide Web Consortium (W3C), the Web Content Accessibility Guidelines (WCAG) are a set of recommendations for digital accessibility to ensure all people can access Web content (W3C, 2023). There are four core principles of WCAG: Perceivable, which concerns content presentation; Operable, which ensures navigability; Understandable, meaning the content is easy to comprehend; and Robust, which allows content to be interpreted by assistive technologies. To analyze the problem of document accessibility and inadequate training to assess accessibility, I will focus on the Operable and Understandable principles of the WCAG as I feel these are the most important for student document accessibility.

Operable

The Operable principle refers to how a piece of content on the Web functions (W3C, 2023). It includes accessibility recommendations for user input, content and interface timing, general navigation, and avoiding adverse physical reactions like seizures. For document accessibility, the Operable principle allows individuals to easily navigate text or fillable components regardless of whether they use assistive technology.

The documents and forms available to students in my workplace do not follow the Operable principle. The forms do not include tagged headings, meaning they are not navigable for an individual with a screen reader. A screen reader would likely read the text left to right and not identify the changes in sections or content. This would be problematic for the forms where only some fields are to be filled by students, especially if the fields are on different pages across the document. Due to this lack of definition of the fillable areas, students would not be able to skip to the sections that are specific to them. The one positive aspect of the forms is that they are machine-readable, though this is an unacceptable minimum.

Understandable

The Understandable principle builds upon Operable, ensuring that the information presented in a piece of Web content and the operation of this content makes sense (W3C, 2023). In other words, Web content must include clear language and have predictable and consistent functionality. Additionally, places for user input should be identified and clearly explained. The Understandable principle is crucial for document accessibility, especially for documents that include sensitive information or require contractual signatures. An individual should have at least a general understanding of the presented information or the required task within a document.

The forms and documents provided to students can be difficult to understand. There is a short and vague explanation of the form in small font at the top of the page. The result is many questions from students asking for clarification about what is needed or which form to use. Staff are often frustrated with students and assume they did not read the document properly, but if I were viewing one of the forms for the first time, I would be confused, too. When students first open a document, they are usually met with a sea of blue indicating the fillable areas. The font size used to explain what should be written in each field is small. It can be overwhelming for a student to navigate due to the blank space.

Review of the Literature

The literature review I conducted on document accessibility in higher education included consideration of the WCAG principles outlined above. Interestingly, limited publications focused on administrative documentation that students use. However, the main results of the studies on libraries and academic publishers can be used in a higher education workplace context.

PDFs are one of the most common document formats in schools, academic publishing, and corporate offices (Chee & Weaver, 2022). However, the accessibility standards for PDFs are not widely known, resulting in the publication and distribution of inaccessible documents (Acosta-Vargas et al., 2017; Nganji, 2018). This is especially problematic in higher education, where the information students need is found online and in digital document files. Rather than making documents accessible in the first place, students have an unfair responsibility of seeking an accessible document when needed (Arzola, 2015; Nganji, 2018).

Unfortunately, many people are unaware of how to make a document universally accessible (Arzola, 2015; Kasdorf, 2018). This stems from a lack of appropriate training in the workplace, weak relationships with stakeholders, a lack of resources such as employees and access to applications like Adobe Acrobat Pro, and the time and money needed to learn and execute accessibility protocols (Chee & Weaver, 2022; Kasdorf, 2018). These barriers are not expected to be overcome anytime soon due to the structure of current accessibility protocols (Kasdorf, 2018); pivoting is difficult when flaws are engrained in a workflow.

Ideally, staff and faculty within an academic institution would receive formal training as the primary solution to document accessibility issues. They would learn about the WCAG 2.0 principles and the recommended processes for accessibility (Acosta-Vargas et al., 2017; Arzola, 2015; Kasdorf, 2018), plus receive access to Adobe Acrobat Pro to apply these processes (Chee & Weaver, 2022; Power, 2024). One of the most important processes for document accessibility is “tagging” headings, which creates a defined and consistent structure for screen readers to navigate (Acosta-Vargas et al., 2017; Nganji, 2018; Power, 2024). Additionally, it allows individuals with and without screen readers to skip or return to sections of a document without having to scroll or restart their reading (Kasdorf, 2018; Power, 2024).

Without training, there are still ways individuals can advocate for disability inclusion. Both Arzola (2015) and Kasdorf (2018) encourage people to be the first to speak up when issues arise rather than waiting for someone else to do so, even if there is no clear solution yet. Collaborating with different departments within your institution, especially accessibility experts, can be a strategic way to voice concerns and receive advice to get things started (Arzola, 2015; Chee & Weaver, 2022; Kasdorf, 2018). One of the simplest actions one can take is to talk to others about accessibility. This includes engaging in discussions with colleagues and higher management, plus getting feedback from the students who need accessible documentation to understand what could be improved (Arzola, 2015; Chee & Weaver, 2022; Kasdorf, 2018).

Solutions and Conclusion

Based on the literature, my main recommendation for workplaces would be to improve the breadth and depth of accessibility training. As I explained at the start of this paper, I received minimal accessibility training; I completed basic AODA modules that did not align with my responsibilities. I have spoken to others in my office who agree that better accessibility training should be introduced. For example, one of my colleagues who deals with policy and academic affairs explained that they could see many accessibility issues with the form used when a thesis student wishes to change their supervisor. However, they are not confident in making any changes due to a lack of training, and no one else in the office can assist.

Additionally, I learned that our relationship with internal stakeholders, such as the office of accessibility, is rather weak, so we do not have a reliable contact should any questions arise. Having reliable, direct contact with an accessibility officer when we notice accessibility issues in our student forms and documents, for example, would allow us to solve problems quickly.

Of course, limited funding and resources are major barriers to implementation. We are understaffed, to which many higher education institutions can attest. We cannot hire an accessibility expert whose job is to address these problems I have outlined. Introducing new training would take time due to the number of personnel needed to develop and approve the content. Though it will not be easy, improved training is a necessary step for all higher education employees to consider.

In place of a full training session, I found a few online resources that could benefit staff and encourage accessibility in their work. Both the University of Oxford (Centre for Teaching and Learning, n.d.) and the University of Waterloo (Voichita et al., 2022) have created resources specific to document accessibility in a higher education context. While they are geared towards teaching and learning in higher education, they could be relevant workplace resources. The Centre for Teaching and Learning (n.d.) provides a condensed table of key accessibility problems and how to fix them, including defining the first row and column in your tables, adding alternative text to images, and saving your PDFs to ensure bookmarks are created for each heading. Voichita et al. (2022) outline best practices, such as ensuring that text is placed in a meaningful order for screen readers. They also provide an excellent example of a PDF workflow, including training, tagging, feeding PDFs through a screen reader, and auditing any issues.

Cited in Power (2024), an accessibility infographic produced by Geissmann (2024) is another detailed resource that could be used in the workplace. One approach I think is useful is ensuring that any links are descriptive and avoiding the use of “click here” or related phrases. Additionally, color should not change the meaning of a task or function. For example, one can include an icon that indicates an error in a field rather than only highlighting text in red (Geissmann, 2024).

With these resources, I believe we could vastly improve my workplace. Accessibility training should not be done once and never revisited. Instead, we should always practice and improve our knowledge and ensure we have the most up-to-date information possible. This way, we can ensure that our responsibility to assist students in their academic journey is truly fulfilled. An educational institution without accessibility at the forefront only leads to confused and frustrated students who do not feel supported. Even with steps as small as distributing the infographics cited above, we could make a significant difference in our processes. After all, we must start somewhere.

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Increasing Accessibility to Address Unique Needs of Adults with Developmental Disabilities Preparing for the Workforce

CHELSEA MORANDIN

Introduction

Adults with developmental disabilities may face significant barriers when accessing workplace training programs due to the lack of accommodations and support tailored to their individualized needs (Applied Science Technologists & Technicians of British Columbia, n.d.).

Individuals with developmental disabilities may face difficulties such as limited comprehension of complex instructions, challenges with communication, and difficulty adapting to the fast-paced or demanding nature of traditional training environments (Garcia et al., 2020). These obstacles can undermine their work ethic and job performance, potentially leading to frustration and disengagement. Research indicates that the lack of appropriate accommodations and support can severely impact the employment outcomes of individuals with developmental disabilities. For instance, approximately 30% of individuals with ID leave their jobs within the first year of employment due to various challenges related to the work environment (Ellenkamp et al., 2016).

This chapter explores various evidence-based approaches, including Behavioral Skills Training (BST), shaping and chaining techniques, and the integration of digital resources like video modeling and virtual reality, all of which can positively contribute to breaking down barriers and increasing accessibility for adults with developmental disabilities in a workplace training environment.

Instructional Design Strategies

Individualized and Accessible Training Programs

Individualized and accessible training programs for adults with developmental disabilities can significantly break down barriers and enhance accessibility in several ways. These programs maximize engagement and effectiveness by tailoring training to everyone's unique needs and strengths. They address barriers such as communication challenges, sensory sensitivities, and cognitive differences by providing personalized support and accommodations. Moreover, accessible training programs ensure that learning materials, instructions, and environments are adapted to accommodate diverse abilities, promoting inclusive participation and empowering individuals to succeed in the employment sector.

The Opportunities Fund for Persons with Disabilities is a grant through Service Canada that aims to help individuals with disabilities enter and sustain employment. This initiative is implemented nationwide through Service Canada Centres in collaboration with community organizations (Employment and Social Development Canada. (n.d.). Service Canada partners with community agencies to deliver an individualized program to a group of young adults that addresses accessibility barriers. This is done by customizing the training curriculum to meet the needs and interests of each participant in the first section of the program and focusing on soft and hard skills to prepare participants for competitive employment. For the second part of the program, participants are matched to employment opportunities that may be suitable based on their skills, interests, and location and are supported by job coaching. The wage subsidy is provided to employers for the duration of the program to incentivize hiring young adults with disabilities. A report of the Opportunities Fund grant by Handouyahia et al. (n.d.) show that participants experienced an increase in incidences of employment and employment earnings in the five-year post-participation period, as well as a reduction in the dependence on income support during the post-participation period.

The Opportunities Fund for Persons with Disabilities stands as a pivotal resource in Canada's efforts to break down accessibility barriers for adults with disabilities. By providing comprehensive supports such as job search assistance, training programs, wage subsidies, work placements, and employer outreach initiatives, this unique grant addresses the diverse challenges individuals face in securing and maintaining employment. By empowering individuals with disabilities to achieve economic independence and contribute meaningfully to the workforce, the Opportunities Fund plays a crucial role in creating a more accessible and equitable employment environment across the country.

Behavioural Skills Training (BST)

Building on the importance of individualized training programs, Behavioural Skills Training (BST) offers a structured approach to teaching complex skills. While individualized programs address diverse needs through customized support, BST provides a systematic method to teach and reinforce specific job-related skills.

BST is an evidence-based behavioral approach used to teach new skills or modify existing behaviors (HowToABA, n.d.). It consists of four main components: instruction, modeling, practice, and feedback. The method is widely used in various settings, including education, therapy, and vocational training, to effectively teach complex skills to individuals with developmental disabilities. Examples and practical applications of BST are provided to demonstrate its effectiveness in promoting learning and behavior change.

BST has been extensively researched for teaching job-specific skills to individuals with Intellectual Disabilities and ASD. Studies have applied BST to work-related tasks such as envelope stamping, restaurant duties (like dishwashing and table bussing), fire safety education as a mascot, behavior technician skills for working with ASD children, and basic computer skills (using Microsoft Word, Excel, and PowerPoint) (Kisamore et al., 2023).

From teaching job-specific tasks like dishwashing and fire safety education to imparting essential computer skills, BST adapts flexibly to various learning needs, empowering individuals with IDD and ASD to acquire essential skills crucial for employment and daily life (Kisamore et al., 2023). While BST focuses on structured skill acquisition, shaping and chaining techniques further refine this process by breaking down complex tasks into manageable steps. These methods complement BST by offering detailed strategies for tackling specific workplace challenges.

Shaping and Chaining

Shaping and chaining are behavioral techniques that can be highly beneficial for workplace training with adults who have developmental disabilities. Shaping involves gradually reinforcing behaviors that approximate the desired skill or task. It breaks down complex behaviors into smaller, manageable steps (Cooper et al., 2007). For adults with developmental disabilities, many tasks in the workplace can initially be overwhelming due to their complexity. Shaping allows trainers to start with simpler tasks or behaviors that are within the individual's current capabilities. As the person demonstrates proficiency, trainers can gradually shape these behaviors toward the desired workplace tasks. An example would be when learning how to operate a cash register. Shape might begin with simple tasks like understanding how to handle money, followed by learning how to enter prices, and then progress to handling customer transactions.

Chaining involves teaching a sequence of behaviors or steps to complete a complex task. It can be forward chaining (teaching steps in sequence from start to finish) or backward chaining (teaching steps in reverse order) (Cooper et al., 2007). Adults with developmental disabilities often benefit from structured routines and clear sequences of tasks. Chaining provides a systematic approach to teaching these sequences, ensuring that each step is learned in the correct order and connected to the next. An example would be teaching how to assemble a product, which involves chaining each step: gathering materials, following assembly instructions, and ensuring quality control at the end. Researchers have studied backward chaining to effectively teach cleaning tasks to individuals with ASD and guided compliance, which includes instructive feedback, for teaching various skills like janitorial and laundry tasks to individuals with IDD (Kisamore et al., 2023).

Shaping and chaining techniques offer structured and effective methods for training adults with developmental disabilities in workplace settings. Shaping breaks down complex tasks into manageable steps, starting with simpler behaviors and gradually progressing toward the desired skills. Chaining, whether forward or backward, provides a systematic approach to teaching sequences of tasks, ensuring thorough understanding and proficiency in each step. These strategies contribute significantly to skill acquisition and independence in vocational training for individuals with developmental disabilities (Kisamore et al., 2023).

Digital Resources

As traditional methods like shaping and chaining address immediate skill acquisition, digital resources provide additional tools to enhance engagement and simulate real-world tasks. As explored by Wicker et al. (2022), the utilization of technology in vocational skills training for individuals with intellectual and developmental disabilities (IDD) has several benefits, such as increased engagement, personalized learning opportunities, and the ability to simulate real-world work environments. Wicker et al. (2022) also discuss the challenges to utilizing technology, such as access to technology, training for instructors, and the need for ongoing support.

Video Modelling

Bross et al. (2021) highlight the effectiveness of video modeling interventions in enhancing job skills among autistic adolescents and adults through their meta-analysis. This approach synthesizes findings across studies, demonstrating significant improvements in task completion, social interactions, and job-specific behaviors. The tailored nature of video modeling underscores its practicality and accessibility in employment settings for individuals on the autism spectrum.

Building on this, Kisamore et al. (2023) emphasize the successful application of video modeling and video prompting techniques in teaching a wide range of job-specific skills to individuals with ASD and IDD, including tasks like mascot duties, gardening, and clerical responsibilities. Importantly, they note that these skills not only translate into real job opportunities but also foster enjoyment and garner positive feedback from supervisors, highlighting the potential of these methods to overcome barriers and promote inclusive workplace training environments for adults with developmental disabilities.

Video modeling interventions, as demonstrated by Bross et al. (2021) and Kisamore et al. (2023), significantly enhance job skills for autistic individuals, fostering practical and inclusive employment opportunities. These techniques not only improve task proficiency and social interactions but also contribute to job satisfaction and positive workplace outcomes for adults with developmental disabilities.

Virtual and Augmented Reality

Recent research highlights the transformative potential of virtual reality (VR) and augmented reality (AR) technologies in addressing the educational and vocational needs of individuals with intellectual and developmental disabilities (IDD). Yalon-Chamovitz and Weiss (2008) underscore VR's effectiveness in providing engaging leisure activities for young adults with IDD, noting their sustained interest and consistent performance throughout the intervention period. Building on this foundation, Tan et al. (2022) propose a gamified AR vocational training program tailored specifically for adults with IDD. This innovative approach integrates interactive simulations and game-like elements to enhance motivation and engagement while addressing traditional barriers such as complex instructions and abstract concepts. By creating a simulated environment that mirrors real-world vocational tasks, the program aims to make learning more accessible and understandable for individuals with IDD, thereby promoting skill acquisition and task performance in a supportive, interactive setting.

Similarly, Kim et al. (2022) explore the application of VR to enhance work-related social communication skills for autistic individuals, emphasizing the collaborative potential between autistic employees and their support networks. This approach not only benefits autistic individuals but also enhances understanding and empathy among neurotypical employees. It is also important to note that despite the many benefits of VR and AR when it comes to accessibility in a workplace training context, there are also drawbacks to this emerging technology, such as cost and availability. Collectively, these studies highlight the transformative impact of VR and AR technologies in fostering inclusive educational and vocational environments, improving social skills, and enhancing the overall quality of life for individuals with IDD.

Conclusion

Looking ahead, the integration of evidence-based approaches and innovative digital resources presents an opportunity to further workplace training for adults with developmental disabilities. Future research should focus on longitudinal studies to evaluate the long-term efficacy of these approaches in diverse employment settings and identify which combinations of strategies yield the best outcomes. Additionally, policymakers should consider developing and funding more inclusive training programs and incentives for employers. This includes expanding support for technologies like virtual reality and video modeling and advocating for comprehensive training and resources for job coaches and support staff. Encouraging businesses to adopt these inclusive practices can not only enhance job opportunities for individuals with developmental disabilities but also foster a more diverse and equitable workforce. The journey towards a fully inclusive employment environment is ongoing, but with ongoing commitment to research, policy development, and practical implementation of strategies and digital tools, we can build a future where everyone can achieve their full potential in the workforce.

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Addressing Visual Impairment in Higher Education: Integrating Instructional Design and Digital Resources

ANNABEL EMORE

Abstract

Visual impairment presents significant accessibility challenges in higher education, affecting students' ability to engage fully with instructional materials and participate in learning activities. This paper identifies the impact of visual impairment on teaching and learning in higher education and proposes solutions through the integration of instructional design strategies and digital teaching and learning resources. By leveraging technology and inclusive design principles, educators can create accessible learning environments that accommodate visually impaired students and enhance their educational experience.

Introduction

Visual impairment encompasses a range of visual disabilities, including low vision and blindness, which impede students' ability to see printed materials, images, and digital screens. These challenges can significantly hinder their ability to engage with standard educational content, participate in classroom activities, and complete assignments. Students with visual impairments face substantial barriers in higher education, where the learning environment often relies heavily on visual content. These barriers include difficulty accessing textbooks, reading lecture slides, and using online learning platforms, leading to frustration, decreased academic performance, and a sense of isolation.

Students with disabilities are at greater risk in higher education, facing significantly higher dropout rates and considerably lower graduation rates than their nondisabled peers (Lombardi et al., 2016). Their academic and social challenges can be overwhelming, leading to disengagement and attrition. As stated by Becker & Palladino (2016), dropout rates increase when students with disabilities feel unsupported by their institution. This lack of support can manifest in various ways, such as insufficient accommodations, lack of understanding from faculty, and inadequate access to assistive technologies.

Students with visual impairments encounter unique educational barriers not experienced by many other students. They may have visible and invisible needs, as Gierdowski & Galanek (2020) highlighted. For instance, while some students may require braille materials or screen readers, others might need enlarged text or high-contrast visuals. The diversity of these needs requires a flexible and individualized approach to support. Furthermore, the social aspect of their education is equally important; students with visual impairments may feel isolated if they cannot participate fully in group activities or discussions.

This chapter explores the challenges visually impaired students face and proposes instructional design strategies and digital resources to enhance accessibility in higher education. Educators can create a more inclusive educational experience by leveraging technology and innovative teaching methods to ensure that all students, regardless of their visual abilities, have equal opportunities to succeed academically and participate fully in the educational community.

Impact of Visual Impairment on Teaching and Learning

Access to Instructional Resources

Power (2024) asserts that educators frequently distribute resources to students by sharing PDF files, including articles, textbook excerpts, novel passages, and other materials, making PDFs a common method for sharing educational content. However, visually impaired students may encounter numerous obstacles in accessing traditional instructional materials. These materials, such as textbooks, slides, and handouts, are predominantly visual, rendering them inaccessible without proper adaptations. Although digital content has the potential to be more accessible, it often lacks the appropriate formatting for screen readers and other assistive technologies, which are essential for visually impaired students to engage with the material. Moreover, classroom activities, such as group work, often rely heavily on visual cues, posing additional challenges. These barriers can significantly hinder the academic success and engagement of visually impaired students, highlighting the need for inclusive instructional design and accessible digital resources in higher education.

The barriers visually impaired students face can lead to decreased academic performance and engagement. Without access to the same information as their peers, these students may struggle to keep up with coursework, participate in discussions, and complete assignments. This disparity can result in lower grades and diminished motivation, impacting their overall educational experience and success.

Technological Barriers

Technological barriers pose significant challenges for visually impaired students in higher education. A primary issue is the incompatibility of digital resources with assistive technologies crucial for accessing course materials. For example, screen readers are essential tools that convert text into speech, enabling students with visual impairments to navigate digital content (Kisanga & Kisanga, 2022, p. 792). However, many educational resources, such as PDFs, websites, and multimedia presentations, often lack the necessary formatting for effective interpretation by screen readers. This limitation not only restricts students' access to essential learning materials but also impedes their ability to fully engage with course content.

Furthermore, the absence of accessibility features in digital documents and multimedia, such as captions for videos and alternative text formats for images, compounds these accessibility challenges. Without these accommodations, visually impaired students encounter significant barriers when attempting to comprehend and interact with various forms of digital content used in higher education.

Academic Performance

Visually impaired students often face academic performance challenges in higher education due to accessibility barriers. These students frequently encounter difficulties in keeping pace with coursework and completing assignments within the expected timelines. The delay or incomplete access to course materials, especially digital resources that lack proper formatting for screen readers or other assistive technologies, contributes to these struggles. Consequently, the inability to access timely information may lead to lower grades as visually impaired students find themselves at a disadvantage in meeting academic expectations. In a study conducted by Reed & Curtis (2010), 59 % of higher education students with a visual impairment, reported occasional difficulty in accessing appropriate accommodations due to delays in providing alternate formats of materials, inaccessible materials, unreliable notetakers, or teaching staff denying accommodations like audio recordings.

Moreover, the presence of accessibility barriers can significantly impact the motivation and engagement levels of visually impaired students. When educational resources are not readily accessible in formats suitable for their needs, students may experience frustration and reduced interest in participating actively in classroom activities and discussions. The reliance on others for accessing information or encountering repeated barriers can undermine their confidence and enthusiasm for learning, ultimately affecting their overall academic performance and educational experience in higher education settings.

Assessment Challenges

Visually impaired students face significant challenges with assessments that heavily rely on visual components. Efforts to broaden access to higher education include outreach in schools, special admissions programs, and ongoing support for diverse student success. However, there's limited attention on assessment, which may hinder diverse students' academic achievement and overall success in higher education (Moriña, 2017, p. 1).

Tasks such as interpreting graphs, diagrams, and charts can be particularly inaccessible without suitable adaptations or alternative formats. This limitation may result in visually impaired students being unable to complete these assessments accurately or independently, impacting their overall academic performance and grades. Furthermore, the emphasis on visual cues in assessments may overlook the diverse ways in which visually impaired students can demonstrate their comprehension and mastery of course content. Educators can use methods that allow students to demonstrate their knowledge and skills through means other than visual interpretation. By implementing these approaches, educators can ensure that visually impaired students have equitable opportunities to showcase their academic capabilities without the inherent disadvantages posed by visually dependent assessments.

Support and Resources

Visually impaired students often face challenges due to insufficient support and resources in higher education settings. Institutions frequently lack adequate assistance tailored to the needs of visually impaired students, such as accessible learning materials and necessary accommodations. This shortfall can impede students' ability to access course content effectively and participate fully in academic activities, potentially impacting their overall educational experience and success. Reed et al. (2003) found that most Canadian colleges and universities offer accommodations for students with disabilities, but the extent and types of accommodations vary widely among institutions, often tailored to the prevalent disabilities among their student populations. This variability may mean that accommodations designed for the majority may not adequately meet the needs of students with visual impairments, who constitute a smaller proportion of registered students with disabilities.

Moreover, there is a noticeable deficit in the training provided to educators regarding the creation and delivery of accessible content. Many educators may lack the necessary knowledge and skills to format materials in ways that accommodate students with visual impairments, perpetuating barriers to learning and limiting the effectiveness of educational approaches aimed at inclusivity. Additionally, the availability of assistive technologies and support services specifically designed to aid visually impaired students is often limited, further complicating their ability to navigate the academic environment independently and access the resources necessary for success in higher education.

Learning Management Systems (LMS)

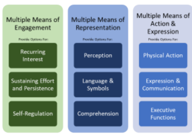
Learning Management Systems (LMS) are intended to be accessible through the Web Content Accessibility Guidelines (WCAG) 2.0 by the W3C. Despite these standards, many LMS platforms remain inaccessible to visually impaired students (Nascimento et al., 2019). Challenges include inaccessible navigation, non-compatible screen readers, and unclear layouts. According to American computer network research, 98% of websites were incompatible with screen reading software commonly used by the visually impaired, such as JAWS and ZoomText (Dabi & Golga, 2023). Such barriers can significantly impact the educational experience of visually impaired students, limiting their engagement with digital course content and interactions within the LMS environment.

Proposed Solutions to the Issue through the Integration of Instructional Design Strategies

Enhancing Accessibility in Higher Education through Instructional Design Strategies

Addressing the challenges faced by visually impaired students in higher education requires a multifaceted approach that integrates instructional design strategies. Educators must undergo comprehensive training programs focused on creating accessible digital content. This includes using accessible PDF formats, incorporating alternative text for images, ensuring compatibility with screen readers, and providing transcripts for audio and video materials. McNicholl et al. (2021) highlight that assistive technology can enhance functionality, diminish activity limitations, foster social inclusion, and boost participation in education, the labor market, and civic life. Therefore, institutions should invest in assistive technologies and create comprehensive support systems to ensure students can fully access and benefit from these resources.

Implementing Universal Design for Learning (UDL) Principles



To ensure equal opportunities and inclusion for students with disabilities, higher education institutions should integrate inclusive education principles and Universal Design for Learning (UDL) into their policies and practices (Moriña, 2017, p.5). UDL emphasizes providing multiple means of representation, action and expression, and engagement to accommodate diverse learners. For visually impaired students, this approach could involve offering materials in Braille or audio formats, allowing oral presentations as alternatives to written assignments, and incorporating tactile learning tools in laboratory settings. As asserted by Dabi & Golga (2023), people who are visually impaired desire access to information in formats that suit their preferences, enabling effective engagement in daily activities such as civic participation, understanding rights, making informed decisions, reducing uncertainty, and using information for work, learning, and leisure pursuits. By embracing UDL principles, educators can create flexible learning environments that cater to diverse learning needs, ensuring equitable opportunities for all students to succeed.

Promoting Inclusive Assessment Practices

Tai et al (2021) defined Inclusive assessment as creating fair and effective assessment methods that allow all students to demonstrate their full knowledge and abilities. Assessment practices can make disabled students feel “different,” “special,” and “lesser” compared to their peers, especially when they are visibly singled out, such as staying behind after exams for extra time, and this reflects ableism, as these assessments are based on the ideal, able student (Nieminen, 2024, p. 842). For this reason, allowing students to demonstrate their knowledge through various assessment methods is essential in accommodating diverse abilities, including those of visually impaired students. Assessments should offer options such as oral presentations, written reports, or multimedia projects, enabling students to showcase their strengths effectively. Engaging students through interactive activities like online discussions and collaborative projects, designed with non-visual elements, fosters motivation and active participation among visually impaired students.

Potential Digital Teaching and Learning Resources

Enhancing Accessibility with Assistive Technologies

To improve the education and involvement of students with visual impairments in inclusive settings, it is essential to provide materials in accessible formats and/or utilize assistive technology” (Kisanga & Kisanga, 2022). Incorporating assistive technologies into instructional design is essential for supporting visually impaired students in higher education. Tools such as screen readers like JAWS and NVDA convert text and visual content into synthesized speech or Braille, offering alternative means of accessing information. Text-to-speech software such as

Kurzweil 3000 and Read & Write provide auditory alternatives by reading digital text aloud and offering features like text highlighting for improved comprehension. Magnification software such as ZoomText assists students with low vision by enlarging text and images on screen, facilitating easier reading and navigation of digital materials.

Creating Accessible Course Materials

Creating accessible course materials is crucial for ensuring equitable access to education for visually impaired students. This involves formatting digital documents such as PDFs, Word files, and PowerPoint presentations for accessibility. Structuring documents with headings, lists, and tables makes them compatible with screen readers while including alt text descriptions for images and descriptive links enhances usability. Utilizing accessibility checkers within tools like Microsoft Office helps identify and correct accessibility issues, ensuring content is accessible to all students. Videos used in courses should include captions, transcripts, and audio descriptions to provide comprehensive accessibility for individuals (Kulkarni, 2019).

Ensuring Accessibility in Learning Management Systems (LMS)

Learning management systems (LMS) are pivotal in delivering digital course content, and ensuring their accessibility is foundational to creating inclusive learning environments. LMS platforms such as Blackboard, Canvas, and Moodle should adhere to web accessibility standards like WCAG, offering features such as keyboard navigation and text alternatives for non-text content. Customizable interfaces that allow students to adjust settings such as text size and color schemes further enhance accessibility within the LMS. Providing alternative formats for course materials within the LMS ensures that visually impaired students can fully engage with digital content.

Conclusion

Addressing visual impairment in higher education demands a comprehensive integration of instructional design strategies and digital resources to ensure equitable access and promote inclusive learning environments. The challenges faced by visually impaired students, from inaccessible instructional materials to barriers in technology and assessment practices, underscore the urgency for proactive measures. By implementing Universal Design for Learning (UDL) principles, educators can cater to diverse learning needs, offering multiple avenues for representation and engagement.

Moreover, enhancing accessibility through assistive technologies like screen readers and text-to-speech software not only facilitates information access but also empowers students to participate fully in academic activities. Ensuring that learning management systems (LMS) comply with accessibility standards further supports inclusive education, providing customizable interfaces and alternative formats that accommodate varying visual needs. These efforts, combined with ongoing educator training and institutional support services, are pivotal in fostering an educational environment where all students, regardless of visual abilities, can thrive academically and contribute meaningfully to their academic communities.

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The Consequences of Missteps: How Poorly Crafted Alternative Text Affects Higher Educational Institutions on Social Media

PAA BOATENG

Introduction

The significance of accessibility in higher education cannot be overstated, as it ensures that learning opportunities are fairly available to all students. With universities increasingly prioritizing their online presence (Hall, 2015), it is crucial to ensure that their social media platforms are accessible. One key aspect of making digital content accessible is including alternative text (ALT text) for images. Social media accounts for schools may contain various important elements of a school's educational structure, including information on financial opportunities for students, important academic information, and other helpful resources, making it important to ensure accessibility.

Srivatsan et al. (2024) define ALT text as “an HTML attribute associated with digital images, which is intended to provide a literal language description of an image’s content and can be rendered by a screen reader or braille display.” This means providing descriptive ALT text is crucial, particularly for visually impaired students who depend on screen readers to understand visual content.

Social media platforms like Instagram (Meta, 2024*b*), X (n.d.), Facebook (Meta, 2024*a*), and LinkedIn (2024) all allow for ALT texts for images. However, research has shown that ALT text issues persist. A study in 2007 found ALT text problems to be the most frequent issue on websites (McEwan & Weerts, 2007), and as of 2023, approximately 57% of 1 million websites still have ALT text errors (WebAIM, 2024). Current ALT text guidelines also struggle to address complex visual representations (Williams et al., 2022), making it challenging for authors to create accurate and useful ALT text. On platforms like X (n.d.), only 0.1% of images have ALT text, and the quality of user-written ALT text is inconsistent due to a lack of awareness of best practices (Gleason et al., 2020). This chapter examines the impact of improperly created ALT text on social media accounts for higher education institutions and proposes solutions through the integration of instructional design strategies and digital teaching and learning resources.

The Importance of ALT Text

ALT text is crucial for enhancing learning by providing a textual description of visual content. It enables visually impaired students to fully engage with educational materials, promoting better understanding and retention of information. Statistics from

2019 estimate that around 1.2 million Canadians, constituting 3.2% of the total population, live with Vision Loss (Gordon, 2021), with 4.1% of them being blind. By including ALT text in images where needed, all students can have an equitable learning experience, which is a fundamental aspect of inclusive education.

Accessibility in higher education is not just an ethical or optional consideration – it is a legal requirement. Legislation, including the Americans with Disabilities Act (ADA) (1990), the Accessibility for Ontarians with Disabilities Act (AODA) (2005), and the Web Content Accessibility Guidelines (WCAG) (W3C, 2022) mandate that educational institutions deliver accessible digital content. The World Wide Web Consortium stipulates that a text equivalent of an image must be provided, fulfilling the same function for a disabled person as it does for a person without a disability (2015). This underscores the importance of ALT text as a fundamental requirement for ensuring that visually impaired students can access and comprehend visual information on their school's digital platforms. Given the global reach of the internet, enforcing accessibility laws across national boundaries can be challenging. As a result, educational institutions should set an example, particularly since they are responsible for educating and raising awareness in societies.

The Problem of Wrongly Created ALT Text

One major issue with improperly created ALT text is that it may provide misleading or incomplete information. For instance, an image of a complex graph with the ALT text "graph" fails to convey the necessary details needed by visually impaired learners to understand the data presented. This incomplete information can lead to misunderstandings and hinder the learning process. On the other hand, unnecessarily long ALT text makes it more difficult for users of assistive technology to understand an image's content. Given that the quality of ALT text generally depends on the creator, there is a chance for human errors and inconsistencies, resulting in varying quality and effectiveness of ALT text, which impacts accessibility.

Additionally, not all images require ALT text. An overuse of ALT text for decorative purposes is another common problem. Images that do not convey meaningful content should either have null ALT text (alt=" ") or be marked as decorative in the web content. When such images are given unnecessary ALT text, it can clutter the screen reader's output, making it difficult for students to focus on relevant information. This issue arises because the process of creating ALT text involves multiple layers of interpretation, each influenced by the biases and assumptions of the creator (Edwards et al., 2023). This complexity can lead to misinterpretations and reduced effectiveness of the ALT text.

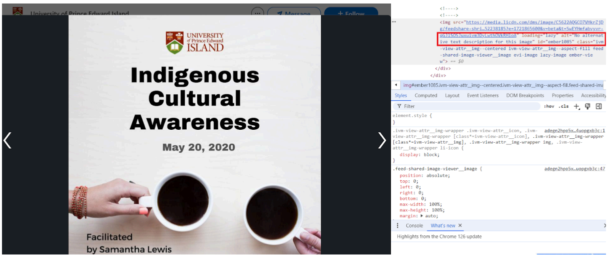
Technical errors, such as missing or incorrectly formatted ALT text, are also possible. These errors can occur due to oversight or lack of knowledge about accessibility standards. While acknowledging the human errors that can occur with the creation of ALT text, it is important not to ignore the functional limitations. The end-user experience in ALT text creation is inconsistent across different media (McCall & Chagnon, 2022). For example, the user experience differs significantly between social media websites, PDFs, and desktop applications and varies depending on the screen reader. Incorrectly formatted ALT text can cause screen readers to misinterpret the information, and functional errors can detract from the overall learning experience.

Case Studies of ALT Text Issues on Schools' Social Media

One university's post on LinkedIn, as shown in Figure 1 below, features an image with details about a session on Indigenous Cultural Awareness. However, upon inspecting the web page, it was noted that the image is missing ALT text. This means that individuals using screen readers will not have any information about the image or its content.

Figure 1

Screenshot of a LinkedIn Post From a University's Official Page

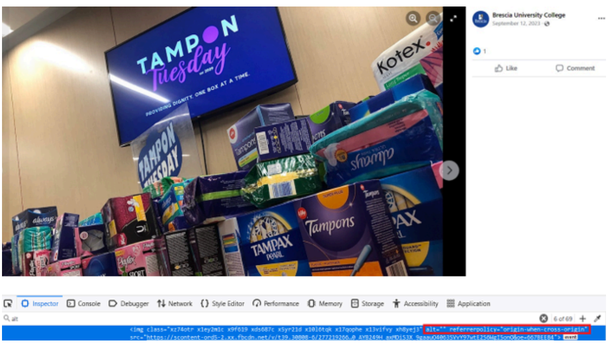


Note. *The image on the left side of the screenshot is the visual content shared by the university, while the right side includes inspection details of the page content, providing insight into the post's alternative text status. Screenshotted on LinkedIn. Retrieved on July 01, 2024. Copyright 2020 by UPEI Office of Continuing Education and Professional Development on LinkedIn.*

In another instance, on another higher education institution's Facebook page, there is an uploaded image (shown in Figure 2) that appears to display a set of feminine hygiene items. The image has no caption and provides an ALT text that reads "referrerpolicy="origin-when-cross-origin"". This ALT text may make it difficult for a screen reader to interpret, and it would not convey meaningful information to the listener. If the image was meant to be decorative, a better designation would have been more appropriate. Additionally, the lack of a caption indicates that important context is missing. This use of ALT text creates distractions for students using screen readers, making it challenging for them to focus on the actual content.

Figure 2

Screenshot of a Facebook Post From a College's Official Page



Note. *This figure provides an example of a school's social media engagement, featuring an image with no caption and unnecessary alternative text in the page inspection section. Screenshotted on Facebook. Retrieved July 01, 2024. Copyright 2023 by Brescia University College on Facebook.*

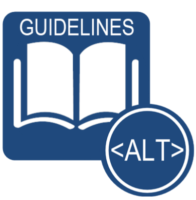
The Way Forward: Possible Solutions

Instructional Design Strategies

Training and Awareness Programs

Institutions should implement comprehensive training programs for faculty and web developers to emphasize the importance of ALT text and how to create it correctly for persons with visual impairments. This can include workshops, online courses, and resources that highlight best practices for writing descriptive and concise ALT text.

ALT Text Guidelines and Templates



To simplify the creation of ALT texts, universities can develop clear guidelines and templates for creating ALT text for various social platforms. These guidelines should provide examples of correct and incorrect ALT text and offer specific instructions for different types of images, such as charts and complex diagrams. Consistency in ALT text is crucial for providing a unified user experience. Unfortunately, existing web guidelines are frequently too broad and fail to address the unique needs of specific organizations or teams (Edwards et al., 2023). Therefore, universities should develop uniform guidelines to ensure consistent ALT text quality across various projects.

Regular Audits and Feedback

Institutions need to conduct regular accessibility audits of their social media platforms to identify and rectify ALT text issues, as shown in the two case studies.

Digital Teaching and Learning Resources

Automated Tools for ALT Text Generation

Institutions can start by using automated tools and software to generate ALT text, especially when the author lacks experience. These digital tools typically take prompts about the request or the image and then generate suggestions accordingly. Several options are available for institutions to consider (Uzegbu, 2024). Research shows that interfaces designed to assist authors in choosing content for their descriptions result in higher-quality ALT text (Mack et al., 2021). While these tools should not replace human judgment, they can provide a useful starting point, especially for simpler images.

Accessible Content Management Systems (CMS)

Institutions can adopt CMS platforms that prioritize accessibility features, including ALT text prompts and validation checks. As CMS tools are typically used to create website content and content for other platforms, these systems can help ensure that ALT text is not overlooked during the content creation process.

Collaborative Platforms for Content Creation

Encourage the use of collaborative platforms where faculty and accessibility experts can collaborate in creating and reviewing ALT text. The creation of ALT text can be integrated into the overall User Experience (UX) design process for various institutions. This involves developing specific guidelines, involving multiple stakeholders (such as artists, writers, and art directors), and ensuring ALT text receives the same level of attention as other UX elements (Edwards et al., 2023). This collaborative approach can improve the quality and accuracy of ALT text, making it more meaningful for students.

Conclusion

Higher education institutions have been pioneers in many areas of education, and their influence can extend to their social media presence as well. Incorrectly created ALT text on images on school social media platforms presents a significant accessibility issue in higher education. It hinders the social learning experience of visually impaired students and undermines the principles of inclusive education. This chapter discussed the current deficiencies in ALT text usage on social media by some higher education institutions, explained why this is problematic, and suggested ways to address it. By implementing effective instructional design strategies and utilizing digital teaching and learning resources, educational institutions can enhance the accuracy and usefulness of ALT text. This will ensure that all students have equitable access to digital content, fostering a more inclusive and supportive learning environment.

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Enhancing Accessibility for Deaf and Hard of Hearing Students in Medical Education

STEPHANIE KUNTZ

Terminology

This chapter will use terminology as defined by the Canadian Association of the Deaf (n.d.). The term deaf (with a lowercase "d") will refer to individuals with little or no functional hearing. Deaf (with an uppercase "D") will refer to individuals who engage in the culture, society, and language of the Deaf community, which is based on Sign language. *Hard of hearing* will refer to individuals with hearing loss whose usual means of communication is spoken language. The acronym DHoH (D/deaf and hard of hearing) will encompass all individuals with hearing loss. Identity-first language will be used, as is generally preferred by the DHoH community and in the literature.

The term disability will describe a wide range of lived experiences caused by the inaccessibility of services, lack of accommodation, and ableist expectations of others (Schumm, 2023). Though members of the Deaf (with an uppercase "D") community are not disabled, individuals who are deaf (with a lowercase “d”) or hard of hearing may identify as having a disability due to the challenges they face living in a hearing-centric world (Schumm, 2023).

The sources referenced in this chapter will include both academic publications and accounts of barriers and solutions shared by DHoH medical trainees and physicians.

The Scope of Accessibility Barriers in Medical Education

While efforts to improve diversity in healthcare education have increasingly focused on addressing gender and ethnic disparities, limited attention has been paid to medical trainees with varied accessibility needs (Hill et al., 2022). In 2023, the Canadian Resident Matching Service reported that 5.1% of both Canadian and international medical trainees self-identified as having a disability. This rate is far lower than the 22% prevalence in the general Canadian population (Gertsman et al., 2023). Individuals who are DHoH are similarly underrepresented in healthcare, especially among physicians (McKee et al., 2013). Although more than 15% of the general population experiences hearing loss, medical students with hearing loss represented only 0.01% of US medical school graduates between 2001 and 2010 (Argenyi, 2016).

Over the past decade, the number of DHoH medical professionals has increased by 26%, yet there is still a lack of published strategies for designing inclusive medical education programs (Hill et al., 2022; National Deaf Center on Postsecondary Outcomes, n.d.). This gap is reflected in the experiences of Dr. Jessica Dunkley, Canada’s first Deaf and

Métis doctor, who faced significant challenges when the University of British Columbia denied her request for Sign language interpreters, leading to her dismissal from the residency program. Five years later, the British Columbia Human Rights Commission and the Supreme Court of British Columbia ruled in her favor, acknowledging the discrimination she faced during her medical education (Moulton, 2017).

Accessibility Barriers and Proposed Instructional Design and Technology Solutions

Physician education in Canada comprises at least three years of medical school, divided into pre-clinical and clinical stages. The pre-clinical stage focuses primarily on acquiring foundational biomedical knowledge, typically in large lecture halls and small group settings. After pre-clinical education, medical students move on to clinical education, where they rotate through various medical specialties, gaining hands-on experience in clinics, operating rooms, emergency rooms, and hospital wards. These clinical experiences allow students to translate theories learned in the classroom into professional practice (Fovet, 2021).

DHoH students face barriers at every stage of medical education, some unique to each aspect of training.

Ableism

Ableism has long been entrenched in the culture of medicine and refers to a framework of thought and action that prefers certain types of bodies and minds over others (Agaronnik et al., 2021; Kaundinya & Schroth, 2022). A commonly reported concern regarding students with disabilities is the assumption that they will not be able to withstand the rigours of medical education or be able to undertake a broad scope of practice upon graduation (Gertsman et al., 2023). In medicine, implicit messages that students with accessibility needs do not belong often stem from institutional policies, customs, and rituals collectively known as the *hidden curriculum*. This hidden curriculum is shaped by everyday practices discouraging trainees from asking for help or missing shifts or classes. Frequent and subtle microaggressions, such as derogatory comments about disability accommodations from medical staff or peers, are disturbingly common (Gault et al., 2020).

To ensure fair representation of DHoH students in medical education, conscious efforts must be made to promote a medical school culture that includes and values all students (Gault et al., 2020; Kaundinya & Schroth, 2022). Anti-ableism goes beyond rejecting ableism; it involves implementing actionable changes in medical school admissions criteria and curricula to foster a culture of inclusion in healthcare (Kaundinya & Schroth, 2022).

Admission Biases

Bias entrenched in medical school admissions poses a significant barrier to accessibility for DHoH students. While the U.S., Australia, and New Zealand have national guidelines outlining the inclusion of applicants with disabilities, Canada lacks standardized guidance beyond the legal duty to accommodate to the point of undue hardship (Gertsman et al., 2023).

Technical standards refer to the essential abilities that medical students must possess to complete their education and practice medicine competently. In the U.S., 73% of medical schools used discriminatory language in their technical standards, and only 13% included mention of accommodating students with disabilities (Stauffer et al., 2022). In Canada, medical schools set their own technical standards, which are often vague. For example, Ontario medical schools require students to be able to "acquire all relevant sensory information" without clarifying the nuance of what is required (Council of Ontario Faculties of Medicine, 2016). The unclear wording of this technical standard may discourage applicants from applying to medical schools or declaring their accessibility needs (Gertsman et al., 2023; McKee et al., 2013). Additionally, Canadian medical school admission websites lack information on accommodations (Gertsman et al., 2023).

To address these barriers, technical standards should be revised to allow safe alternatives when certain skills cannot be performed, even with accommodations. Some schools in the U.S. address this by focusing on the necessary skills without prescribing the exact methods by which these skills must be demonstrated (Gertsman et al., 2023). For example, a physician should be expected to diagnose pneumonia, but this does not necessitate the ability to hear the lung sounds associated with pneumonia (McKee et al., 2013). Technical standards should also be updated regularly to reflect the improvements in accommodative technology (Kaundinya & Schroth, 2022). Finally, medical schools must provide publicly available resources for prospective students that detail how their programs are accessible. This increased transparency would empower students to apply to medical schools, knowing their accessibility needs will be met (Gertsman et al., 2023).

Barriers Faced During Pre-Clinical Education

Pre-clinical education presents numerous potential barriers for DHoH learners, stemming from the physical learning environment and the overwhelming volume of information conveyed predominantly auditorily. Large lecture halls, in particular, may present barriers for DHoH students due to the ambient noise and challenges of lip reading, especially when the speaker is far away or is talking quickly (Karunaratne & Karunaratne, 2021). In small group settings, incomplete sight lines and rapid verbal exchanges with overlapping conversations can also be barriers (Karunaratne & Karunaratne, 2021).

Accommodations in these settings may involve using interpreters or assistive technology. The term interpreter can refer to either a Sign language interpreter or an oral transliterator. A Sign language interpreter translates between Sign language and English, while oral transliterators silently repeat spoken English to facilitate lip-reading from a single, easily visible person (National Deaf Center on Postsecondary Outcomes, n.d.). In Canada, the main Sign languages are American Sign Language (ASL) and Langue des signes québécoise (LSQ). There is also a regional dialect, Maritimes Sign Language (MSL). Individuals accustomed to using Sign language should be aware that the ASL lexicon does not have specific signs for many medical terms. There is often a learning curve related to mastering the specialized jargon and terminology of medicine (Hill et al., 2022).

Assistive technology may take the form of speech-to-text services and assistive listening systems. Speech-to-text services, also called Computer Assisted Real-Time Translation (CART), provide visual text with nearly instantaneous translation of the spoken word. A CART provider types the speaker's words on a stenographic machine connected to a computer with software to translate the stenographic code into English. The translation can be read on a mobile device, a computer screen, or projected onto a wall. CART can be provided remotely through an Internet and telephone link (David, 2008).

Assistive listening systems represent another form of assistive technology. These systems enhance sound quality for individuals with incomplete hearing loss and can be considered "binoculars for the ears." They differ from hearing aids as hearing aids amplify all sound, but assistive listening systems enhance hearing in specific settings by reducing background noise. Assistive listening systems can range from small, portable devices to preinstalled systems built into rooms. The many different assistive listening systems present unique advantages that can be tailored to different settings and user needs. Medical students at the University of British Columbia can borrow portable assistive listening systems from Assistive Technology BC at no cost (Lui, 2019). Lecturers should be aware that students using a portable assistive listening system cannot hear classmates' comments unless they speak with a microphone. Lecturers should repeat brief comments from other students or pass the microphone to students making longer comments (National Deaf Center on Postsecondary Outcomes, n.d.).

In addition to interpreters and assistive technologies, note-takers can be used so that DHoH students can focus on accessing information without diverting their eyes from the source of information. Educators should also share their materials in advance and supplement lectures with captioned media. Learning environments should be designed to give all audience members a clear sight of the speaker. Adequate lighting is important for lip reading and watching interpreters (David, 2008).

Another potential barrier in pre-clinical education stems from assessments such as non-traditional "bellringer exams" frequently used to evaluate anatomy, pathology and radiology knowledge. During bellringer exams, students rotate through stations, identify anatomical structures, and answer related questions. General instructions during assessments are often given verbally (Lui, 2019). Similarly, bells, as the name implies, notify students when a station is over or ends early (Lui, 2019). This reliance on auditory information poses a barrier for DHoH students, as they may miss crucial verbal instructions, time warnings, and auditory signals. To address this barrier, multiple modalities should be used to convey key information during assessments, and visual alarms should be used in addition to auditory notifications (David, 2008).

Barriers Faced During Clinical Education

Transitioning from a classroom to a clinical environment is a distinct aspect of medical education that presents unique barriers for DHoH students. Spoken communication is especially challenging to process in emergency departments and hospital wards due to high noise levels and poor environmental engineering (Chodosh et al., 2020). DHoH students may use an interpreter, a text-to-speech service, or an assistive listening system to overcome this barrier (Meeks et al., 2018). If an interpreter is used, this should include coverage for regular clinic hours and hours spent “on-call”, which can amount to greater than 60 hours of interpreter engagement per week. Two interpreters may be required in situations where interpreting could be prolonged (Hill et al., 2022). Medical educators can also improve emergency department and hospital ward teaching if conducted in smaller groups with an effort made to face the DHoH student while talking (Karunaratne & Karunaratne, 2021).

Masking is another barrier encountered during clinical education. During the COVID-19 pandemic, 95% of individuals with hearing loss cited masks as an obstacle to communication (Chodosh et al., 2020). Many clinical settings still require learners to wear face masks. By default, hospitals only stock opaque face masks, which block lip movement visualization and muffle high-frequency sounds essential to speech (Chodosh et al., 2020; Meeks et al., 2015). To address this barrier, transparent surgical masks with a clear window over the mouth can facilitate lip-reading (Meeks et al., 2015). Unfortunately, there are not, as of yet, any windowed N95 masks for interacting with patients with airborne infections (Lui, 2019).

Clinical rotations involving operating rooms have their own unique set of barriers (Meeks et al., 2015). In addition to mandatory masking, learners must follow verbal instructions from supervisors while simultaneously monitoring patients and equipment that use alarms to alert the care team (Meeks et al., 2015). To address these barriers, Sign language interpreters should be allowed in surgical suites. If space is a limiting factor, or if the learner does not use Sign language, CART and/or assistive listening systems may be used with some adaptations (Meeks et al., 2015). For monitors that alarm using sound, a vibrating alarm attached to a beeper or other small device can alert DHoH students. Students may also benefit from reviewing anticipated surgical cases one-on-one with a surgical team member before each surgery. This may assist the student in familiarizing themselves with the procedure, vocabulary, anticipated outcome, potential concerns, and the techniques being used (Meeks et al., 2015).

Finally, many medical professionals rely on auscultation (the act of listening to internal sounds of the body) to examine the status of the circulatory, respiratory, and gastrointestinal systems (Rabinowitz et al., 2006). It is a common misconception that DHoH learners cannot use a stethoscope, which is required for auscultation. Stethoscopes come in many varieties and may be acoustic (traditional, unamplified) or amplified, providing amplification up to 40 times with noise cancellation. Some amplified stethoscopes have an audio output jack that can be attached to a recording device, a second listener, headphones, or an assistive listening system. Some stethoscopes can also stream through hearing aids or cochlear implants (Lui, 2019). In addition to stethoscopes, some physicians may use portable ultrasounds to help visualize what the stethoscope is capturing (Lui, 2019). Non-auditory stethoscopes connect to a laptop or personal digital assistant and display visual representations of auscultated sounds (Rennert et al., 2004).

Conclusion

Accessibility gaps must be addressed in medical education. Not only is failing to do so a violation of human rights, but welcoming DHoH students in medical education enriches the experiences of DHoH learners, peers, practicing physicians, and patients. Including DHoH students in medical education offers an experiential way to educate peers and faculty on DHoH accessibility and helps shift the perception of DHoH persons from patients to colleagues. Moreover, DHoH medical students and physicians often act as role models and mentors for those who aspire to medical careers previously thought out of reach. DHoH physicians can also provide linguistically accessible and culturally appropriate health care to DHoH patients historically marginalized in the health care system. At the very minimum, Deaf patients should have access to ASL-fluent doctors (McKee et al., 2013).

By addressing barriers at each stage of medical education, institutions can foster a culture of inclusion and support. Educating DHoH physicians should prioritize outcomes, accessibility training for educators, and support the use of interpreters and assistive technologies when requested. Admission committees, faculty, and administrators should also recognize the diversity within the DHoH community in medicine and actively engage DHoH learners to identify their preferred accessibility solutions across various settings (McKee et al., 2013).

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RESOURCES FOR SPECIFIC ACCESSIBILITY ISSUES

Enhancing Access for Students with Dyslexia

AMANDA HENDERSON

Introduction

In the education system, ensuring that all students have equal opportunities to learn is essential. According to Tarjiah et al, “Dyslexia is a neurodevelopmental disorder that may lead to difficulties in reading and other language-related cognitive processes” (2023). These difficulties are typically a result of a deficit in the phonological component of language (Dyslexia Canada, n.d.). The International Dyslexia Association states that “10-20% of the population has a language-based learning disability” (n.d.). It affects males and females equally, as well, as different ethnic and socio backgrounds. Dyslexia is a hereditary disability, and it is caused by genetics. There are typically signs and indicators of dyslexia in children that appear as early as preschool age (Dyslexia Canada, n.d.). However, all children learn at their own pace but when a child is struggling with reading and writing, it could be dyslexia. Some indicators to look for are language, reading (decoding), writing, spelling, rhyming, and speaking challenges. Students with dyslexia, do not struggle in the same way. Some students will struggle with sounding out words, while others have comprehension struggles. As students age, it can look different and change over time (Dyslexia Canada, n.d.).

In K-12 education, students with dyslexia often face challenges that hinder their academic performance and overall learning experience. This chapter explores the nature of these challenges and suggests solutions to enhance accessibility and support for students with dyslexia. However, students with dyslexia often face significant barriers that prevent them from accessing the same learning opportunities as their peers.

Challenges Faced by Students with Dyslexia

Students with dyslexia encounter a range of challenges that can impact their academic performance and overall learning experience. These challenges are often multifaceted, affecting various aspects of reading, comprehension, and writing. Some major challenges faced by students with dyslexia include reading, writing, and information overload.

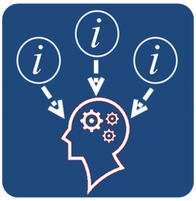
Reading

Students with dyslexia often face challenges with decoding when learning to read. This difficulty arises from the way we acquire reading skills. Learning to read is a complex process. When learning to read the brain is learning to map between print and sound. The mappings are between phonemes which are the smallest until of speech, and graphemes, letters, and letter groups called diagraphs (Snowling et al., 2020). However, in English, there are many inconsistencies in the mappings, making it challenging to read. As children learn the alphabetic code, they can translate print into sounds and from that access the meaning of familiar words (Snowling et al., 2020). Over time, with experience, relying on decoding decreases, and word recognition becomes increasingly automatized as they gain automaticity. This allows children to go from print to meaning rapidly and effortlessly. For students with dyslexia, they are slower to learn to decode and gain fluency. According to Snowling et al. (2020) “[i]t is well established that in cognitive terms, dyslexia is caused by problems at the level of phonological representation.” When students are struggling to decode, and read, it has other effects. Students with dyslexia will often have poor comprehension skills due to labored reading. Students typically struggle with reading the text, processing it, and understanding the meaning of the text they are reading. Struggling with reading can lead to frustration, reduced self-esteem, and more likely to avoid reading tasks.

Writing

Students with dyslexia often struggle with writing. Writing is linked to reading as they use the same processes in the brain. According to Hebert et al., “reading is theorized to be a central component of writing in some cognitive models of writing development” (2018). Writing difficulties can be attributed to their reading difficulties. Writing difficulties can present in many ways such as poor spelling, poor legibility, lack of diverse vocabulary, poor idea development, and/or lack of organization. Writing difficulties occur for two main reasons. The first reason would be writing relies on underlying processes. Writing relies on the encoding process which is the ability to break down spoken words and write them down (Hebert et al., 2018). Secondly, reading is a subskill of writing. Writers often need to read materials before writing and need to read/reread their writing to find spelling errors, grammar errors, and disorganization (Hebert et al., 2018). Additionally, if students have poor handwriting skills, it can make it more challenging for them to read their work. Writing difficulties can make assignments for students more challenging, time-consuming, and daunting (Hebert et al., 2018).

Information Overload



Students with dyslexia can experience information overload. When the material is too much and all at one time, it can become stressful for students (Butcher, 2021). There are three main reasons for information overload. The first reason students might experience information overload is that students tend to process incoming information differently compared to other students (Butcher, 2021). Dyslexics may process information more slowly, and often recognize/identify information in pictures or images instead of words (Butcher, 2021). Secondly, students may struggle with memory and information retention. Therefore, individuals may struggle with recalling and remembering information. Finally, students may have difficulty with processing and receiving large portions of information especially if presented in a format they struggle with (Butcher, 2021). An example of this would be, a large amount of text to read in a limited period or crowded textbooks that lack scaffolding. Scaffolding refers to the process where a teacher will offer support for students learning new concepts or skills. An example of this would be "I do, We do, You do" (GCU, 2019).

Proposed Solutions

As educators, it is crucial to provide students with dyslexia the specific support they need for their academic success and overall well-being. Dyslexia presents unique challenges that require target strategies. The following solutions aim to create a more inclusive and supportive learning environment for students with dyslexia, enabling them to overcome challenges and barriers. These solutions encompass a range of approaches from implementing a Universal Design of Learning to Assistive Technology to create an inclusive classroom. Here are some solutions to help students with dyslexia in the learning environment.

Instructional Design

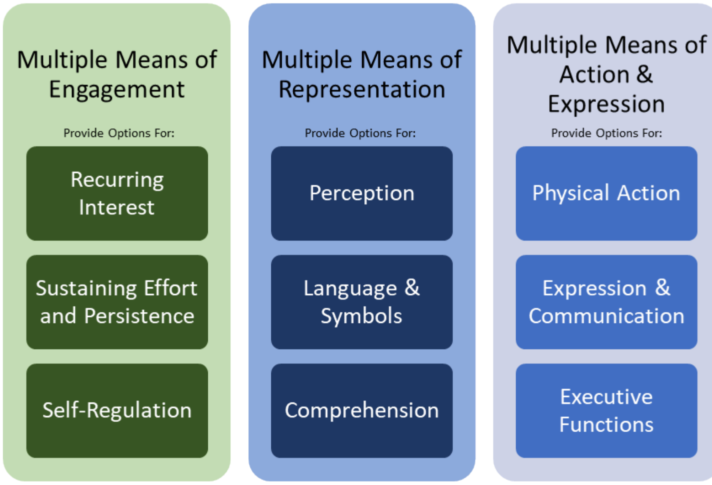
Universal Design for Learning (UDL) Principles

Universal Design for Learning (UDL) is a "scientifically valid framework for guiding educational practice that:

- provides flexibility in the ways: information is presented, students are engaged, and students respond or demonstrate knowledge and skills.
- reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient" (Research Guides at Mt San Antonio College, n.d.).

Figure 1

Domains of UDL (CAST, 2018)



The three domains of the UDL guidelines include Multiple Means of Engagement, Multiple Means of Representation, and Multiple Means of Action & Expression.

Multiple Means of Representation

When giving content, provide it in different formats. Different examples of formats would be text, audio, video, and interactive graphics to meet different learning preferences. These are called multiple means of representation or multimedia learning environments (Knoop-van Campen et al., 2022). Multimedia environments have become an important part of learning (Knoop-van Campen et. al, 2022). Knoop van Campen et al. (2022) state “These principles focus on minimizing the burden on the working memory so that working memory capacity can be used to process the information stored in long-term memory. Off-loading working memory capacity to enhance learning." It is recommended to use graphic organizers, charts, and visuals to support text-based information. This allows for the modality principle. To the best, modality, you should pair audio with pictures instead of text.

Multiple Means of Action and Expression

Multiple means of action and expression means that student should be allowed to demonstrate their understanding in various diverse ways. According to MT SAC library, "learners differ in the ways that they can navigate a learning environment and express what they know" (2024). This can be done through oral presentations, visual projects, or interactive activities. When doing this you should incorporate different technologies that support students to use different assistive technology. Examples of this would be voice-to-text or text-to-speech.

Readable Text and Layout

Clear Fonts and Layouts

When typing and using fonts ensure they are dyslexia-friendly fonts (for example, OpenDyslexic, Arial, or Verdana) and ensure there is adequate line spacing and font size. A study conducted by Rello and Baeza-Yates (2017), found that larger found size improves readability, larger character spacing, no greyscale, and standard character spacing and 44 characters per line was best for readers with dyslexia (2017).

Simplified Layouts

When giving out instructional materials, it needs to be clear and concise. For example, the instructions need clear headings, bullet points, and white spaces to enhance readability. Clear headings help to organize information and guide the reader through the material. According to Lorch, “headings and subheadings structure information in a way that makes it easier to process and recall” (1989). Bullet points break down complex information into manageable chunks, which can help comprehension and retention. As well you could also use chunking which is breaking down information into smaller, more manageable sections with clear headings and subheadings. As noted by Hartley, “bullet points can make the text more digestible and accessible by highlighting key points and separating information into distinct units” (2014). These design elements help make the content more accessible. When structuring information, you should include summaries and key points at the beginning or end of sections to reinforce understanding and retention. Students with dyslexia often struggle with memory and retention. Adding reinforcement, allows the students to hear the information once more, helping them to more likely retain the information.

Interactive and Engaging Content

When presenting content for students, the content should be interactive and engaging for students. First off, you can present content, in multiple media. Examples of this would be videos, animations, and interactive simulations to present complex information in an accessible way. Another way to make content interactive and engaging would be to use gamified learning. Incorporating game-based learning is a way to make content interactive, less intimidating and overwhelming.

Digital Resource Solutions

When using digital tools in education, often accessibility challenges can affect the learning experience of students with dyslexia. Although technology and educational resources have advanced, many digital platforms and materials still lack accessibility, creating barriers and challenges for students. This section will discuss different solutions to alleviate the barriers. As stated above, there are many different challenges for students with dyslexia. Often, they struggle with reading and writing, and content overload. However, there are solutions that educators in the K-12 system can use to relieve some of the stressors for students with dyslexia. The first one would be to use different assistive technologies. According to Dawson et al. (2018):

> The term *assistive technology* (AT) refers to the services and devices that enable people with disabilities to accomplish daily living tasks; assist them in communication, education, work, or recreation activities; and ultimately, help them achieve greater independence and enhance their quality of life.

For example, text-to-speech tools. When you integrate text-to-speech software, it can help students with dyslexia listen to written content and "enabling learners with challenges accessing printed text to access to the content. (Dawson et al., 2018). This will help the student comprehend the text and reduce reading fatigue. Dawson et al., highlight how AT, "can be beneficial for students with dyslexia who exhibit weak decoding skills, low levels of fluency, and strong listening comprehension skills" (2018). Students with dyslexia often struggle with writing and spelling. A solution for this would be speech recognition software. It allows students to verbally response to questions and the software will write their responses for them. This helps students overcome their writing difficulties. A piece of assistive technology that combines both text-to-speech and speech-to-text would be a Chrome extension called Google Read and Write (TextHelp, 2024). Google Read and Write provides a toolbar that allows users to select from the different options such as text-to-speech, speech to text-and-word prediction. Other options include Speak It! (2023), NaturalReader (Naturalsoft, n.d.), Bookshare (Beneficent Technology, 2024), and Audible (2024) for accessing information, and Mercury Reader (Softonic, n.d.), Beeline Reader (2017), and Voice Dream Reader (2024), for the display of information. Dawson et al. (2018) list AT tools for writing and spelling, including word processors, voice typing, CO:Writer Universal (Don Johnston Incorporated, 2016), Write:Outloud, and Siri (Apple Inc., 2024).

Implementation and Best Practices

Training and Awareness

As educators, there are certain strategies that we can implement for ourselves, our students, and their families. Implementing training for staff such as professional development. By providing ongoing training for educators on the best practices for teaching students with dyslexia, including assistive technology and UDL principles. An example of this would be a book club discussing the book UDL NOW! This will help educate staff on understanding dyslexia, which will help to create an inclusive classroom/school environment that is supportive. As well, schools can conduct awareness campaigns to educate the school community about dyslexia and the importance of accessibility in education. Parents should be involved in campaigns to help them understand and support that is provided to their children.

Policy and Standard

Schools need to develop policies that are school-wide, to mandate the creation of accessible learning materials and environments for students. They need to ensure these policies are aligned with the national and international accessibility standards. When using digital content, ensure it adheres to the Web Content Accessibility Guidelines (WCAG) 2.1. WCAG provides a set of criteria for making content accessible to individuals with disabilities. This will allow them to comprehend content better. As well, it needs to comply with the Accessible Canada Act, which mandates the identification, removal, and prevention of barriers in all areas including information and communication technologies. This allows for means ensuring that digital educational resources are designed to be accessible, allowing them to access and engage with content without unnecessary difficulties. Ensuring digital content adheres to these standards is crucial for supporting students. They provide a framework for creating accessible educational materials that enhance their education and learning.

Conclusion

Addressing the accessibility challenges faced by students with dyslexia in K-12 education is crucial for their academic success and overall well-being. By implementing comprehensive instructional design principles and digital resource solutions, educators can create a more inclusive and supportive learning environment. This not only benefits students with dyslexia but also enhances the educational experience for all learners, fostering a more equitable and effective educational system.

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Effectiveness and Challenges of Task Management Apps for Students with ADHD: A Focus on Task Organization and Time Management

BRENDA CARR

Abstract

Children with Attention-Deficit Hyperactivity Disorder (ADHD) face an increased risk of academic challenges compared to their neurotypical peers (McDougal et al., 2022). To promote the academic success of students with ADHD, teachers play a crucial role in addressing their behavioral, organizational and time management needs, preparing them for success in everyday life (Kreider et al., 2019).

Using technological interventions alongside traditional methods enables teachers to effectively support their students with ADHD (Bellanti, 2011). Various apps are available to help students develop study skills, manage time, and organize tasks, which are essential to future success (Hart Barnett, 2017).

Further research and teacher training are essential to ensure

the effectiveness of intervention tools and create a conducive learning environment that fosters success for students with ADHD (Moore et al., 2017).

Keywords

ADHD, Attention-Deficit Hyperactivity Disorder, classroom strategies, educational apps, intervention tools, teacher training, technology

Introduction

Attention-deficit hyperactivity disorder (ADHD) is a neurobiological disorder that affects between 5-12% of the population, translating to 1-2 students in every classroom. This common disorder is often associated with learning disabilities (LD). However, it is important to state that ADHD is not a learning disability (Learning Disabilities Association of Ontario, 2024). Learning disabilities are a variety of disorders that impact the acquisition, retention, understanding, organization, or use of verbal and non-verbal information (Learning Disabilities Association of Ontario, 2024).

There seems to be a prevalent correlation between ADHD and LDs in children. Studies indicate that 70% of children with ADHD present a severe learning disability in written expression, which is twice as common as a learning disability in reading, math, or spelling (Mayes et al., 2000). In essence, it is suggested that learning and attention problems are interrelated.

To ensure the academic success of students with ADHD, educators must assist students in addressing their organizational and time management impairments, as these skills are needed for productivity within education and everyday life (Kreider et al., 2019). It is equally important that educators understand that not all students with ADHD have the same challenges (Oplan | Technology's Powerful Impact on ADHD, 2022). However, innovative technologies offer a variety of apps with promising solutions. These digital tools can help students manage their time effectively and organize tasks, thus enhancing their learning experiences (Eydoxia & Driga, 2023).

This chapter will explore the effectiveness and challenges of using task management apps as a support tool for students with ADHD. Specifically, it will evaluate how these apps help these students organize tasks and manage time.

Literature Review

Overview of ADHD in Educational Contexts

ADHD is a chronic developmental disorder that affects a student's ability to execute self-management successfully (Bellanti, 2011). Approximately 25-50% of students with ADHD have an additional diagnosis of a co-occurring learning disorder. This learning challenge becomes more complex if the child struggles with writing and fine motor skills (Bellanti, 2011). Executive functioning deficits, such as organization, working memory, and inhibition, have long been associated with ADHD (Guan Lim et al., 2020). As a result, children and young adults with ADHD experience great difficulty with time management, organizing tasks, and following them through to completion, causing them to fall behind their peers (Bellanti, 2011).

Furthermore, they have difficulty staying focused on the task, controlling their impulses, and remaining still like a statue in the classroom (Bellanti, 2011). ADHD creates an additional level of challenge for students, particularly in maintaining social interactions and relationships at school, compared to children without ADHD (Bellanti, 2011). Unstructured situations, such as bus rides, recess, and collaborative time with small groups in the classroom, require social skills and self-control, which is particularly challenging for children with ADHD (Hart Barnett, 2017). Their inability to self-regulate can hinder peer relationships due to difficulties initiating and maintaining conversations, managing conflicts, following social rules, adhering to daily routines, controlling impulses, recalling important details, and effectively solving problems (Forry, 2023).

Technological Advancements: An Overview

Innovative technologies have and continue to transform the educational landscape. Technological advancements have led to the emergence of novel treatment approaches for Attention Deficit Hyperactivity Disorder (ADHD) (Guan et al., 2020). Through technology in education, teachers now have additional resources to support their students with ADHD in receiving the necessary interventions (Bellanti, 2011).

Researchers have worked diligently to develop technological tools to assist students with ADHD. Some technologies focus on cognitive training, providing children with activities or exercises to improve attention, memory, and problem-solving skills (Hart Barnett, 2017; Eydoxia & Driga, 2023). These interventions have proven to enhance the connections and strengthen key neural brain networks essential for cognitive and behavioral control (Guan et al., 2020).

Using technology and computerized cognitive training, interventions can be created to train and adjust the brain networks affected by ADHD by addressing psychological and physiological deficiencies (Guan et al., 2020). One considerable benefit of these technological tools is that they enable personalized interventions that can be delivered at home or in school, thus making them accessible to many (Guan et al., 2020).

To ensure effective treatment for a child in the context of ADHD, supportive interventions and strategies must be implemented in the child's daily life and usual settings (Bellanti, 2011).

Digital Interventions

While traditional tools exist to promote attention, technology is transforming classrooms by offering several ways to keep students engaged in learning. Creating various apps, games, and software provides students with game-like experiences that serve as interventions to help address specific deficits common to ADHD (Hart Barnett, 2017). These apps mainly target task or time management, presenting tech-driven supports such as games, quests, or exercises to maintain user engagement (Hart Barnett, 2017).

These tools are designed to be beneficial for students with ADHD, addressing particular deficits with the end goal of gradual improvement and being tailored to the target audience (Guan et al., 2020). Features of these interventions include improving memory and brain processing speed to help the user remember daily tasks, complete to-do lists, problem-solve, and promote fine motor skills and hand-eye coordination, all while encouraging creativity and imagination (Eydoxia & Driga, 2023; Forry, 2023).

One notable example is EndeavorRX (Akili Interactive Labs, 2024), which claims to be the only FDA-approved video game and app for children with ADHD and qualifies for coverage through most insurance companies (Forry, 2023). Forry (2023) lists several apps that parents and educators should consider to help children with ADHD. It is important to note that individuals with ADHD have the same abilities and intelligence as those without ADHD but may need additional tools or accommodations to reach their goals in completing daily tasks or succeed in daily tasks, school, or life (Forry, 2023).

Previous Research on Technology-Based Interventions for ADHD

Individuals with ADHD have an underdeveloped attention control system. To address this, a computer game, RECOGNeyes, was designed as an intervention for training visual attention in children with ADHD. The game features eye-tracking technology that can improve the visual attention system in students with ADHD (García-Baos et al., 2019). This game, created by people with Attention Deficit Hyperactivity Disorder, trains people to gain control over their attention (García-Baos et al., 2019). As the user progresses through different levels in the game, they learn to control different aspects of their visual attention system. While this game was developed as an intervention for training attention in ADHD, it has also been proven to help people with dyslexia, autism and other conditions to have greater control over their direction of gaze (García-Baos et al., 2019).

Analysis of Effectiveness

Improvements in Task Organization

Technology has had a positive impact in helping students with ADHD gain the necessary skills to be successful. Various apps can assist in bolstering study skills by either using a timeline to display a visual representation of work done or mapping out other upcoming assignments (Hart Barnett, 2017). Online charts can assist students in organizing, sequencing, and planning homework assignments, as well as developing visual learning guides to help prepare for assessments (Eydoxia & Driga, 2023). Furthermore, some apps can assist students with writing tasks, strengthen weak executive function skills, and improve working memory issues (Hart Barnett, 2017). Several tech tools can assist students with ADHD in managing time and tasks effectively through the use of timers and alarms, as well as other apps that help students measure and evaluate their use of time regarding focused versus unfocused activities (Hart Barnett, 2017).

Challenges and Limitations

Teacher knowledge of ADHD is crucial for effectively supporting students with the disorder. To provide adequate support, teachers should be familiar with the effective tools available to deliver intervention for various needs (Jones & Chronis-Tuscano, 2008; Moore et al., 2017). Evidence suggests that teachers with a better understanding of ADHD have a more positive mindset towards students with ADHD compared to those with limited knowledge (McDougal et al., 2022). Gaps in knowledge about ADHD often lead to misconceptions.

Schools must ensure teachers receive the necessary training and professional development to support their students effectively. Special education teachers, in particular, should use appropriate behavior management strategies in the classroom (Jones & Chronis-Tuscano, 2008; Moore et al., 2017). Informed teachers are best equipped to select the most suitable services and resources to address the specific needs of their students. (Jones & Chronis-Tuscano, 2008; McDougal et al., 2022).

Additionally, there needs to be increased awareness of the focus of attention in ADHD students, as many children with ADHD can sustain attention on activities that interest them (Bellanti, 2011).

Technological Barriers

Accessibility and Usability Issues

While innovations in digital technology provide students with increased opportunities to address common issues of ADHD, there is a critical need to ensure that all families and schools have equitable access to technology (People for Education, 2019). The widespread adoption of technology in classrooms, particularly since the pandemic, has enhanced learning by achieving, expanding, and accelerating learning in previously impossible ways (Fullan et al., 2014). However, accessibility remains a challenge for some families and schools. The research indicates that some apps are offered at a cost to the user (Forry, 2023), presenting financial constraints for parents, especially considering socioeconomic factors (Fullan et al., 2014).

Additionally, schools in remote rural areas may struggle with internet access, creating barriers for students to access the specific software. Moreover, accessing these resources requires digital devices such as tablets, iPads, Chromebooks or smartphones, which can be a struggle for some families.

Recommendations for Practice

Technological tools are a valuable addition to traditional methods for supporting students with ADHD. While individuals with ADHD have an increased risk of Internet addiction compared to neurotypicals (Kutscher & Rosin, 2015), some innovative and engaging apps can be used in moderation to help students complete tasks and manage time effectively (Forry, 2023).

Teachers need to monitor student use and reduce screen-based activities (Bellanti, 2011) while offering these forms of intervention to support students academically. In addition to monitoring screen time, teachers need to ensure that students are actively engaged and learning from the technological applications or digital devices being used.

Teacher Training

While teacher training is effective in helping teachers better understand ADHD and their students, there needs to be an emphasis on continuous in-service training. Such training should be delivered by experts, such as board psychologists, who can provide critical feedback and suggestions on strategies observed while supporting students in the classroom. Teachers will not be adequately prepared to help their students succeed without in-school support.

Some students with ADHD typically display more problematic behaviors compared to children without ADHD, leading to functional impairment. Therefore, teachers require increased training in behavioral intervention techniques using evidence-based approaches (Jones & Chronis-Tuscano, 2008).

Further Research

More research is needed to determine the most effective ways to help teachers develop the necessary knowledge to confidently support their students with ADHD (Jones & Chronis-Tuscano, 2008). In addition to behavioral interventions, teachers also need opportunities to learn more about apps, software, and websites that can help support their students effectively. They may also need assistance learning how to use the digital devices necessary for these tools. While these apps assist students with ADHD in developing essential skills for daily school and life, it is recommended that teachers allow all students to use these apps, as these tools can benefit all students (Forry, 2023).

Conclusion

Summary of Key Findings

Technology-assisted interventions have shown success in addressing the needs of students with ADHD and reaching specific benchmarks. It is important to note that the duration and intensity of the treatment varied across the studies due to differing needs among students with ADHD (Guan Lim et al., 2020).

Further research is needed to thoroughly understand recent evidence related to the challenges with ADHD and the successful use of technology in addressing these needs (Guan Lim et al., 2020). It is also important to monitor technological apps' effectiveness and long-term benefits in addressing student needs, especially regarding functional improvement (Guan Lim et al., 2020).

While medication remains necessary for some students with ADHD, technological interventions offer a viable alternative to pharmacologic therapy (García-Baos et al., 2019). These interventions, such as screen time activities provided through games and apps, effectively maintain engagement among students with ADHD by offering frequent and immediate rewards (Hart Barnett, 2017). However, teachers must be mindful that technology interventions present students with stimulating visual graphics, sounds, action, continuous change, and immediate feedback, thus requiring careful monitoring of screen time (Hart Barnett, 2017; Kutscher & Rosin, 2015).

Further research is needed to understand how the physical classroom can be modified to better accommodate students with ADHD, similar to effective strategies for students with autism, such as visual timetables (McDougal et al., 2022). Currently, insufficient research is available to guide teachers in creating an optimal classroom environment and implementing effective strategies to support students with ADHD and enhance learning outcomes (McDougal et al., 2022).

In addition to research, ongoing in-service training is necessary to provide teachers with the tools and best practices required to support students with ADHD to their fullest potential.

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Addressing Accessibility Issues Involving Service Dogs for Mobility, Retrieval, Anxiety, and Fall Alerts in K-12 Classrooms

ERICA FERLISI

Introduction

Service dogs are invaluable companions for individuals with various disabilities, providing critical assistance in areas such as mobility, retrieval tasks, anxiety management (i.e., during panic attacks), and fall alert signals. Integrating service dogs into K-12 classrooms presents unique accessibility challenges that must be addressed to ensure an inclusive and supportive learning environment. This paper explores these accessibility issues and proposes solutions through instructional design strategies and digital teaching and learning resources. The legal frameworks guiding accessibility, such as the Accessibility for Ontarians with Disabilities Act (AODA, 2005), the Accessible Canada Act (2019), and other related statutes, are considered to ensure compliance and inclusivity.

To gain a better understanding of service dogs and their roles, you can watch the following videos, which illustrate their significance to their handlers:

How to Explain the Purpose of Service Animals to Kids! (Rocky Mountain ADA Centre, 2022):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-1

Sesame Street: Gina Explains Service Dogs (Sesame Street, 2013):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-2

Accessibility Challenges

Mobility and Retrieval

Service dogs may assist students with physical disabilities by aiding mobility and retrieving items. "The medical model of disability defines mobility-impaired individuals as those who experience the inability to use one or more of their extremities or the lack of strength to walk, grasp, or lift objects" (Treece, 2021, p.3). However, classroom physical space limitations can hinder these dogs' ability to perform their tasks effectively. For example, Sarah, a student who uses a wheelchair and relies on her service dog to retrieve dropped items, may struggle in a cluttered classroom where her dog cannot easily navigate around desks and chairs. Vermeersh and Heylighen (2015) advise that "the social model recognizes disability as a complex phenomenon which includes the interplay between the medical model definition (noting the physical components of the body) and the barriers the built environment has on the individual" (as cited in Treece, 2021, p.3). Additionally, traditional classroom layouts often do not provide enough space for service dogs to maneuver, which can impede their ability to assist students effectively. This can lead to decreased independence for students who rely on these services, potentially affecting their academic performance and overall well-being.

For a closer look at a service dog in action within an elementary school, you can watch the following video:

Service Dog Keeps Young Student Health (Herald and News, 2015):

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Anxiety and Panic Attacks

Students with anxiety or panic disorders may rely on a service dog to provide comfort and intervention during episodes. For instance, Jake, a student with severe anxiety, has a service dog that is trained to provide deep-pressure therapy during panic attacks. However, the presence of a service dog in classrooms can be misunderstood by peers and staff, leading to potential stigma or inadequate response during emergencies. “Studies showed that there is evidence supporting the positive physiological impact that dogs have on humans… school has potential to reap valuable benefits for children by using therapy dogs to help regulate their physiological functions during their school day” (Zeman, 2017, p. 14). Furthermore, maintaining a calm environment conducive to the effective operation of a service dog can be challenging, especially during high-stress situations like exams or emergency drills. This can exacerbate the student’s anxiety and reduce the effectiveness of the service dog.

To learn more about how service dogs assist during anxiety and panic attacks, you can watch the following videos:

Service Dog Giving Deep Pressure Therapy DPT for Anxiety and/or PTSD (Yadier Goldendoodle Service Dog, 2017):

> *One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-4*

Psychiatric Service Dog Tasks (Daryl the Service Dog, 2020):

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Fall Alert

Service dogs trained to alert others during a fall must operate in environments where their actions are recognized and understood by school staff, students, and the community. For instance, Emily's service dog alerts teachers if she falls due to her epilepsy. Miscommunication or lack of awareness about the dog's role can delay critical responses to falls, compromising Emily's safety. Although, "prevention and improved de-escalation of emotional crisis, improved student attitudes toward school and positive impact on student understanding of responsibility, respect, and empathy" (Kalkoske, 2018, p.24), not all classrooms are equipped to handle medical emergencies, and without proper training, staff may not know how to respond appropriately when a service dog alerts them to a fall. This can lead to delayed medical attention and increased risk for the student.

To see examples of how service dogs assist during fall alerts, you can watch the following videos:

Service dog trained to help Apex middle school student with seizures (CBS 17, 2018):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-6

Epilepsy seizure alert support dog Wadsley (Support Dogs, 2019):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-7

Legal Frameworks, Guidelines & Proposed Solutions

Accessibility for Ontarians with Disabilities Act (AODA)

The AODA mandates that educational institutions provide accessible learning environments (AODA, 2005, c.11, s.6 (6)). This includes accommodating service animals and ensuring physical spaces and instructional materials are accessible to all students. The act outlines specific requirements for educational institutions to follow, ensuring that all students/staff, regardless of their disabilities, have equal access to education and job opportunities. This includes modifications to physical spaces, training for staff/students/community and the development of individualized education plans (IEPs) that take into account the needs of students with service dogs.

For an alternative format explaining the AODA, you can watch the following video:

Accessibility for Ontarians with Disabilities Act 2018 Final (Video UDGSB, 2018):

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Ontario Human Rights Commission Guidelines

The Ontario Human Rights Commission (OHRC) emphasizes the need for proper documentation and accommodation for students with mental health disabilities (OHRC, 2016). These guidelines support the inclusion of service dogs for anxiety and panic attack management. The OHRC's guidelines ensure that students with mental health disabilities are provided with the necessary accommodations to support their educational journey. This includes recognizing the role of service dogs in managing anxiety and ensuring that their presence in the classroom is respected and accommodated.

To further understand the OHRC guidelines and their implications for students with disabilities, you can watch the following videos:

Ontario's Human Rights System Explained (HRLSC CAJDP, 2023):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-9

Everyone Has the Right: Eleanor Roosevelt and the Universal Declaration of Human Rights (FDRLibrary, 2021):

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Accessible Canada Act

The Accessible Canada Act aims to create a barrier-free Canada by 2040, emphasizing the importance of accessibility in public services, including education (Accessible Canada Act, S.C. 2019, c.10). This act supports the integration of service dogs into educational settings by mandating inclusive practices. The act outlines the responsibilities of public institutions to remove barriers and promote accessibility in all aspects of life, including education. This ensures that students with service dogs are provided with the necessary accommodations and support to thrive in the classroom environment.

To further explore why the Accessibility Canada Act is important and what it means for accessibility in Canada, you can watch the following videos:

Why is there an Accessible Canada Act? (Accessibility Television, 2019*b*):

> *One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-11*

What Does a Barrier-Free Canada Mean? (Accessibility Television, 2019*a*):

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Proposed Instructional Design Strategies Solutions

Universal Design for Learning (UDL)

Implementing UDL principles can help create flexible learning environments that accommodate all students, including those with service dogs. UDL guidelines suggest providing multiple means of engagement, representation, action and expression (CAST, 2018). For example, flexible seating arrangements can accommodate the space needs of service dogs. In Sarah's case, removing excess furniture and creating clear pathways allows her dog to navigate and assist her more effectively. Additionally, varied instructional materials, such as interactive digital content, can help reduce anxiety triggers for students like Jake.

To learn more about UDL and its application in creating inclusive classrooms, you can watch the following video:

Universal Design for Learning: UDL (Teachings in Education, 2019):

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Educator Training and Awareness

Training programs for educators and staff on the role and needs of service dogs can foster a more supportive environment. Educators should understand how to interact with service dogs and recognize the signs when a dog is alerting for a fall or assisting with anxiety. Training and awareness can be provided virtually through educational resources (Power, 2020). For instance, teachers can be trained through online resources such as YouTube (n.d.) to recognize when Emily's service dog is alerting them to her fall and respond promptly and appropriately. This training should also include understanding the specific tasks the service dogs are trained to perform, the legal rights of students with service dogs, and the best practices for creating an inclusive classroom environment.

To gain insights into service dogs and how educators can support their roles effectively, you can watch the following videos:

Service Dogs 101 (National Center on Health, Physical Activity and Disability (NCHPAD), 2019)

> *One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-14*

Service Dog Etiquette – Do's and Don'ts (SourceAmerica, 2020):

> *One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-15*

Digital Accessibility Tools, Learning Resources and Recommendations

Online Learning Platforms

Digital platforms can provide accessible learning materials that reduce physical barriers for students with mobility issues. Features like text-to-speech, adjustable text sizes, and interactive content can cater to various needs (Gierdowski & Galanek, 2020). For Sarah, who may struggle to pick up physical books or materials, digital textbooks that she can access via her tablet/laptop/cellphone would be highly beneficial. These platforms can also include features that allow for real-time collaboration and communication, enabling students to fully participate in classroom activities, regardless of their physical limitations.

To delve deeper into digital accessibility tools and their benefits for inclusive education, you can watch the following webinar:

Digital Accessibility Essentials for Educators Webinar (Power, 2021):

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Virtual Reality (VR) and Augmented Reality (AR)

VR and AR technologies may be implemented to stimulate classroom environments, allowing service dogs and their handlers to learn in virtual settings. Creating immersive and interactive learning experiences, it enhances accessible learning for all students, also, VR and AR can cater to various learning preferences and needs (AlGerafi et al, 2023). This approach can significantly benefit students like Jake, who might find traditional classroom settings overwhelming and/or inaccessible.

To explore examples of VR and AR in education and their potential benefits for inclusive learning environments, you can watch the following video:

10 Best Examples AR & VR in Education (Marr, 2021):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-17

Accessibility Checkers

Tools like the Web Content Accessibility Guidelines (WCAG) checker can ensure that digital content is accessible to all students (Power, 2023). These tools can identify potential barriers in digital content and provide recommendations for making the content more accessible, including regular accessibility audits that can help maintain compliance with legal standards. This ensures that all students, regardless of their disabilities, can access and engage with the learning materials.

To learn more about using accessibility checkers and understanding WCAG guidelines, you can watch the following videos:

Using the Accessibility Checker in Microsoft Word [Tutorial] (MDTech Videos, 2022):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-18

WCAG for beginners – What are the Web Content Accessibility Guidelines? – Web Accessibility (Silktide, 2022)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-19

Medical Applications

Medical apps designed for individuals with disabilities can assist in managing and monitoring one's health. These apps can send alerts to teachers/emergency services during a fall, anxiety episode, and/or health concern, ensuring timely intervention (Dewangan & Vaishnava, 2020). Aiding this, Emily's service dog can notify her teacher immediately if it detects a seizure, ensuring that help arrives quickly. These apps can also provide real-time updates on individual conditions, allowing teachers and emergency services to make informed decisions and provide appropriate support.

For a real-world example of how medical apps and technology can provide life-saving alerts, you can watch the following video:

Man praises Apple Watch for life-saving alert after suffering medical emergency (TMj4 News, 2023) (Note – Embedding disabled – opens in external window.)

Recommendations

Inclusive Classroom Design

Creating an inclusive classroom environment involves more than just physical adjustments, it requires a holistic approach that considers the diverse needs of all students. Schools should prioritize service "dogs... as tools rather than living beings"

(Abat-Roy, 2021, p.9) assuring flexible seating arrangements, clear pathways, attention to excessive noise and the use of digital learning tools. For instance, adjustable desks/chairs can accommodate all students, especially those with different physical needs, and electronic textbooks can make lessons more accessible and interactive.

Training Programs

Educator training programs should be comprehensive and ongoing as "schools and teachers are obligated to adhere to the IEP (Individualized Education Plan) guidelines as enforced under IDEA (Individuals with Disabilities Education Act) (Gupta et al., 2023). They should cover the legal rights of students with disabilities, the specific needs of students with service dogs, and the best practices for creating an inclusive classroom environment. Schools could partner with organizations specializing in disability rights and service dog training companies to provide these programs for staff, students, and the community. Regular refresher courses and workshops can help ensure that staff remain informed and confident in supporting students with service dogs.

Leveraging Technology

Technology plays a crucial role in making education accessible, ensuring immersion "in a variety of different visuals, audio cues, and simulations… to create more engaging virtual worlds… and interesting learning experiences" (Al-Ansi et al, 2023). Schools should invest in digital platforms that can offer customizable learning experiences, such as VR and AR technologies for immersive learning, and mobile apps that support the needs of students with service dogs. For example, AR can be used to create interactive learning experiences that cater to different learning preferences, notwithstanding, mobile apps that can provide real-time health updates and alerts to teachers.

Collaboration and Support

Collaboration between educators, parents, students, community and service dog trainers is essential for creating "equitable and inclusive classrooms… implementing EI teaching approaches that center students and their identities in the learning process and are reflected in the classroom and curriculum" (Duncan et al, 2023). Regular meetings can help ensure that all parties are aware of the student's needs and progress. Schools could establish support groups for students with service dogs, providing a platform for sharing experiences and resources. Additionally, involving students in the development of their IEPs can empower them to advocate for their needs and preferences.

Accessible Service Dog Examples

1) Sarah and Mobility Assistance

Sarah, a grade 3 student with a physical disability, uses a wheelchair and relies on her service dog to retrieve dropped items and help with mobility. In her classroom, desks and chairs were initially arranged in a way that made it difficult for her and her service dog to move freely. By implementing UDL principles, her school reconfigured the classroom layout to create clear pathways and reduce barriers. Digital textbooks were also introduced, allowing Sarah to access her learning material electronically. These changes significantly improved Sarah's independence and participation in class activities.

To see a heartwarming example of a student and her service dog in theatrical roles, watch the following video:

17-Year Old Stars in 'Wizard of Oz' With Service Dog as Toto (Inside Edition, 2019):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-20

2) Jake and Anxiety Management

Jake, a grade 8 student with severe anxiety, has a service dog trained to provide deep-pressure therapy during panic attacks. Initially, Jake's classmates and teachers were unsure how to interact with his service dog, Leading to stigmas and misunderstandings. Through educator training programs, staff learned about the importance of service dogs and how to support students with anxiety. The school also introduced virtual reality simulations that allowed Jake to practice coping strategies in a controlled environment. As a result, Jake's anxiety levels decreased, and he was able to focus better on his studies.

For an inspiring story related to service dogs and their impact on individuals like Jake, watch the following video

A Story of Hope (Can Do Canines, 2016):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-21

3) Emily and Fall Alerts

Emily, a grade 10 student who has epilepsy, relies on her service dog to alert teachers if she falls. Initially, there was confusion among staff about how to respond to these alerts. After receiving training on the role of service dogs and emergency response procedures, teachers became more confident in handling such situations. Additionally, a mobile app was introduced that sent immediate alerts to teachers when Emily's service dog alerted for a fall/seizure. This ensured that Emily received prompt assistance, reducing the risks associated with her condition.

To see examples related to service dogs and their capabilities in different medical contexts, you can watch the following videos:

How Dogs Sniff Out Seizures (Insider Science, 2019):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-22

Diabetes Service Dog Saves 9-Year-Old Girl's Life (Inside Edition, 2023):

> *One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-23*

Conclusion

Integrating service dogs into K-12 classrooms requires addressing accessibility barriers and challenges related to mobility, retrieval, anxiety, and fall alert tasks. Similar to the hypothetical case studies of Sarah, Jake, and Emily. I (as a student and teacher) utilize a multi-purpose service dog for mobility, retrieval, anxiety, and fall alerts and strongly believe by leveraging instructional design, strategies like UDL and implementing digital teaching and learning resources, educators and school communities can create more inclusive environments that support all individuals. Compliance with legal frameworks, such as the AODA, and the Accessible Canada Act, is essential in fostering accessibility and ensuring the success of students and teachers with service dogs in educational settings. Through thoughtful planning, comprehensive training, and the use of technology, schools can provide a supportive and inclusive environment where all individuals have the ability to thrive. However, potential limitations include possible allergic reactions to canines, as well as the necessity for continuous training and monitoring to ensure behaviours toward the service dog are appropriate.

Additionally, accommodating service dogs may require mindful adjustments to classroom layouts and routines, which can be challenging for some educational environments.

For a closer look at the integration of Service Dogs in educational settings, watch the following videos:

Inside California Education: Service Dog in the Classroom (PBS KVIE, 2017):

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=356#oembed-24

Teacher's service dog also serves students (KJRH-TV | Tulsa | Channel 2, 2023) (Note – Embedding disabled – opens in external window.)

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ADHD in the Classroom: Transforming Accessibility with Smart Design and Technology

FAITH ZWARYCH

Introduction

Attention Deficit Hyperactivity Disorder, or ADHD, is a common neurodevelopmental disorder. Addressing accessibility issues for students with ADHD is crucial, as their condition can lead to many difficulties, including maintaining focus, staying organized, and managing impulsivity. These difficulties can drastically impact these students' academic performance and classroom behavior. Inclusive education is essential to ensure that all students, regardless of their neurodevelopmental differences, have equal academic and social opportunities. This paper aims to identify the specific challenges faced by students with ADHD in the K-12 educational setting, as well as some proposed effective solutions and tools.

Attention Deficit Hyperactivity Disorder

Attention Deficit Hyperactivity Disorder, or ADHD, is characterized by symptoms such as inattention, hyperactivity, and impulsivity, which can significantly affect a student's ability to function effectively in school (American Psychiatric Association, 2013). Statistics show that in North America, particularly in Canada, there is a rise of K-12 students being diagnosed with ADHD at 5-9% (Polanczyk et al., 2014). This increase is largely due to improved diagnostic practices, greater awareness, and broader criteria for identifying ADHD.

Accessibility

Accessibility in the K-12 educational setting refers to creating equitable opportunities and resources that enable all students, including those with diverse learning and physical needs, to participate and succeed in school. This would include physical, instructional, and technological accommodation tailored to individual student's needs. Doing these things helps to ensure that all students can access and engage with the curriculum and activities in the classroom (National Center on Universal Design for Learning, 2020).

Accessibility Challenges Faced by K-12 Students with ADHD

Students with ADHD in K-12 educational settings face significant accessibility challenges. The following are some of the main accessibility challenges that some of these students may face:

Difficulty with Focus and Sustained Attention

Having difficulty with focus and sustained attention means that they are easily distracted by things in the classroom, such as noise or movement (Barkley, 2015), which hinders their ability to stay engaged with the curriculum and impacts their academic performance. This might mean that the students need extended time to complete tasks or tests, as they might find it challenging to stay focused for longer periods.

Impulse Control Issues

For students with ADHD and in K-12 classrooms, difficulties with impulse control will present themselves as disruptive behaviors. This may look like interrupting teachers or classmates, blurting out answers, or engaging in physical movements that disrupt the learning environment (Barkley, 2015). Doing these things will not only affect their learning but disrupt the learning of their peers and their teacher's instruction.

Hyperactivity

Hyperactivity among K-12 students with ADHD can lead to challenges in classroom behaviors and engagement. They struggle to remain seated for extended periods of time and often require movement breaks to release their energy (American Psychiatric Association, 2013). If they do not get this, it could result in physical outbursts or fidgeting, impacting the overall learning environment.

Time Management Issues

Time management is a significant challenge for K-12 students with ADHD. These challenges may be shown by difficulty pacing themselves during tests or tasks, rushed work, or incomplete tasks (Langberg et al., 2011). It is also common for students to procrastinate when starting assignments, adding to their academic stress and overall performance.

Working Memory Deficits

Working memory deficits impact one's ability to follow instructions and remember information, especially in K-12 students with ADHD. Not being able to follow instructions correctly and remember previously learned concepts will drastically hinder one's academic progress and ability to organize one's thoughts during tasks (Barkley, 2015).

Emotional and Social Challenges

Emotional and social challenges in K-12 students with ADHD will look like heightened emotional responses, including frustration and anxiety, particularly when they are working on academic tasks. These challenges can impact their motivation and engagement in learning activities (Langberg et al., 2011). Socially, they may struggle with peer interactions due to impulsivity or difficulties in understanding social cues, affecting their relationships and sense of belonging within the school community.

Policies

There have been recent improvements in research surrounding ADHD and its impact on education. With that in mind, Canadian provinces have implemented policies to support children with ADHD in schools, emphasizing early intervention and support systems.

Individual Education Plans

Across Canada, Individual Education Plans (IEPs) are developed for students with exceptionalities, including ADHD. These plans outline specific accommodations and support their individual learning needs. These plans are mandated under provincial educational policies to ensure students receive appropriate academic and behavioral support (Government of Ontario, 2020).

Provincial Education Acts

Each Canadian province has its own Education Act that outlines rights and accommodations for students with disabilities, including ADHD. These acts mandate inclusive education practices and ensure that schools provide necessary accommodations to support students' learning and participation in the classroom (Education Act of British Columbia, 2020).

Accessibility Standards

In some provinces, accessibility standards are legislated to ensure that educational instructions provide accessible environments and resources for students with disabilities, including ADHD. These standards may cover physical accessibility, assistive technologies, and inclusive teaching practices to support diverse learning needs (Government of Ontario, 2020).

Support Services

Educational policies also support providing support services such as psychological assessments, counseling, and specialized teaching strategies for students with ADHD. These services aim to address any accessibility challenges students with ADHD may face in the K-12 educational setting (Government of Canada, 2020).

These policies and frameworks demonstrate Canada's commitment to promoting accessibility and inclusive education practices for students with ADHD, ensuring they have equal opportunities to thrive academically and socially.

Proposed Solutions: Instructional Design Strategies

Implementing effective instructional design strategies, including Universal Design for Learning (UDL), is crucial to addressing the accessibility challenges faced by K-12 students with ADHD. These strategies focus on creating flexible learning environments that accommodate diverse needs, emphasizing multiple means of representation, action, expression, and engagement. Some of these strategies include:

Individualized Education Plans (IEPs)

Individualized Education Plans (IEPs) are essential for providing personalized accommodations to students with ADHD based on their unique needs. Effective accommodations might include extended test time, a quiet space for taking tests, organizational tools, and preferential seating to minimize distractions.

Structured and Clear Instructions

Students with ADHD benefit from straightforward, concise directions that are broken down into manageable steps. Techniques for effective communication include using visual aids, providing written and oral instructions, and conforming understanding through repetition or paraphrasing. Checklists and timelines are also useful to help students stay on track with their assignments accurately and on time.

Positive Reinforcement and Behavioural Interventions

Positive reinforcement and behavioral interventions are effective strategies for managing impulses and hyperactivity, which are often seen in students with ADHD. Some examples of positive reinforcement could include rewarding desirable behaviors, such as verbal praise, stickers, or extra playing time. Behavioral interventions might include setting specific, achievable goals and providing immediate dieback on performance.

Frequent Breaks and Movement Opportunities

Incorporating frequent breaks and movement opportunities throughout the school day is very beneficial for students with ADHD. Regular breaks help them manage their energy levels and maintain concentration in the classroom. Ensuring that there are classroom activities that allow movement, such as stretching or standing desks, can improve their ability to focus and learn effectively.

Proposed Solutions: Digital Teaching and Learning Resources Assistive Technologies

Assistive technologies, such as timers, organizational apps, and text-to-speech software, support students with AHHD. Timers help students manage their time effectively by breaking tasks into smaller, more manageable pieces. Organizational apples, like Trello, provide tools for tracking assignments and deadlines, helping students stay organized and on task. Text-to-speech software, such as Kurzweil 3000, assists students in reading and comprehending text, making learning more accessible.

Trello

Trello is an organizational app that provides a visual and intuitive platform for managing tasks and projects (Trello, n.d.), making it particularly beneficial for students with ADHD. This tool uses boards, lists, and cards to help users organize their assignments, set deadlines, and track their progress. For students with ADHD, Trello's visual layout makes it easier to break down large tasks into smaller, more manageable steps. The app allows for color-coding, labeling, and additions to due dates and checklists (Trello, n.d.), which can help students prioritize their work and stay on track. Trello can help students with ADHD reduce overwhelming feelings and improve their time management skills, leading to better academic outcomes and reduced anxiety.

Interactive Learning Platforms

Interactive learning platforms, like Kahoot and Quizlet, can significantly benefit students with ADHD by increasing their engagement and retention. These platforms offer game-based learning to make education fun and interactive, which helps maintain students' interest and motivation. They can also create flashcards, enabling students to study more dynamically and interactively. Instant feedback is also available on both platforms, which is essential for reinforcing learning and keeping students engaged.

Quizlet

Quizlet is an online learning platform that supports students with ADHD by facilitating interactive study through customizable digital flashcards (Quizlet, n.d.). It promotes active learning strategies like repetition and active recall, which benefit students with attention deficits. Quizlet's instant feedback features (Quizlet, n.d.) also enhance engagement and help students with ADHD manage their study sessions effectively, fostering improved academic performance.

Online Course Platforms

Online course platforms, such as Moodle and similar services, offer many opportunities for accessible learning, particularly for students with ADHD. These platforms provide remote access to a wide range of courses, allowing students to learn at their own pace and according to their own schedules. These platforms cater to diverse learning needs, offering various formats like videos, interactive modules, and discussion forms. This flexibility helps students with ADHD by accommodating their unique learning styles and providing a more personalized educational experience.

Moodle

Moodle is a widely used online course management system that provides schools and educational institutions with a way to deliver courses in an engaging virtual learning environment. It supports students with ADHD by offering flexible access to learning material, assignments, and communication tools, which can be personalized to accommodate diverse learning needs (Moodle, n.d.). The platform's structure allows educators to organize content integrate multimedia resources, and provide interactive activities, enhancing student engagement and self-placed learning (Moodle, n.d.).

Potential Moderators of Effectiveness

In research, a moderator is a variable that influences the relationship between an independent variable (such as instructional strategies) and a dependent variable (such as academic performance or behavior) (DuPaul & Stoner, 2014). Moderators can either enhance or diminish the effectiveness of interventions by introducing variability or conditions that impact outcomes. For example, inconsistent implementation of strategies across classrooms or limited resources can hinder the effectiveness of instructional strategies designed to support students with ADHD (DuPaul & Stoner, 2014). Understanding and addressing these moderators is crucial for optimizing the impact of interventions in educational settings.

Lack of Consistent Implementation

Inconsistencies in implementing Individualized Education Plans (IEPs) and Universal Design for Learning (UDL) principles across classrooms can undermine their effectiveness for students with ADHD (DuPaul & Stoner, 2014). Variability in educator understanding and application may lead to uneven support and outcomes, affecting academic performance and engagement levels.

Limited Resources and Support

The availability of resources and support plays a crucial role in the success of strategies for students with ADHD (DuPaul & Stoner, 2014). Schools with inadequate funding or access to assistive technologies and specialized training for teachers may struggle to provide essential accommodations, hindering the implementation of effective instructional strategies.

Resistance to Change

Resistance from educators or administrators to adopt new instructional strategies and technologies can hinder efforts to support students with ADHD effectively (DuPaul & Stoner, 2014). Overcoming resistance and fostering a supportive environment for change is essential to implementing positive reinforcement techniques, structured instructions, and other beneficial strategies.

Complexity of Behavioural Interventions

Behavioral interventions require consistent monitoring and adjustment to meet the dynamic needs of students with ADHD (DuPaul & Stoner, 2014). Educator training and ongoing professional development are critical to understanding and effectively implementing these interventions to manage impulsivity and improve behavioral outcomes.

Environmental Factors

Environmental factors such as classroom size, noise levels, and overall learning environment can impact the feasibility and success of instructional strategies for students with ADHD (DuPaul & Stoner, 2014). Addressing these factors through supportive classroom arrangements and modifications can enhance the effectiveness of structured instructions, breaks, and other supportive strategies.

By addressing these potential moderators through comprehensive training, adequate resource allocation, and ongoing support, educators can enhance the effectiveness of instructional strategies and better support the academic and behavioral needs of students with ADHD.

Conclusion

In conclusion, addressing the accessibility challenges faced by K-12 students with ADHD requires a multifaceted approach that integrates effective instructional design strategies, digital resources, and supportive policies. By implementing these strategies and tools, educators can create inclusive learning environments that cater to diverse learning needs. However, the effectiveness of these strategies can be influenced by factors such as inconsistent implementation across classrooms, limited resources, and resistance to change. To optimize outcomes, it is essential for educators to receive comprehensive training and for educational policies to support the provision of necessary accommodations and services. By fostering an inclusive educational environment that addresses these challenges systematically, Canada can ensure that students with ADHD have equitable opportunities to succeed academically and reach their full potential.

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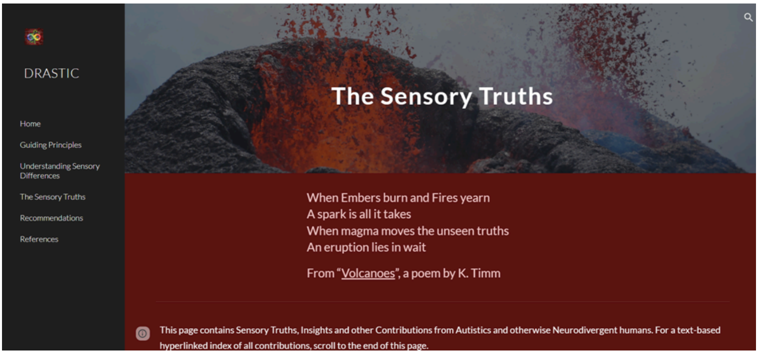
DRASTIC: Digital Repository of Autistic Sensory Truths, Insights and other Contributions

KAREN TIMM

Overview

The **Digital Repository of Autistic Sensory Truths, Insights and other Contributions (DRASTIC)** is a web-based learning tool for use by educators and other professionals who are seeking to be allies to the Autistic Community (colleagues, students, clients, family and community members). With a focus on **understanding and removing workplace barriers related to Sensory Processing Differences**, DRASTIC has been developed to align with the principles outlined in the [United Nations Convention on the Rights of Persons with Disabilities (UNCRPD)], in the spirit of Nothing About Us Without Us (United Nations, 2006). As such, a key feature of this resource is the compilation of a 'living' repository of **authentic experiences shared by members of the Autistic (and otherwise Neurodivergent) Community who tell their sensory truths, in their own ways.**

Access the Interactive DRASTIC Resources Site



Click on this image, or the following link to access the DRASTIC resources site!

References

All references and resources can be accessed directly via the DRASTIC resources site References page.

Nonverbal Communication Supports for an Inclusive Classroom

LESLIE SUMNER

Introduction

Over the last decade, a significant technological increase has impacted society considerably. One of these impacts is the mortality rates of children in Canada; with advanced medical technology, many children are living longer but are also living with profound disabilities (O'Neil, 2024). This influx of children with disabilities also impacts our education system and has caused unique accessibility issues. One of these accessibility issues is students with limited communication abilities (non-verbal students). In this paper, I will focus on students with physical or neuromuscular issues that impair communication by limiting speech and physical movement but not cognitive function. In a research project from 2016, 71% of families agreed that a barrier for their child was finding knowledgeable staff and resources (Ferenczy & van Schouwen, 2016). With little change to the foundation of the Ontario education system combined with the influx of students with disabilities, the system is struggling to support all students, especially non-verbal students, in mainstream classes. Many educators find it difficult to believe that students with complex needs can or need to learn like their peers. Presuming intelligence for all students is essential, but biased opinions can hinder teachers' inclusive practices. These biases must be addressed, as they can hinder the progress towards a more inclusive education system. Students with disabilities face discrimination and ableist attitudes, which undermine their ability to get the educational resources needed to assist them in achieving high levels of academics. Once these biases are addressed, work can be done to ensure more equitable practices in our education system. Educators need a better understanding of inclusive instructional design and technology to ensure that non-verbal students can access the curriculum alongside their classmates.

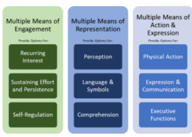
First Step

As a teacher and mother of a non-verbal child, I have encountered resistance at all levels within the public school system. My son's first experience in a public school was meeting his kindergarten teacher; her first question was, "Aren't there schools for kids like him?". This is the type of ableist attitude held by many mainstream public school teachers. High-needs students are seen as burdens and take attention and resources away from other students (Rose, 2000). Teachers must stop viewing students with disabilities as people who need to be fixed or accommodated so they can access education like 'normal' students (Rose, 2000), and they must see them as students who have abilities that need to be celebrated. Anti-ableist training is an essential starting place to help promote awareness and increase empathy and advocacy among educators (Nieminen, 2022). Without this training, making positive strides towards an inclusive public education system will not be easy. Anti-ableist training for educators can help teachers recognize their prejudices, encouraging empathy (Nieminen, 2022) and, in turn, help them understand the importance of changing their teaching pedagogy. School efficacy is essential and can be accomplished if teachers feel confident to share their knowledge to support inclusive pedagogy. A robust, positive learning community that celebrates the sharing of authentic practices for non-verbal learners lessens the burden on a single educator. Anti-ableist training is an essential foundation for teachers, helping them understand the need to embrace systemic educational changes and ensuring all students are supported and celebrated for their differences.

Instructional Design

Making a classroom equitable for all students can seem unattainable for classroom teachers, especially with class sizes upward of 30 students and many of those students with individual education plans (IEPs). Many standard school practices, like curriculum delivery and assessment, are inherently discriminatory (Nieminen, 2022). The standard lecture and ability for students to raise their hands and ask questions is a skill many physically disabled non-verbal students can not participate in, making this a practice that can discriminate against students. Most forms of assessment, like exams, standardized testing, essay writing, or presentations, are also familiar educational practices that can discriminate against students with disabilities (Nieminen, 2022). Public schools are traditionally assessment and output-focused, emphasizing programming for the average student. Ontario's public education's main principle is improving all students' learning (King's Printer for Ontario, 2010). However, many standard common practices are rooted in prominent discriminatory practices that inherently do not support all students, especially students with unique learning disabilities, like communication impairments.

Universal Design for Learning (UDL)



Two guiding educational documents in Ontario are *Growing Success: Assessment, Evaluation, and Reporting in Ontario* (King's Printer for Ontario, 2010) and *Learning for All: A Guide to Effective Assessment and Instruction for All Students* (King's Printer for Ontario, 2013). Both enforce the importance of equitable education practices. Even though they are over a decade old, these documents have value with their focus on Universal Design for Learning (UDL). UDL helps teachers overcome the extra classroom burdens, especially around individual programming, by using an inclusive approach to designing curriculum, including assessment (CAST, 2018). The UDL framework is recognized by the education system in Ontario as one of the three practical approaches to learning outlined in the provincial document *Learning for All* (King's Printer for Ontario, 2013). This forward-thinking approach to programming can be intimidating for teachers because it is less structured and allows for student choices at all stages: what they want to learn, how they want to learn, and the final output to show learning (CAST, 2013). UDL looks at the 'big idea' of curriculum, allowing flexibility that helps to promote a more inclusive environment (Rose, 2000). This programming style does not remove all individual programming, but it can help overcome many issues, allowing the teachers to focus on specific needs for more complex disabilities. UDL shifts the teacher's role from a curriculum deliverer to a facilitator who guides students' learning, which can also reduce the burden teachers feel when accommodating multiple complex students. UDL's strength is focusing on the student's differences as a starting place for curriculum building and celebrating those differences instead of trying to fit student diversity into normative standards. CAST, a leader in guidelines and promotion of UDL, outlines that students need multiple means of engagement (motivation), representation (introducing, guiding information), and actions or outcomes (goal-oriented strategies); this is fundamental for a nonverbal student. Allowing students to participate in their programming at all three stages can also help reduce the overall struggle for teachers and empower students to have control of their education. This mindset shifts from teacher-focused to student-focused, strips away the biases of the leader, and can promote diversity among learners. All students can benefit from this type of classroom design, but allowing for learning diversity is highly beneficial for students who struggle with communication impairments; multiple avenues to access information can be crucial, especially while you figure out best practices for individuals.

Assessment

Assessment is an area in which non-verbal students are discriminated against regularly. Many assessments used in classrooms are not accessible to non-verbal students, especially when there are other medical complexities. Using these exclusive practices in your classroom, knowing a student can not access the material, is the definition of discrimination (Tai et al., 2022). Ungrading, the practice of not giving a formal grade to learning but instead focusing on the learner and using timely feedback to promote learning, would remove the inherently discriminatory practice and facilitate learning (Blum, 2023), especially for non-verbal students. Ungrading is controversial for many educators, but evidence supports inclusion and autonomy (Blum, 2023). Educating teachers on the benefits of changing their grading system by informing them of the discrimination traditional grading can cause could be another positive aspect of anti-ableist education. Assessment is essential for learning, but if it is a discriminatory practice, how can it be valid or have academic integrity (Tai et al., 2022)? Understanding how a standard common practice is exclusive should help motivate educators to try something new for the benefit of their students.

Like UDL, assessment for inclusion (AFI) observes the diversity of individuals first and produces evaluations that can be accessed without extensive accommodation (Nieminen, 2022). Rethinking how, what, and for whom you assess can help remove biases and celebrate human diversity. This approach is unfamiliar to many educators and can be intimidating to put into practice. Embracing partnerships with all students and encouraging them to be actively involved in their assessment can reduce the stress for educators and support a better learning environment.

Assessment for Engagement

As an educator for over 25 years, I have worked with students with high needs for many years and have struggled with constructive assessments for my students. An idea I have pondered is assessment for engagement. Assessing students on their level of engagement in a subject could be an inclusive way to evaluate diverse students. This universal practice could support a diverse and inclusive classroom for all students, including non-verbal students. What would assessment for engagement look like? Students would be assessed on their engagement in a subject. A higher grade would mean the student is more engaged in the subject; a lower grade would be less engaged. Neither a high nor low grade indicates a pass or fail; it is just how motivated or interested a student is in a particular area. Students with a similar engagement in a subject, regardless of their academic level, could contribute positively to a course. There are many unanswered questions when trying something new. However, the education system, as it is, is not promoting diversity for all students, so without alternatives, no systemic changes can happen.

Augmentative and Alternative Communication (AAC)

So far, I have talked about instructional design, which would benefit all students and make our education system more inclusive, which also supports non-verbal students. Now, I am going to focus on support specific to communication disabilities. Augmentative and Alternative Communication (AAC) is essential for working with non-verbal students. AAC includes everything a person can access besides talking to communicate, including facial expressions, body movement, picture communication system (PCS), and technology. Understanding an individual's communication style takes time and practice. Education and specific training are essential to become a productive communication partner. Educators should familiarize themselves with all forms of communication a student may use and model that form of language while teaching. Modeling allows others to understand how to communicate with that student, allows the student to feel included, and teaches them how to communicate what they are learning (Kleinert, 2022).

Eye-Gaze Technology

Tobii Dynavox (2024) is a leader in eye gaze technology, with capabilities on a PC and, recently, the iPad, coupled with apps like TD Snap, Word Prediction, and Gaze Viewer; this technology opens doors for authentic communication for non-verbal students. Eye gaze technology uses an infrared camera; the camera can track a person's eye movement on the computer screen and translate those movements to the computer, acting like a hand-controlled computer mouse. Although very expensive, this technology can be funded in Ontario through the Centralized Equipment Pool if a person qualifies. There are many apps for communication; TD Snap is one example that is user-friendly and supports a robust touch screen (or eye gaze controlled) communication system for people at all different communication levels. Programs like Gaze View can help record and track communication and can be used for multiple purposes. As an educator, I know it can be an excellent resource for assessment.

For technology to be helpful, school staff need training in technology and instruction on how to be good communication partners to help students reach their potential. Educators need to understand the need for clean and simple language, large targets, and uncluttered assignments to allow for the optimal ability of eye gaze. Although complex technology can be highly liberating to students, it is challenging and takes much practice for even simple conversation. Without well-informed educators helping students become proficient with this technology, it could lead to frustration and even more communication issues.

Resources for non-verbal students, specifically eye gaze users, are difficult to find. Susan Norwell, M.A. in Special Education, with over 25 years of experience and co-founder at

Rhett University, is well known for her remarkable materials and educational strategies for nonverbal students (2020). She has numerous courses to aid students in academic settings, focusing on literacy and communication. The Rhett University website is an accessible resource and a convenient starting place for professional development for educators. Using outside sources to build efficacy in the school setting needs to be promoted when new technology and skill sets are outside the scope of the specialists within a school board.

Brain-Computer Interface (BCI)

Brain-computer interface (BCI) has the potential to be another future technology that could play a critical role in augmentative and alternation communication (AAC). BCI allows electrical signals from the brain to be linked to a computer. Once the computer learns these electrical pathways, it can be translated into a functional command (Kinney-Lane et al., 2020). For example, if a person thinks about the word yes, the computer can learn the electrical pathway to recognize that thought pathway as the word yes and, in turn, display the word. The research on this technology has been primarily with adults. However, researchers are seeing the need to focus on pediatrics (Kinney-Lane et al., 2020). BCI is a long way from becoming functional or affordable. However, with the push for pediatrics research, this may be another way to help non-verbal students find authentic communication methods.

Conclusion

Non-verbal students are a unique group who deserve access to education like their classmates. Their diversity should be celebrated and not seen as a teacher's burden that detracts from the 'normal' student's resources. Anti-ableist training is an essential first start for teachers to learn empathy and advocacy skills to motivate themselves to find the resources and training they need to promote an inclusive classroom. Many inclusive strategies, like instructional design and technologies, can facilitate an inclusive classroom where no student is seen as a burden and potentially decrease the teacher's workload. Ontario government documents support these ideas. However, many teachers believe it is not their responsibility to support complex students without the resources and training, and they do not need an inclusive classroom; accommodation for individual students is enough. However, are accommodations sufficient to make a practice inclusive, or does this also continue to promote exclusion? Teachers must embrace change, especially if their practices exclude the diversity that should be encouraged in their classrooms. Teachers need to be given the opportunities to learn about universal design for learning and be supported while transitioning from traditional lesson planning to ensure an inclusive classroom can be established. Finding a core group of teachers who promote change, support each other, and encourage efficacy at the school level is essential to ensuring that all students can be supported.

Students with non-verbal communication issues need individualized support. Augmentative and alternative communication resources can be unfamiliar to teachers, but with education, they can become communication partners and model language used by non-verbal students. Understanding the complexity of eye gaze technology and being open to future technologies like brain-computer interfaces could be life-changing for students. However, I believe the key to inclusive education is for the teacher first to understand their biases and non-inclusive practices and their ability to advocate for change. Change is difficult, but if educators can step into their complex students' shoes and be as vulnerable as they are, this will build empathy and a sense of community that can celebrate diversity.

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Boosting Writing Skills in K-12 Dyslexic Students Using Read&Write

LISA FOISY

Introduction

Dyslexia is a prevalent form of learning disability (LD), yet it is often misdiagnosed and misunderstood (Barua et al., 2022). Students with dyslexia often struggle with reading and writing, causing an accessibility barrier to learning in the K-12 classroom. Addressing the unique needs of these students is essential to ensuring their academic success.

One tool that can support students with dyslexia with their writing skills in the K-12 classroom is Texthelp's (n.d. -b) Read&Write. Read&Write is a form of assistive technology (AT) that provides features including speech-to-text (STT), text-to-speech (TTS), and word prediction, which can enhance reading and writing performance for dyslexic students. While there are other tools available that provide specific capabilities, such as Google Docs Voice Typing, Microsoft Word's Dictate, and Apple's dictation option, Read&Write provides more capabilities in one tool, supporting both reading and writing development.

This report critically analyzes how integrating digital teaching and learning resources like Read&Write can address accessibility issues for K-12 students with dyslexia. It covers the key topics of dyslexia as an accessibility issue, the proposed solution of using Read&Write, and barriers to using Read&Write.

Accessibility Issue

Students with dyslexia often struggle with reading, language comprehension, spelling, and writing tasks (Dyslexia Canada, n.d.). These students can experience accessibility issues that hinder their access to the curriculum.

What is Dyslexia?

The International Dyslexia Association (IDA, 2018, para 1) defines dyslexia as:

> a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.

As highlighted in the “What is Dyslexia” video below, dyslexia is a neurological difference that affects up to 20% of the population (TED-Ed, 2013). Dyslexia is a phonological processing problem where students struggle with manipulating language. However, people are affected differently by dyslexia and it occurs on a continuum. Watch the video to learn more about dyslexia.

What is Dyslexia? (TED-Ed, 2023)

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Impacts of Dyslexia

Dyslexic students face several challenges, including:

- Reading fluency
- Spelling
- Writing

As shown in the following video, “What is it like to have dyslexia?”, students with dyslexia share their experiences of living with dyslexia and how it affects them in the classroom (Learning Ally, 2016). Watch the video to learn more from these students.

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Students with dyslexia face many challenges, both in school and in life. They can experience difficulties with low self-confidence (Gaggi et al., 2017; Sood et al., 2018), low academic performance (Barua et al., 2022; Hall et al., 2015), low educational attainment (Gaggi et al., 2017; Sood et al., 2018), mental health disorders of anxiety and depression (Barua et al., 2022), poor health in adulthood (Young et al., 2018), and low employment opportunities and successes (Stetter, 2018; Young et al., 2018).

Learn more about dyslexia and available resources on the Dyslexia Canada website.

Proposed Solution: Assistive Technology of Read&Write

In 21st-century classrooms, students have increasing access to technological devices (Goldman et al., 2023). They can use their devices and install software applications to support their learning, including reading and writing. High school students with LDs using STT programs produced better-written output than handwritten work (Evmenova & Regan, 2019). This section delves into a potential solution of using

Read&Write to address the reading and writing accessibility issues for students with dyslexia.

Assistive Technology Defined

To bridge the achievement gap between students with dyslexia and their neurotypical peers, assistive technology (AT) is commonly used to support learning by addressing impediments related to LDs (Schmitt et al., 2019). The Assistive Technology Industry Association (n.d.) defines AT as “any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities” (para. 3). AT has the potential to boost academic outcomes students with learning disabilities like dyslexia (Barua et al., 2022; Schock & Lee, 2016; Young et al., 2018). AT can allow these students to learn and function while overcoming challenges independently (Dawson et al., 2018).

A few examples of how using AT can support dyslexic students include (Dawson et al., 2018):

- Word processors with spell-checkers can improve spelling, written text organization, structure, and confidence in writing.
- Talking word processors translate written work into spoken text to improve written output.
- Speech-to-text programs convert spoken words into writing to improve writing and spelling performance.
- Word prediction software can improve spelling and vocabulary usage.
- Writing instruction applications can improve handwriting, spelling, and sentence composition.

STT and TTS are standard AT features available in most K-12 classrooms on student devices, including Google Docs Voice Typing, Microsoft Words Dictate, and Apple's dictation option (Maas, 2024). As mentioned previously, these tools only provide dictation support. Texthelp's Read&Write includes a broad spectrum of capabilities which this report discusses as a proposed solution to the accessibility issue that dyslexic students face in the K-12 classroom.

Digital Teaching and Learning Tool: Read&Write

Texthelp's (n.d. – b) Read&Write supports dyslexic students in the classroom, at home, and in the workplace, with over 35 million users (Aquino, 2021). Read&Write aims to help users engage with their digital content to suit individual needs and learning abilities, allowing users to gain confidence with reading, writing, researching and studying (Google, n.d.). Read&Write provides critical features, including:

- "Text-to-speech to hear words, passages, or whole documents read aloud with easy-to-follow dual color highlighting
- Text and picture dictionaries to see the meaning of words explained
- With speech-to-text, dictate words to assist with writing, proofreading & studying
- Word prediction offers suggestions for the current or next word as you type
- Collect highlights from text in documents or the web for summarizing and research
- Create and listen to voice notes directly inside of Google Docs

- Simplify and summarize text on web pages to remove ads and other copy that can be distracting." (Google, n.d., para. 3)

The following short video, "Intro to Read&Write for Google Chrome," describes and demonstrates the capabilities of Read&Write (Texthelp, 2023a).

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Short Read

The Read and Write for Education webpage is a useful resource for teachers that includes a description of features, how-to videos, use case information, and ideas for using it in the classroom.

- Texthelp. (n.d.-b). *Read and write education*. https://www.texthelp.com/products/read-and-write-education/

Benefits of Using Read&Write

For producing content, Read&Write is the best tool for typing in Google Docs, as it has a 92% accuracy rating (Rebelo, 2023;

Bajorek, 2018). It also supports 118 languages and dialects, which explains why it is used worldwide (Rebelo, 2023). Further, the Talk&Type feature provides students with two voice setting options, Talk&Type and Google Voice Typing, allowing them to choose the most comfortable option (Texthelp, 2023c).

The Change to Talk&Type feature in Google Docs webpage describes how to change the voice setting option in Read&Write

- Texthelp. (2023c, September 20). *Change to Talk&Type feature in Google Docs.* https://support.texthelp.com/help/change-to-talktype-in-google-docs

For editing their written work, students can use the TTS read-aloud capabilities within Read&Write to read their written work, allowing them to hear their mistakes and correct them on the fly. The TTS feature can be adjusted to read in the desired language and at the desired pace using a customizable word highlighter (Evmenova & Regan, 2019). Evmenova and Regan (2019) found that using the talking word processor improved the accuracy of spelled words and the quality of work for students with dyslexia.

Additional benefits from speech technology include:

- "Individualized Practice and Agency: Learners can work on material in personalized ways. Learners can learn more about their own personal speech habits and tendencies. Beyond common pronunciation difficulties, users can also see how many filler words, "um" and "uh" type words they produce.
- Time Immersed: By speaking the language, learners can spend more time thinking and being in an immersed environment. Spending time speaking and interacting

with the second language are crucial for acquisition.

- Immediate Feedback: With almost instantaneous processing speed, students get direct feedback about what the speech recognizer did or did not understand.
- Focus on Speaking: Learners can speak for longer durations than many typical classrooms may support.
- Skill Building: Students can see direct connections between their speech and writing skills.
- Speed: Manually typing can be fatiguing and slow. Speech can be significantly faster because of using your voice not your hands to communicate." (Bajorek, 2018)

Students with dyslexia may prefer using voice typing because it allows them to get all their ideas written more quickly than handwriting, reducing forgotten ideas and producing a higher quality of written work more easily than handwriting (Kudickar, 2018).

Universal Design for Learning and Read&Write

Universal Design for Learning (UDL) "is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn (CAST, n.d., para. 1). Within a classroom, students have a wide range of skills, experiences, and interests (Texthelp, n.d.-c). Teaching with UDL will reduce barriers to student learning and increase learning outcomes.

Figure 2

The Domains of UDL

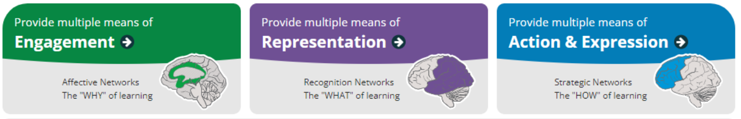

Image of CAST's Universal Design for Learning three principles of multiple means of engagement, representation, and action & expression

Read&Write supports the UDL framework and follows the UDL principles:

- Multiple means of engagement
- Multiple means of representation
- Multiple means of action and expression

Read&Write allows students to choose how they access and engage with their learning content. When considering multiple means of engagement, Read&Write provides audio, text-to-speech, and visual picture dictionaries. Regarding multiple means of representation, Read&Write has options for students to access information, such as text-to-speech, speech-to-text, vocabulary lists, and visual representations of topics. For multiple means of action and expression, Read&Write lets students express their ideas using written and audio formats (Texthelp, n.d.-c).

Lesson Plan Ideas

Teachers look for AT tools to help their struggling students, including those with dyslexia who struggle to produce written work (Boyd Waters, 2015). It can be beneficial to teach all students in the K-12 classroom to use STT technology. In the following blog, read more about the top reasons teachers use Google Read&Write, specifically Voice Typing:

- Bell, K. (2022, October 18). 7 reasons you need to try voice typing in Google Docs. *Shake Up Learning*. https://shakeuplearning.com/blog/7-reasons-need-try-voice-typing-google-docs/

For teachers who have not tried using Read&Write, consider using Google's Voice Typing. As mentioned, Google's Voice Typing is one of the two voice settings available in Read&Write. All that is needed is having Google Docs installed on a device with a microphone (Kendell, 2017).

The following two resources include ideas for incorporating Google Voice Typing into classroom instructional learning activities, such as practicing voice typing and editing written work (Kendell, 2017) and pronouncing word lists (Bajorek, 2018).

Short Reads

The EdTechSandyK blog on Ideas for Using the Voice Typing Tool in Google Docs contains tips for educators to incorporate STT in their classrooms.

- Kendell, S. (2017, July 13). Ideas for using the voice typing tool in Google Docs. *EdTechSandyK*. https://edtechsandyk.blogspot.com/2017/07/ideas-for-using-voice-typing-tool-in.html

Bajorek's 2018 article on Google Speech Technology: Gboard & Voice Typing discusses the benefits of using speech technology on various devices and includes lesson plans and tips for using STT in the classroom.

- Bajorek, J.P. (2018, July). *Google speech technology: Gboard and Google voice typing*. The FLT Mag. https://fltmag.com/google-speech-technology-gboard-voice-typing/

Getting Started with Read&Write

Refer to the getting started with Read&Write for Google Chome website instructions for installation and configuration details.

- Texthelp. (2023b, August 1). *Getting started with Read&Write for Google Chrome.* https://support.texthelp.com/help/lets-get-started

The following video tutorial explains how to use Read&Write using the Google Chrome extension, including installing the software and the reading and writing capabilities:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=364#oembed-4

Lastly, visit the Read&Write for Windows learning resources (Texthelp Academy, n.d.) webpage that contains resources on using Read&Write, including the following quick reference guide for tool usage, a detailed training guide, and much more.

- Quick Reference Guide
- Detailed Training Guide
- Tools for the Writing Process
- Critical Tools for Specific Learning Needs

Barriers to Using Read&Write

Read&Write is not without barriers. The most significant barrier is that there is a cost to using it. While Read&Write is free for teachers, there is a cost for schools to purchase licenses per student. The price as of 2024 is $16 USD per student and $160 USD for an individual license (Texthelp, n.d.-a).

Another barrier to using Read&Write is that its simple toolbar can be unengaging (Beltran, 2022). Read&Write lacks ‘bells and whistles’ that would attract students to use it and hold their attention.

There are also privacy and data protection concerns, with Common Sense’s privacy rating of 52% (Beltran, 2022). For data safety, it is not yet determined whether the product supports only trusted-user communication and whether the user’s personal information is displayed publicly.

Lastly, Read&Write STT capability is most accurate for white male Californian speakers. Thus, students using non-native languages may experience reduced accuracy (Bajorek, 2018).

Conclusion

For students with dyslexia, Read&Write is one tool in their toolbox that helps them with daily reading and writing tasks. Future research is needed on the effectiveness of using STT and TTS AT, like Read&Write, as most of the research is outdated and performed on postsecondary students (Evmenova & Regan, 2019). Additionally, the Ontario Human Rights Commission's inquiry on the Right to Read and subsequent report (2022) identified that Ontario education is failing students with reading disabilities by not teaching reading using evidence-based approaches (OHRC, 2022). The Ontario government has started to take steps toward early literacy screening using evidence-based early reading screening tools (Government of Ontario, 2022). Going forward, more is needed, including teaching educators to use evidence-based reading instruction programs. Until then, Read&Write is one tool that can support dyslexic students in the K-12 classroom and make their lives easier (Evmenova & Regan, 2019).

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Addressing Accessibility Challenges in Mobile Technology for Children with Autism Spectrum Disorder: Issues and Potential Solutions

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Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in communication, social interaction, restricted interests, and repetitive behaviors (American Psychiatric Association, 2013). Autism impacts more than 70 million people worldwide (Autism Speaks, 2017). The prevalence of ASD is significant, affecting approximately 1 in 100 children globally (Zeidan et al., 2022), with a higher prevalence of 1 in 50 children in Canada specifically (Government of Canada, 2019). Children with ASD face challenges in academic learning, social skills development, speech and language therapy, fine motor skills, and promoting independence, necessitating varying levels of support tailored to individual needs (Corkum et al., 2014).

The support needed for ASD can range from none to very significant. Individuals with ASD may find assistive technologies beneficial due to difficulties in communication and social interaction (Lancioni & Singh, 2014). In recent years, assistive technologies have emerged as crucial tools in supporting the learning, communication, and overall well-being of children with ASD (Benssassi et al., 2018). Assistive technology refers to any device or piece of equipment that encourages teaching new skills development, enhances existing abilities, and decreases the impact of disability on everyday functioning (Debeuf et al., 2023). These high-tech assistive devices have transformed the educational experiences of autistic children (Chinchay et al., 2023), enhancing their learning and communication skills and supporting various academic areas, social skills, speech and language therapy, fine motor skills, visual supports, life skills, organizational skills, and independence (Ayres et al., 2013; Lofland, 2016).

Despite these potential benefits, the use of mobile technology for children with ASD presents several issues (Xie et al., 2018). Among these, sensory overload is a significant concern; the bright screens and sounds of mobile devices can easily overwhelm children with ASD, making it difficult for them to focus or engage meaningfully (Deng & Rattadilok, 2022). Additionally, fine motor skill difficulties pose another challenge, as many children with ASD may struggle to manipulate touchscreens and other input methods on mobile devices effectively (Quezada et al., 2017). Another critical issue is using Augmentative and Alternative Communication (AAC) systems effectively. While AAC has the potential to enhance communication for non-verbal children with ASD significantly, integrating these systems into mobile technology in an accessible and user-friendly manner requires careful design and implementation.

Addressing these issues is crucial to ensuring that mobile assistive technology can effectively support the educational needs of students with ASD. Therefore, this paper will explore these issues in depth, examining the specific problems faced by children with ASD using mobile technology and proposing potential solutions to overcome them. By understanding and addressing these problems, mobile technology can be better utilized to enhance the educational experiences of children with ASD.

Issues and Potential Solutions

Issue 1: Sensory Overload

Mobile assistive devices have significantly enhanced the support available for individuals with sensory impairments, particularly those with ASD (Deng & Rattadilok, 2022). These devices, equipped with various applications, aim to provide therapeutic programs and educational content tailored to the needs of children with ASD. However, they also present sensory-perceptual challenges that significantly affect their usability and effectiveness. Sensory issues are frequently observed in individuals with ASD. According to Mikropoulos et al. (2020), individuals with ASD often exhibit challenging behaviors in response to sensory stimuli, which is a common observation among caregivers and educators. These behaviors can be triggered by various forms of sensory input, making the design of mobile assistive devices particularly complex.

Touchscreen sensitivity is one of the primary sensory issues associated with mobile assistive devices. Many children with ASD have access to touchscreen devices, which offer multisensory stimulation through touch and movement (Deng & Rattadilok, 2022). These devices can be incredibly beneficial; however, the sensitivity of the touchscreens can pose significant challenges. Children with tactile impairments or those who experience hyper- or hypo-sensitivity to touch may find it challenging to use these devices effectively (Nevada Autism Center, n.d.). For instance, a hypersensitive child may discover the lightest touch overwhelming, while a child with hyposensitivity might struggle to register their touch on the device.

Auditory feedback is another critical area where sensory issues arise. Weisblatt et al. (2019) point out that the flexibility to adjust auditory feedback is crucial, as certain sounds meant to be positive can be distressing for those with auditory sensitivities. This can manifest in various ways, such as poor volume control or sudden, loud sounds that can cause distress. King et al. (2017) highlight that ASD children who are highly sensitive to auditory input may react negatively to sudden loud noises from devices. Therefore, these devices must allow users to adjust the auditory feedback to their comfort levels to prevent such reactions. Visual feedback is another aspect that requires careful consideration. Devices designed for users with ASD often incorporate bright lights and vivid colors to capture attention and aid learning. However, these visual stimuli can be overwhelming for visually oversensitive children. Weisblatt et al. (2019) noted that the visual intensity of stimuli needs to be adjustable, allowing families or therapists to modify the visual settings to suit children's individual needs. This can help prevent overstimulation and make the device more user-friendly for individuals with varying levels of visual sensitivity.

Potential Solutions

To address sensory problems, it is essential to implement customizable sensory inputs. Developing touchscreens with adjustable sensitivity settings can cater to hypersensitive and hyposensitive users. Similarly, auditory outputs should be customizable, allowing users to control volume levels and select less startling prompts. Visual interfaces can be optimized by offering high contrast, more extensive text options, simplified layouts, and allowing users to adjust brightness and color schemes. Another innovative solution is the Sensory Management Recommendation System (SMRS), which gathers the sensory profile of the user and enables the real-time data collection from the user's environment via sensors to adjust the device settings accordingly. Additionally, engaging with users from diverse sensory backgrounds to gather insights and feedback during the design process ensures that the final product is accessible and user-friendly.

While mobile assistive devices offer significant benefits for individuals with ASD, addressing the sensory-perceptual challenges is essential to maximize their effectiveness. By implementing customizable sensory settings and inclusive design practices, these devices can become more accessible, enhancing the quality of life for ASD children with sensory impairments.

Issue 2: Fine Motor Skills

Fine motor skills involve the coordination of small muscles, typically using the fingers and often in coordination with the eyes (Cleveland Clinic, 2023). For children with ASD, difficulties with these skills can create significant obstacles to efficiently utilizing mobile devices. A recent study by Quezada et al. (2017) found that 28% of the ASD children in the study group had motor disabilities, including impairments in fine motor skills and motor planning abilities. These disabilities affected their ability to perform tasks on mobile devices, particularly struggling with vertical swiping due to the interface design and device orientation. While they could perform drag tasks, it took considerably longer than expected. However, simpler actions like tapping and keystrokes were easier for autistic users to manage.

Tasks involving longer drag distances on touchscreen devices are particularly challenging for children with ASD (Rocha et al., 2019). Many new mobile devices require highly coordinated fine motor movements such as pinching, swiping, and touching. These demands often exceed the motor skills of many individuals who require Augmentative and Alternative Communication (AAC), limiting their ability to utilize these communication tools effectively. Furthermore, these devices often lack sufficient affordances to indicate required movements, making it even more difficult for children with motor impairments (McNaughton & Light, 2013). Although there have been recent developments in alternative access methods for mobile technologies, these options still need improvement.

Potential Solutions

Mobile applications should have touch targets larger than 63 pixels to reduce interaction difficulties and accommodate motor skill limitations. Reducing the required drag-and-drop distances can further ease interactions for children with ASD, minimizing effort and enhancing usability. Simplified and intuitive user interfaces with clear visual cues and straightforward navigation paths can also reduce cognitive load and improve usability.

For instance, children with ASD were 26% slower when interacting with standard touch targets (Rocha et al., 2019). To address this, incorporating settings that allow caregivers or educators to adjust the interface according to the child's needs can provide a more personalized experience. These settings could include modifying touch target sizes, drag distances, and overall interface complexity, creating a more inclusive and accessible digital environment for children with ASD. It is recommended that mobile applications be designed with larger touch targets and shorter drag distances to facilitate easier interaction for children with ASD.

Issue 3: Challenges with Augmentative and Alternative Communication (AAC) Systems

Mobile devices such as iPad-based communication systems have emerged as effective tools in teaching various communication skills, including manding, multi-step requesting, and tacting (Al-Rashaida et al., 2022). An analysis by Al-Rashaida et al. (2022) offered a comprehensive overview of the impact of mobile devices, specifically iPads and iPod Touch, on the communication skills of children diagnosed with ASD. The review highlighted the efficacy of these devices as augmentative and alternative communication (AAC) systems, showing a consistent improvement in the ability of children with ASD to make requests. However, one of the significant issues with using AAC tools for children with ASD is the variability in AAC modes. Different AAC systems, including Speech Generating Devices (SGDs), picture exchange systems, and manual signs, offer varying levels of organizational structure, representation, and vocabulary. This diversity can impact the effectiveness of AAC interventions, making it challenging for parents, educators and therapists to identify the most suitable approach for each child.

Additionally, the effectiveness of AAC modes heavily relies on the instructional methodologies employed alongside these tools. The success of AAC interventions depends not solely on the technology itself but significantly on the quality of training and evidence-based instructional practices. Proper training for users and practitioners is crucial to use the tools effectively to enhance communication skills. Without appropriate instructional strategies, even the most advanced AAC tools may fail to produce the desired outcomes in communication improvement for children with ASD (Lorah et al., 2022).

Potential Solutions

Developing personalized AAC systems is essential to meet the unique needs of each child. The first step involves conducting thorough assessments to understand the specific communication abilities and preferences of children with ASD. Practitioners can significantly enhance their effectiveness by tailoring AAC tools to meet individual needs. Personalization includes selecting appropriate vocabularies, adjusting the organizational structure of the tools, and incorporating elements that resonate with the child's interests and daily experiences. This tailored approach ensures that each child receives a communication system that is both intuitive and engaging, thereby facilitating better learning and use.

Providing ongoing technical support for AAC devices is equally crucial. The functionality and reliability of these tools significantly impact their effectiveness in improving communication skills. Regular maintenance, updates, and troubleshooting support are necessary to ensure AAC devices function smoothly and effectively. This support should include training sessions for practitioners and caregivers on using and maintaining the devices, thereby ensuring that children can consistently benefit from their use without interruptions, improving their communication abilities continuously.

Conclusion

This chapter has highlighted some critical issues surrounding mobile assistive technology in supporting children with (ASD) learning and development. While the current research provides valuable insights into the challenges of these technologies, there is a clear need for more in-depth investigation. It is essential to note that for children with ASD, a one-size-fits-all approach is ineffective when designing educational interventions with assistive technologies. Each child with ASD has unique needs, strengths, and challenges, necessitating personalized and adaptable solutions. The lack of use of Universal Design for Learning (UDL) principles in developing these technologies often results in tools that are not flexible enough to meet the diverse needs of ASD children. UDL emphasizes the need for multiple means of engagement, representation, action and expression, which are crucial for accommodating the varied learning styles and preferences of children with ASD.

Future research should focus on further developing and refining personalized (AAC) systems, exploring the effectiveness of different instructional methodologies, and investigating the long-term outcomes of using mobile technology to support children with ASD. By continuing to advance in these areas, it is possible to create more inclusive and supportive environments for children with ASD that will enhance their learning and development and promote greater independence and quality of life.

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SUBJECT-SPECIFIC RESOURCES

Addressing Physical Accessibility Issues in Science Laboratories

ROBERT SZOSTAK

Introduction

Science has been at the forefront of humanity's development, leading to discoveries that have contributed to the betterment of the lives of many. We better understand our world through the cumulative efforts of scientists such as Charles Darwin and Isaac Newton. For centuries, women have been excluded from participating in this process due to their sex, resulting in the domination of ideas from one group and preventing different experiences and perspectives from being synthesized with scientific academia (Pitman, 2023). Various factors, such as societal expectations and systemic barriers, have posed a problem (Pitman, 2023); however, the representation of women in science has been increasing with time (Entradas, 2023). This issue has been discussed, but the same line of thinking and problems can be connected to those dealing with physical disabilities in science.

Laboratory work is integral to scientific education (Hofstein & Lunetta, 2004); it is often utilized in education to provide hands-on experience. Nevertheless, there are accessibility barriers for students, such as inaccessible workspaces and equipment (Fiss et al., 2023). When faced with these barriers, pursuing a career in science can become daunting and lead to systemic exclusion. Hence, the purpose of this analysis is to examine these barriers and look at potential solutions that can be implemented for those with physical disabilities.

Barriers for Those with Physical Disabilities in a Laboratory

Despite being an integral part of the science curriculum, laboratories possess a host of systemic barriers that can exclude those with physical disabilities from succeeding in this field. Those with physical disabilities may have conditions restricting mobility, hindering them from participating in activities (Goodwin & Watkinson, 2000). Jeannis et al. (2019) outline two significant barriers preventing students from fully engaging within a laboratory. The first pertains to physical accessibility, preventing students from engaging in an assigned task. Entering the building or laboratory room is a common barrier. Within the lab, aisles between benches are too narrow, stools block pathways, workspaces are cramped, or items are out of reach. The second barrier relates to task execution, with half of the participants limited to passive roles; watching a lab partner complete the task, or only taking notes.

Inclusive environments that promote collaboration and meaningful interactions boost students' learning (Santiago-Garabieta et al., 2023). Delegating students to take notes or make observations inhibits them from becoming meaningful participants. Accessible microscopes were an issue for some students (Jeannis et al., 2019). If students cannot gain essential skills, it creates an additional challenge during their scientific career when they graduate. Additionally, it may be inferred that the work environment can be a safety hazard, ranging from accidental chemical spills to fires.

Figure 1

Front of a Building at the University of Manitoba

Note. Front entrance is non-accessible, students must enter from the back where trash is often stored. From "Planning and Designing Accessible Public Spaces in Canadian Universities: A Case Study of the University of Manitoba," by K. Bergen, 2019.

Although some steps have been implemented in institutions, it still needs to be improved. Bergen (2019) looked at accessibility for the University of Manitoba (Figure 1); there has been some positive reception with additions such as ramps; however, it is still a negative experience for students. She found there are still physical barriers, such as elevators on top of short stairwells or the need for more power door openers. The Accessibility for Ontarians with Disabilities Act (AODA) mandates that the province be accessible by 2025 or face fines (Jacobs, 2016). Therefore, it is important to consider approaches that can help meet these standards.

Current Accessibility Practices

To help address these barriers, laboratories have been modified to make them more accessible. Hilliard et al. (2013) review modifications that adhere to accessibility guidelines for lab retrofitting. Some key areas were adjustable height workbenches, lowered sink counters, lowered fume hoods, and a lower chain for emergency shower stations for users with wheelchairs (Figure 2). While an improvement, there are still limitations to these adjustments. Depending on the individual, impairments can vary between difficulty with movement and being unable to utilize wheelchairs due to upper-body mobility issues (Iezzoni et al., 2000). There is also still a problem relating to implementation.

Retrofitting labs can be a significant undertaking. Some changes include changing cabinet heights, adding automatic door openers, replacing old wooden benchtops, or adding adjustable seating (Egambaram et al., 2022). Hence, retrofitting buildings to make them more functional comes with a high cost (Solanki et al., 2022). In higher education, funding has been static despite the increasingly complex needs of students, resulting in higher costs (Lanthier et al., 2023). These expenditures and decreased funding can become prohibitive, leading to inconsistent accessibility standards across educational institutions and lower standards. I have observed reactive measures such as buying a height-adjustable desk when needed rather than being proactive and implementing it beforehand in a newly renovated lab. Because of a lack of resources, students continue to encounter labs that are not fully accessible, with educators unsure how to meet legal requirements for students while balancing cost, health, and safety in this legal gray zone (Prema & Dhand, 2019). Therefore, it is crucial to consider instructional design strategies and learning resources that could be utilized to make labs more accessible, which would make the best use of funding and the limited resources available to educational institutions.

Figure 2

Examples of Accessible Retrofitting in a Lab

(a) Height Adjusted Fume-hood

(b) Safety Shower with Reachable Chain

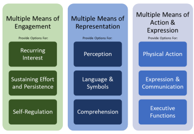
(c) Height Adjusted Sink

(d) Adjustable-Height Workbench

Note. Various accessible features can be used in a lab: (a,c,d) lowered work environments, (b) extended safety shower chains that can be pulled. From "Designing Beyond the ADA—Creating an Accessible Research Laboratory for Students and Scientists with Physical Disabilities," by L. Hilliard, P. Dunston, J. McGlothlin, & B. S. Duerstock, 2013, presented at the RESNA Conference.

Alternative Practices to Address

Barriers



An instructional design strategy that could mitigate these barriers is the universal design for learning (UDL). This framework leads educators to make learning more inclusive by providing multiple means of representation, expression, and engagement (Ralabate, 2011). Each one of these areas can be expanded upon further to address lab inaccessibility. Representation looks at students' learning, providing options for perception (Kohnke et al., 2022). Virtual simulations have been used to simulate lab practices, but were found not to be as hands-on and were not effective in giving experience to working with others (Ma & Nickerson, 2006); considering the purpose of labs to teach these skills, simulations can be reviewed further with the advent of virtual reality and artificial intelligence. Expression is how learning is done, providing options for physical action (Kohnke et al., 2022).

Traditional microscopes can challenge those with mobility impairments (Jeannis, 2018). Instead, institutions can provide digital microscopes, which can be controlled via a computer and show what is being viewed on the screen (Hartati et al., 2011). Engagement looks at the why of learning, which provides options for effort (Kohnke et al., 2022).

Depending on the situation, students could perform roles that best suit their physical ability. However, it is crucial to be mindful that they are not put in passive roles such as only recording observations or calculations (Jeannis et al., 2019).

Expanding further on previously mentioned virtual simulations, this can provide an accessible alternative to a traditional setting concerning virtual reality (VR) and artificial intelligence (AI). As illustrated by Figure 3, VR is a media system that provides interactive, three-dimensional virtual environments, replacing sensory input with computergenerated visuals and sound (Huang et al., 2023). AI is where a machine can communicate, reason, and operate independently, like a human (Du-Harpur et al., 2020). Considering the intersectionality between these two technologies, VR lab simulations using AI could be an area to consider further to train students in laboratory practices. Kaviyaraj and Uma (2021) found that VR can provide an alternative way to provide real-world experience, such as in a physical setting for laboratory work. This technology can be implemented within schools with limited laboratory funding to provide a good learning experience (Bogusevschi et al., 2020).

Figure 3

Simulated Virtual Reality Classroom

Note. *A simulated virtual reality classroom used to train teachers classroom management. From "Comparing Video and Virtual Reality as Tools for Fostering Interest and Self-Efficacy in Classroom Management: Results of a Pre-Registered Experiment," by Y. Huang, E. Richter, T. Kleickmann, & D. Richter, 2023, British Journal of Educational Technology, 54(2), pp. 467-488.*

However, VR could be limited to what is programmed within a developed piece of lab software. AI could provide this change by implementing AI lab partners and procedural generation, creating a more immersive learning environment. Although AI is still developing, the Generative Pre-trained Transformer 4 (GPT-4) large language model (LLM) has been used as an instructional support in a VR laboratory pertaining to thermal fluids using the Unity Game Engine, providing reliable instruction and helping to troubleshoot problems much like a real-life lab assistant (Ayre et al., 2023). Simulating lab spills and communicating with partners provide a dynamic that is lacking in previous iterations of virtual simulations. Either way, virtual simulations have also been found to provide more time and a safer environment for students, with the main criticism being the lack of building collaborative team skills (Shanab et al., 2012).

Considering these two approaches, UDL and VR with AI can be synthesized to provide a holistic learning experience for students with physical impairments. It provides a practical learning experience (Huang et al., 2023) that utilizes an accessible representation method via the construction of a three-dimensional space. It can be more engaging than traditional learning methods (Huang et al., 2023), providing sustained interest for learners.

Lastly, it can be a helpful tool to provide instant feedback for students (Onesi-Ozigagun et al., 2024), making it an effective assessment tool for evaluating lab practices. This approach provides a cheaper yet effective alternative (Bogusevschi et al., 2020), as retrofitting buildings can be expensive (Solanki et al., 2022). Considering safety, it also minimizes risks that could be prevalent in a chemistry setting where it can be easy for a hazardous spill to land on someone seated, making it difficult for someone to make it to an eye-wash station or shower when, considering the previously mentioned barriers of cluttered work-spaces and narrow aisles. Although some limitations should be considered, as Huang et al. (2023) found, this learning method had a higher extraneous load than traditional methods; however, this could have been attributed to insufficient training and participants having to grapple with unfamiliar controls while trying to learn. Considering these points, it does not need to apply only to those with disabilities. With proper investments from educational institutions, this approach could provide an alternative way to train students in science labs, depending on what is being taught or assessed.

Accessible Resources

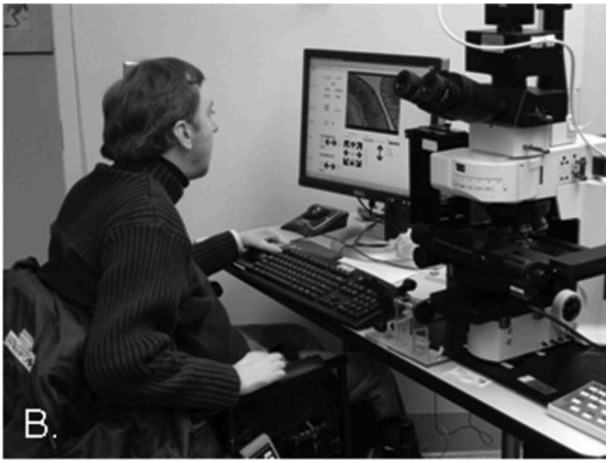
Considering the above mentioned, there are some resources that educators could refer to to create an accessible lab environment. Depending on the area being taught, traditional simulations are usually point-and-click within individual learning modules (Alvarez, 2021). There is a wide abundance of simulations that could be utilized:

- Labster (Alvarez, 2021; Labster, 2024)
- BioInteractive (Alvarez, 2021; BioInteractive.org, n.d.)
- Michigan State University (Alvarez, 2021)
- pHET (Taibu et al., 2021; University of Colorado, 2024)

These resources are available at a low cost or are entirely free on the internet (Alvarez, 2021). A wide variety of digital microscope platforms can be selected, such as the DG-X and ITRC-001 (Hartati et al., 2011). There are also more holistic platforms that aim for users to use light microscopy without any assistance at all, such as the AccessScope (Figure 4); this accessible interface provides remote control, an accessible graphic user interface, slide auto-loaders, a digital camera, an automated research microscope, and a motorized stage (Mansoor et al., 2010). In terms of attitudinal barriers with instructors in the laboratory, it was brought up that often, those with physical disabilities are put into passive roles; instructors must make them active participants by modifying the curriculum and procedures by seeking the help of experts using campus disabilities resource centers or in direct connection with the student (Jeannis et al., 2019).

Figure 4

AccessScope Light Microscope



Note. *Image of a scientist using an AccessScope apparatus to examine a slide without having to stand-up. From "AccessScope Project: Accessible Light Microscope for Users with Upper Limb Mobility or Visual Impairments," by A. Mansoor, W. M. Ahmed, A. Samarapungavan, J. Cirillo, D. Schwarte, J. P. Robinson, & B. S. Duerstock, 2010, Disability and Rehabilitation: Assistive Technology, 5(2), pp. 143-152.*

VR and AI are relatively new areas to consider, but VR laboratories have been used prior. Labster is a commercial system providing lab activities that integrate well with known learning management systems (Höhner et al., 2022). It is available as a subscription service (Wright, 2020). This type of software is more hands-on and engaging than traditional lab simulations and is well-accepted (Shanab et al., 2012). Headsets purchased to be used in a lab could include the PlayStation VR, Oculus Rift, HTC Vive, or the Diger (Çankaya, 2019). A computer will also be required to pair with VR headsets, as the hardware is connected. Different AI models are available for further exploration with their recent rise, such as ChatGPT, Bard, or Bing's AI (Crawford et al., 2023).

Future Accessibility in Science Laboratories

This chapter highlights the accessibility barriers that are still present today for those with physical disabilities within a science laboratory. Although some solutions have been utilized, such as retrofitting entrances with elevators or ramps, gaps still prevent labs from being fully accessible. These gaps pertain to physical layout and instructor attitudes, whether in cramped and inaccessible lab workplaces or delegating students to passive roles. Retrofitting laboratories can be expensive due to static funding, and it takes time. A medium could be implemented utilizing UDL and new digital technological resources such as digital microscopes or VR. VR has been proven to be as effective as laboratory settings in teaching skills, with the additional benefits of not rushing students and working in a safer environment. Augmenting this technology with AI can further enhance the immersive experience of simulations with generative lab settings.

Educators have a vast catalog of resources regarding accessible technology and digital resources. Ensuring accessibility is essential to meet AODA standards and allow for greater inclusion within the scientific community. Creating positive learning spaces where students can participate safely and actively within labs is crucial, as it promotes their integration and efficacy within science. These resources are not just viable for those with physical disabilities but, if integrated, could provide a framework where all students can benefit, similar to other accessible technologies such as screen readers or voice assistants.

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Accessibility Issues in Teaching Mathematics

TOBY WONG

Introduction

Teaching math has pros and cons, and there are many things to consider when planning to teach math. One of the significant components of teaching math is accessibility. As an educator, there are many accessibility issues to think about, like helping visually impaired, deaf, hard-of-hearing, or sensory-impaired students read and interpret math. There are also questions to consider, like whether online and electronic math textbooks are influential for accessibility, whether online e-learning tools are helpful, and whether virtual manipulatives benefit students with math. There can be solutions found in research and the internet, but we have to be careful about what we can trust from the internet. This reading will focus on taking a look at the accessibility issues brought up when teaching math and trying to see the solutions that come up in research. There will also be a look at what accessibility issues, solutions, and resources that come from the internet and some thoughts and analysis by the author regarding some problems found in the research and the internet.

What is Found: The Issues, The

Solutions, and Analysis!

What Comes from Research?

As we know, there are accessibility issues with teaching math, and there are solutions that can help ease those issues and try to remove the accessibility barriers. One problem can be helping visually impaired students interpret and understand math notations. A study by Alajarmeh et al. (2011) found that visually impaired students had a hard time interpreting and reading math notations and formulas because screen readers would mostly read it out as letters and operations, which can make the students not understand the context of the formulas and how to apply or use the formulas in math problems. A solution they found included the implementation of the Math Markup Language (MathML), which is a language software to help understand the context of reading or interpreting math and science notations on the interweb, which is approved by the World Wide Web Consortium (W3C) (Bos, n.d.). W3C is an organization that develops standards and guidelines for accessibility to make the Internet and web-based resources more accessible (World Wide Web Consortium, 2024). This software seems to be one of the fundamentals for reading math online. There can be other software that can help students read math, like the math screenreader MathPlayer (Math for More, 2024), which can read out loud mathematical expressions (Maćkowski et al., 2018). Also, when it comes to helping blind or visually impaired students, educators have to make sure that it aligns with the Digital Accessible Information System (DAISY) standard, which creates a flexible and navigable reading experience for these students (Maćkowski et al., 2018; The DAISY Consortium, n.d.). The DAISY consortium is an organization that helps develop tools, resources, practices, and standards that are compliant with the DAISY standard, ensuring accessibility for people with print disabilities (e.g. impaired vision) (The DAISY Consortium, 2024). When it comes to hard of hearing, deaf, or sensory impaired students, issues for these students are related to the acquisition of language skills that are needed to be successful in speech, writing, reading, signing, and being able to solve math applications (Adamo-Viallani & Wibur, 2008). There are solutions to it when learning math; although not perfect, it comes in the form of 3D animation with sign language and VR technology. Adamo-Villani & Wilbur (2008) suggested two potential software: Smile (Actimage, 2023), which is an immersive learning game, and Mathsigner (Purdue University, 2024), which is a 3D animation sign language interactive software with activities to help teach math. Smile helps sensory-impaired students by playing through a VR game that has a story progression that progresses when students finish the math and science-related tasks the game has while also having sign language support (Adamo-Viallani & Wibur, 2008).

Textbooks are a staple companion to teaching math as teachers and educators need context on what they are teaching, and textbooks give students opportunities to practice their math skills with questions given to them. When the age of digital and online textbooks arrived, textbooks were more easily accessible as students did not need to borrow and return them at the beginning and end of a course, and it does not damage, unlike physical textbooks, which, when you damage it, you have to pay for it. When it comes to digital textbooks, we have to ask if they are effective for accessibility. A study by Lewis et al. (n.d.) found that digital textbooks provided a positive experience for students with disabilities, resulting in improved assessment results while using them, and students developed independence skills in learning math. The study also states that when paired with a math screen reader, students had a positive impact because it helped them concentrate and understand the math concepts.

Now, digital textbooks are one resource we could use, but what about e-learning tools and their effectiveness? E-learning tools can consist of things like drill and practice websites or educational digital games. Wen et al. (n.d) took a look at these things with websites like Khan Academy(2024) and IXL Learning (2024) and games like Prodigy (n.d.) and Kahoot! (2024). They found some reasons for using e-learning tools, such as providing practice for students, trying to motivate and engage students with these activities, and seeing if educators can assess students with these tools and track their performance. While it seems these tools may sound fantastic to use, they also found there may be some issues with them, like trying to understand text-intensive user interfaces, not enough feedback is given for student performance, you are not able to change the difficulty levels on some of the activities, sometimes trying to start the activity with set up and maintenance can be a problem, and implementing/using assistive technology with the tool can be a challenge as well. In the end, the study by Wen et al. (n.d) says that the tools "are not sufficiently effective or inclusive for a large number of students with specific learning disabilities" but have recommended improvements with teacher views (making tools easy to use, involving special education teacher in the implementation of e-learning tools) and student views (better implementation of assistive technology for eLearning tools, avoid negative connotations of making students feel they are bad at math when developing the tools).

Math manipulatives are a helpful tool to help students visualize math problems, but are virtual math manipulatives as good as physical manipulatives? There are benefits and issues with virtual manipulatives. Shin et al. (2017) state that the benefits of virtual manipulatives for students are that they can follow virtual mental images on screen and help look at math relations and patterns with visual and numeric models. This can be used as an accommodation for students; it gets students actively engaged with math, and many of these manipulatives that are online are free and easy to access. They also state that there are some challenges with using virtual manipulatives in terms not all teachers are trained in using them, so practice is needed for educators by using web resources like video tutorials; if there were video tutorials for the students, it is not adequate to help them while the teacher should show them how to use it, teachers also need to find the proper success criteria when planning using these manipulatives, and as well how to implement it in their instructional lesson. Overall, the research shows there are issues in accessibility when teaching math, but there is also an abundance of resources that could help with these issues.

What Comes From The Internet?

Searching the web, some issues and solutions may or may not have come up from the research. CAST (n.d.) has a unique page about teaching with accessible math; they have resources in terms of reading or interpreting math notations like EquatIO (TextHelp, 2024), a software that can help make math expressions accessible by converting into MathML format and well-known math learning software Desmos (2024) which started as math graphing calculator site then became math learning site with activities which can help students with visual impairments. There were some unique math resources from the Diagram Centre by Benetech (n.d.), but an issue was found: some of their resources will be defunct or pulled off the web. Toronto Metropolitan University (n.d) has a webpage that guides how to make math and science more accessible, but they focus on tools like Microsoft Word (2024) and the learning management system D2L (2024). These are assumed to be what the post-secondary institution uses, but they are helpful in terms of using MathML (Bos, n.d.), which makes learning math more accessible. Overall, after looking for a few sites, resources are abundant out there on the World Wide Web that make learning math more accessible, but there are issues like defunct resources that are no longer available.

Thoughts and Analysis

After researching and looking through websites, I noticed some problems. In terms of the websites, I can say there are issues. Other than the issue with resources being defunct and not usable anymore, there can be the issue of biases in terms of Toronto Metropolitan University source; there is the bias in terms these are the tools they used at the university, and it is assumed they are a sponsor for these companies. There also can be an issue where some of the resources are not free and are behind a paywall where you have to pay to use them. The research shows that there can be some issues. For example, I may have used old resources, which can be outdated, and some of the solutions to the issues may be defunct, just like some of the web resources. The source of the 3D animation and VR article may be outdated because that study was an ongoing project and may have evolved. The digital textbook source is also an example of one being outdated as we are in the digital textbook age, but its results can prove essential and guide helping students in need. For my thoughts, I will say there are accessibility issues in teaching math and solutions to help it, but I believe that we are not there fully yet in terms of digital accessibility as the resources that are found adequate but it is not up to today's standards. I will also say I could have looked into more resources if I had the time, but I believe that there are resources out there that I may have overlooked or have not found yet, although when researching this topic, it seemed limited. For the readers reading, I hope this paper got you engaged and interested in continuing this research where I left off. I believe you can expand this analysis more than I did when writing this.

Conclusion

After looking through research articles and websites on the internet, the purpose of this paper is to look at the issues when teaching math and solutions that come up from the research and websites to tackle these issues. Research articles, journals, and studies have revealed that there are issues addressed when teaching and learning math. There are issues like thinking about how to help a student who is visually impaired or hard of hearing. The solutions that are presented are like making math equations and notations accessible with MathML to better read out and interpret equations or using 3D animation or interactive VR games to help a student with their learning. From websites resources are abundant out there on the Web; although some may be defunct, but some are still quite useful, like Desmos, where you can do math activities (Desmos, n.d.). As we are nearing the end, some of these resources found are outdated, not useable, biased, not free, and not finished, but some are still useful. If there were more time, I would have hoped to have found more resources, but as I see, we are not fully there yet with digital accessibility to teaching mathematics as there are many things more to learn and more resources to find, and the research to this seems limited. To conclude, I hope whoever has read this paper is interested and engaged to continue on this research if possible.

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Making Digital Math Accessible: Challenges and Solutions

KATIE GRANT

Introduction

Students with diagnosed learning disabilities, mental health concerns, and communication difficulties are enrolling in programs requiring math more than ever before (Cliffe et al., 2020). There is a demand for graduates with a strong math background, and post-secondary institutions should work toward making their science, technology, engineering and mathematics (STEM) programs accessible to everyone (Schreffler et al., 2019).

The concept of accessible mathematics documents was not brought up at any point in the past two decades that I have spent in mathematics education, as a learner or as a practitioner. Recently, I have noticed a shift. There has been a push in post-secondary education for accessibility checks, alternative text for images, and basic document training to be provided, but specific accessibility challenges for mathematics lag behind. A huge milestone for math accessibility in this century was the interactive whiteboard, allowing the capture of handwritten notes from the board, which can then be saved and distributed to all students, regardless of documented need. Another common delivery mode in post-secondary education is digital slide decks (UVM Center for Teaching & Learning, 2024). Instructors like this delivery mode because slides are easy to share within a teaching team, it takes less time to go through a solution because all the steps are shown on the slides, and it allows for flexibility to teach in a variety of spaces that may not have interactive whiteboards. Slide decks sometimes come pre-packaged with a textbook, so this can also save time for an instructor, and a baseline level of accessibility is assumed to be met. Slides can be easily shared with students either before or after class. Digital math textbooks are common, and there has been a shift to creating more open educational resources (OER) for math, which help alleviate financial barriers to math education (Pennsylvania State University, 2024). Despite these positive strides, there remain barriers to accessibility in mathematics. Barriers exist within the classroom regarding the instructor's choice of and comfort with technology. Barriers also exist with digital math documents. Namely, screen readers and text-to-speech apps may have difficulty deciphering mathematical equations in various digital modalities.

Inaccessible Digital Mathematics

Inaccessible materials create negative associations and disadvantages for students (Pfeifer et al., 2023). In recent years, post-secondary institutions have placed more emphasis on encouraging accessible websites, documents, and slide decks in terms of color contrast, choice of font, and simple, consistent navigation. Online resources must be straightforward to access and developed with the idea that assistive technology (AT) will be used by someone accessing it. However, one area that has seen little acknowledgment is the impact of inaccessible digital math. Visually impaired students are at least one grade level behind in mathematics compared to sighted students

(Barker, 2023). However, the barrier is even wider-reaching since screen readers are used by many individuals, not only those with visual impairments (Bureau of Internet Accessibility, 2021). This includes multilingual learners who may struggle with vocabulary and want more support with how the math is said aloud in a new language, individuals with auditory learning preferences, or those who may need more support with comprehension, attention, and focus.

Mathematics is a symbolic language, but digital formats are mainly developed for letters rather than symbols. When symbolic mathematics cannot be accessed as-is, the user must be able to either modify the visual format (e.g. changing the size or improving the color contrast) or be provided with an alternative format (e.g. alternative text or math-to-speech) (Cooper, 2006). The two most common ways that mathematical expressions are presented digitally are as images and as text-based formulae output. Both formats have accessibility barriers.

Digital Math Images

Inserting images into documents or websites is a relatively basic process for those comfortable with digital documents. If an instructor wants to reuse a mathematical expression from another resource, a simple screenshot or copy/paste is all that is needed. However, as with any image, this method has drawbacks from an accessibility perspective. Firstly, the format of the image dictates how well it can be resized and still maintain image clarity (Cooper, 2006). Secondly, images are difficult to modify to correct typos or change numbers. Most importantly, all images must be accompanied by alternative (alt) text. A mathematical expression rendered as an image without alt text can prevent learners from even getting started on a question (Wright, 2021). Alt text must be individually created for each image, a time-consuming task. Depending on the complexity of the mathematical expression, there is the potential for ambiguity (Cooper, 2006; University of Washington, 2021). Different instructors may use different terminology to represent the same mathematical expression, causing confusion among students.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

(1)

Audio Description of Equation:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=381#audio-381-1

For example, consider the quadratic formula, as seen in (1), commonly recited as, "x equals negative b plus or minus square root b squared minus four a c all over two a". If this was used as the alt text for an image of the quadratic formula, it is quite ambiguous as to what quantity is being squared, square rooted, and divided. An example of a more detailed description is, "x equals the fraction with numerator negative b plus or minus the square root of b squared minus four a c, end square root, end numerator, and denominator two a". This second description uses a technique called chunking, which gives an overview of the expression first, followed by the inner details (Cooper, 2006), and is much less ambiguous than the first description. It emphasizes that the overall structure is a fraction, followed by the contents of the numerator (another chunk), ending with the contents of the denominator. Because mathematical expressions follow this chunked, logical structure, using a text-based rendering of a mathematical expression that is readable by a screen reader would negate the need for math as images and generation of this alt text altogether.

Text-based Formula Output

There are several common ways that mathematical expressions are displayed as text-based formulae, including LaTeX (The LaTeX Project, n.d.), Office Math Markup Language (OMML), and MathML (W3C, 2014). Each format has its own advantages and drawbacks for different use cases. These nuances are not topics of everyday conversation in mathematics education, so instructors may unknowingly create barriers by selecting one type over another.

Designers developed LaTeX in 1984 to typeset mathematics for professional and academic print resources (Cooper, 2006). Using LaTeX requires some level of comfort with coding which not all mathematics instructors have. LaTeX outputs beautifully rendered mathematical PDFs, but unfortunately, these documents can not be reliably read by a screen reader.

OMML, introduced in Microsoft Word 2007 (Microsoft, n.d.-c), is more user-friendly than LaTeX, particularly for individuals or organizations that utilize the Microsoft Office (Microsoft, n.d.-a) suite of products. Some promising accessibility features build off OMML including dictation and math braille (Sargent, 2022). Unfortunately, OMML can only be read by certain screen readers with specific settings enabled, thus is not universally accessible. Screen reader users have preferences for specific products, and many do not wish to switch between them (Bureau of Internet Accessibility, 2022).

MathML, first developed in 1998, has become the standard web-based encoding for mathematical expressions (University of Washington, 2021). The most widely used screen readers and text-to-speech applications can read MathML, and the math-to-speech would be read like the chunking example described in the previous section. There are web-based MathML builders (both free and paid applications), as well as MathML integrations within some learning management systems, so instructors may not need to learn the MathML coding language when building a course webpage from the ground up. The barrier for MathML lies in day-to-day document creation and the lack of a straightforward and economical way to convert other formats into MathML. For example, a third-party paid application is needed to convert OMML expressions to MathML (University of Washington, 2021).

Solutions – Technological Support and Awareness

Post-secondary institutions currently offer training and support to their faculty on making accessible documents and websites. However, some institutions fail to emphasize that mathematical expressions must also be accessible, and do not have standards in place for their instructors to follow. To overcome the barrier of inaccessible digital math, institutions should develop resources and training workshops on these topics and follow up to ensure instructors are adhering to these standards.

Instructor training should include encouragement for testing documents for accessibility issues before sharing them with students, by both using accessibility checkers and a screen reader. Since different screen readers have different capabilities, this testing should be performed in more than one way (Bureau of Internet Accessibility, 2021).

For mathematical expressions, having an institution-wide license for paid applications would be helpful to assist with document conversion from inaccessible formats to MathML. Two such applications are MathType (an equation builder that outputs in MathML) (Wiris, n.d.), and Equatio (Texthelp, n.d.). Equatio has a screenshot reader as a paid premium feature, helpful for both students and instructors. The screenshot reader allows the user to take a picture of math and have it read aloud to them. It can also turn that image into a MathML text equation that could then be reused elsewhere. This is extremely helpful for instructors wishing to reuse older material. Some web-based authoring tools use a modified LaTeX code to render in MathML using a display engine plug-in called MathJax ("What Is MathJax?", 2021).

Another piece of software that has some promising features for accessible mathematics is Microsoft OneNote (Microsoft, n.d.-b). Unlike the rest of the Microsoft Office suite of products which use OMML, OneNote uses MathML. In the subscription-based version, OneNote also can convert handwritten expressions into MathML expressions, which it can read with its Immersive Reader function. However, it does not always recognize handwriting with a high degree of accuracy, so manual corrections must be made after the fact. There is also a built-in basic calculator, graph plotter, and the ability to generate practice questions for some topics (State of New South Wales Department of Education, 2023).

Looking at future technologies, research has already begun on training artificial intelligence (AI) to make mathematics materials more accessible (Wright, 2021). Barker (2023) looked at standardized math test data from over 30 million middle-school students to determine which questions were inaccessible for students with visual impairments and therefore did not accurately reflect their knowledge. The findings will be used to train AI to build accessible versions of these questions for students who use screen readers, braille, or voice commands. A non-profit organization trained AI to assist with converting inaccessible mathematics textbooks to MathML, allowing higher volumes of material to be converted more quickly than relying on people alone (Wright, 2021). There are likely many other ways to leverage AI to assist with universal design for learning that will be developed and improved upon shortly.

In conclusion, math accessibility is a topic that is not top of mind for many instructors in post-secondary STEM programs. Instructors may unknowingly be putting barriers in place for their students with the documents they create, and with the resources they share. Post-secondary institutions should assist their faculty with making math accessible. This should be done through training best practices on digital math formatting, and by providing licenses for technology that can assist with making these changes and updating old documents. For mathematics instructors who want to continue to learn more about making their mathematics accessible, resources to get started are suggested below. These resources are curated in addition to sources already referenced throughout this chapter.

Additional Resources

Math Accessibility at Portland Community College

- A video overview of a project undertaken to improve math accessibility for blind students

- Also discusses Braille and tactile accessibility

Math Content – Colorado State University Accessibility by Design

- Prioritizes steps for instructors to take to improve accessibility in mathematics

Math and STEM Content – PennState Accessibility

- Contains specific details on how to use several tools to improve accessibility in mathematics

Math and Science Accessibility – Portland Community College Instructional Support

- Sorted by resource type, lists key points to consider when making a particular resource accessible
- Provides suggestions for graphing, textbook publisher content, and evaluations

MathML Examples

- Use this webpage to check if a screen reader is configured to read MathML

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UDL AND INSTRUCTIONAL DESIGN

Implementing Universal Design for Learning in Workplace Learning

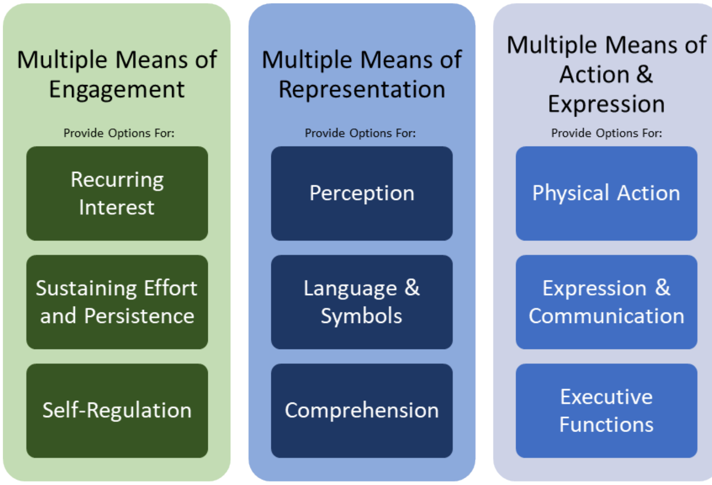
DAWN LEMANIS

Introduction

Higher education focuses on reducing the learning barriers for its students. Workplace learning using higher education as a best practice shall also strive to reduce learning barriers. One of the strategies to reduce barriers is the Universal Design for Learning (UDL) framework. It recognizes that "variability in learning is the norm, not the exception" (CAST, 2018). UDL is a "framework to guide the design of learning environments that are accessible, inclusive, equitable and challenging for every learner" (CAST, 2024c). Using UDL to reduce barriers to learning may positively affect the increase of educational equity for all learners. The research conducted in higher education will be used to transfer the implementation to workplace learning.

Figure 1

Domains of the UDL Framework



The three domains of the UDL guidelines include Multiple Means of Engagement, Multiple Means of Representation, and Multiple Means of Action & Expression.

Let's begin with a short video to introduce UDL.

Rosen, T. (2019). *What is Universal Design for Learning?*

> *One or more interactive elements has been excluded from this version of the text. You can view them online here: https://pressbooks.pub/thealttext/?p=387#oembed-1*

To provide further explanation of the UDL framework, Levey (2023, p.479) describes multiple means of representation by "taking into account the variable ways information may be understood or grasped by students." Multiple means of action and expression "considers the variations in the manner in which students are able to express what they have understood and learned (Levey, 2023, p.479). Multiple means of engagement "takes account of the ways in which a student can be engaged and motivated to learn" (Levey, 2023, p.480).

Before discussing the strategies for implementing the UDL framework into workplace learning, the benefits and limitations will be provided. Addressing the issues may have a positive effect in reducing the likelihood of occurrence in the implementation phase.

Benefits of Implementing UDL

One of the key factors in implementing UDL guidelines is to increase equity in education. Although the focus is on workplace learning, educators should strive to add equity to all facets of learning. UDL "reduces the barriers and impediments facing all students. Therefore, individuals would no longer be required to self-identify to receive accommodations" (Kennette & Wilson, 2019, p.1). Educators designing and implementing UDL guidelines will be proactive in the learning process and will no longer have to provide individual accommodations.

Limitations to Implementing UDL

The area of focus is workplace learning, but we will look at the research in higher education regarding UDL. Addressing the limitations of implementing the UDL framework may assist in its success. Each of the limitations to implementation has been discussed in the HEQCO recommendations.

One of the issues with implementing the UDL framework is the lack of support and clear communication (HEQCO, 2023). To reduce this barrier, HEQCO recommends "establishing a UDL institutional policy" (2023, p. 7). Institutional policies will send a clear message to educators and administration of the value of implementation. Professional development shall be aligned with institutional policy, therefore causing the positive effect of increasing support for providing UDL education.

Another limitation of the UDL framework is the "understanding of UDL is limited to a checklist strategy, therefore limiting the possibilities of design" (Lambert et.al., 2023, p. 2). The UDL guidelines should not limit the design of course material. They should be used as a guideline to increase equity. Educators may not be able to implement every guideline for all course designs. Educators will choose what fits best in every situation based on the UDL guidelines as a resource. Providing educators training on the UDL framework to increase knowledge in the subject is another method to increase understanding. Increasing the educator's mastery of the UDL framework shall be the first step in implementation.

Recommendations

There are several strategies to implement the UDL framework into workplace training. Stepping away from the traditional approach to presenting by lecture alone is one of the first steps. Educators need to provide the optimal learning environment for their learners. There are several methods to begin implementing the UDL framework. Next, the recommendations will be divided into three phases: the multiple means of engagement, representation, and action & expression. The following are examples of how to implement the UDL guidelines for workplace learning but do not address every guideline.

Note: CAST (2024*b*) has recently released the update 3.0 version of UDL Guidelines; click here to view: https://udlguidelines.cast.org/more/downloads/

Figure 2

The three principles, or domains, of UDL

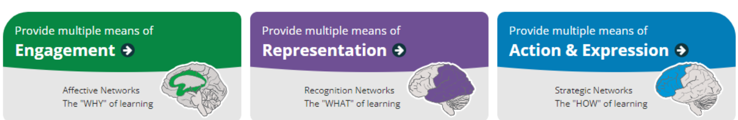


Image of CAST's Universal Design for Learning three principles of multiple means of engagement, representation, and action & expression

Multiple Means of Engagement Strategies

- Provide training resources one week before the session. This allows for pre-learning that may be beneficial for all individuals, those who require additional effort to learn the material or those who do not. Providing resources before the session allows learners to translate the information if required.

- Minimize threats and distractions by communicating the rules of the classroom environment, including respecting everyone in the classroom. Allow learners to participate in the learning process and communicate that all questions are welcome.
- Begin with designing lesson plans intentionally to reduce cultural, cognitive, behavioral, and physical barriers (Lambert et al., p.2). One element is designing the lesson plan, but it is not the only one. Motivation and engagement referenced in the framework "suggest we need to make larger changes than lesson plans" (Lambert et.al., p.3). Increasing motivation and engagement may be achieved by receiving learner input in the design of assignments and assessments. Learners will have greater buy-in if they are part of the development process.
- Divide the class into small groups for case study assignments to "foster collaboration, interdependence, and collective learning" (CAST, 2024*c*).

Multiple Means of Representation Strategies

- Provide multiple means of expression for course material. Provide a linear and visual representation of material in the classroom. Using multimedia in the classroom can assist in this area. Using videos and illustrations to present material will benefit all learners.
- Provide a glossary of terms used in the training. A glossary can be used as a resource to assist learners with varying

degrees of prior knowledge.

- Provide background information for the topic of the session. What is the history, benefits, and limitations of the topic? Providing a complete picture of the topic may assist learners in the transfer of knowledge.
- Relate new concepts to a problem or example in the workplace. Learners may remember a real scenario rather than a hypothetical one.
- Activate prior learner knowledge at the beginning of the learning process.

Multiple Means of Action & Expression Strategies

- Integrate multimedia into the classroom. The use of videos and a digital platform adds additional means for your learners to communicate. Microsoft Teams can be used to add a group to share files or chat with both instructors or other learners.
- Organize and provide course materials in accessible PDF documents to “optimize access to accessible materials and assistive and accessible technologies” (CAST, 2024c).
- Provide options for learners to express what they learned from the material. Giving learners the choice of how to communicate their level of mastery of the topic may increase motivation. Involve learners with setting deadlines for their assessments.
- Provide continuous assessment of learners to enhance the capacity to monitor their progress. Learners will be able to self-regulate to achieve desired results.

Conclusion

Implementing the UDL framework requires ongoing reflection to determine its success. Establishing a community of practice for educators and administrators involved in implementing UDL would be beneficial. This will allow trainers to learn from each other's successes and failures. Develop a community of practice both industry-wide and organizationally. Several UDL strategies in the framework may be easily transferred between industries. One of the recommendations from the study conducted by HEQCO states, "facilitate opportunities for faculty and staff to connect and learn" (HEQCO, 2023, p.21). Building a community of practice addresses this recommendation. There are several means to create a community of practice. Creating a digital artifact using Discord or Microsoft Teams to provide greater access to participants. Conducting virtual meetings monthly or quarterly may also be beneficial to the community of practice. Meetings can provide professional development opportunities to its participants, including the recent revisions to the UDL framework version 3.0. Generating ideas with educators may also reduce anxiety regarding the implementation of the UDL framework.

Implementation is the beginning of the UDL journey. We need to ensure we are proactively using the UDL framework. By reviewing HEQCO's recommendations, we can evaluate the success of implementation. Begin by establishing UDL as an organizational policy, facilitating a community of practice, and evaluating the outcomes of implementation (HEQCO, 2023, p.7). Focusing on reducing barriers in education will promote equity for all learners.

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Are we there yet? The Utilization of UDL Principles to Optimize Learning for Linguistically Diverse Learners in Higher Education

KATHERYNE STEWART

Abstract

The concept of accessibility in education is an exceptionally broad topic and one for which it can be challenging to articulate a focus for discussion. It could be argued that accessibility, in its most intuitive form, involves providing equity of access to those who have been formally diagnosed with identified intellectual, developmental, physical or mental barriers. It is, of course, vital for accommodations to be afforded for such conditions through adequate distribution of funding resources to ensure an equitable learning platform for these students. However, the Ontario Human Rights Commission (n.d.) requires that truly accessible education include, not only physical accessibility, and the provision of necessary supports/ accommodations to ensure students with disabilities have

equal opportunity in their education but also to provide accessible curricula, delivery, and evaluation methodology, as well. This suggests that institutions of higher education must go well beyond the traditional accommodation office to offer support to students and in doing so, through best practices in curriculum design, teaching and learning, will then include students who may be marginalized from these formal diagnoses, such as those students with cultural and linguistic diversity (CLD). The diversity of learners is ever-growing in Canada within higher education, and thus, to assure an accessible pedagogical experience for all, institutions should broaden their definitions of accessibility to include students who are on a *spectrum of ability*, and ultimately, include those who have not customarily been defined as the benefactors of accessibility policies. This chapter will provide an exploration of the challenges and barriers faced by culturally and linguistically diverse (CLD) students in higher education who may be omitted from traditional definitions of appropriateness for access to accommodation measures offered by Canadian institutions. To effectively implement accessible curricula, delivery, and evaluation methodology for all students, the relevance and potential impact of the Universal Design for Learning (UDL) framework will be discussed from the perspective of CLD learners.

Introduction

There is a legal obligation for all publicly funded colleges and universities in Canada to operate an Accessibility Services (AS) office to coordinate and provide accommodations and services to students with disabilities (Transition Resource Guide, n.d.). The nomenclature for such offices often includes either the word ‘disability’ or ‘accessibility’ in their names, but the word ‘accessibility’ is becoming more commonly used, emphasizing that the environment should be adapted rather than the individual.

Common accessibility requests include those students with learning disabilities, Attention Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), mental health disorders, deaf or hard-of-hearing, and blind or low vision (Transition Resource Guide, n.d.). These are, of course, vital conditions to be addressed through the adequate distribution of funding resources to provide an equitable learning platform for all students engaged in higher education. In contrast, accessibility and inclusive education in general can be challenging to define, depending on whether institutions adopt a narrow or more broad view of what students should be the target of these initiatives (Haug, 2017; Kumar & Wideman, 2014). However, in higher education, where the diversity of learners is ever-growing in Canada, the most utilized definitions of accessibility and accommodation tend to exclude students who are on a *spectrum* of ability, including those who have undiagnosed issues, or do not seek assistance, as well as those with cultural and linguistic diversity (Mohler & Godin-Jacques, 2023; Ward, 2012).

Rising Diversity in Higher Education

There is a growing trend of increased enrolment of students with disabilities in Canadian universities; 24% of first-year university students in Canada self-declare having a disability, however, only 6 to 9% of those students seek accommodation (Campbell, 2022). There has also been a significant increase in the enrolment of international students in tertiary education across the country (Statistics Canada, 2023, 2024). Canada is cited as the leader in the internationalization of higher education, with international students comprising 29% of the total of those enrolled in all forms of tertiary education in the country (Statista, 2022). The number of international students enrolled in Canadian public postsecondary educational institutions more than doubled in a decade, while their share of total postsecondary student enrolments worldwide, increased from 7% to 18% in that same period (Statistics Canada, 2024).

As institutes of higher education endeavor to implicitly address diversity, equity, inclusion, and belonging in standard campus practices, internationalization of the student population has become an important methodology to enhance international collaboration, as well as global access to knowledge and diversity (Evmenova et al, 2024; Fovet, 2019); however, more pragmatically, the significant economic competition among institutions has necessitated that colleges and universities proactively pursue increased international student enrollment (Altbach & Knight, 2007; Fovet, 2019). With scarce resources and a simultaneous increase in expectations to effectively meet the needs of all learners, this rapid internationalization has led to the development of pedagogical tension and challenges for institutions (Robertson, 2010).

Striving to Meet the Accessibility Needs of All Students

The Ontario Human Rights Commission (OHRC, n.d.) defines an accessible educational system as one in which persons with disabilities can “access their environment and face the same duties and responsibilities as everyone else, with dignity and without impediment.” This is expanded further and requires the provision of physical accessibility, necessary supports/ accommodations to ensure all students have equitable access and opportunity in their education, as well as accessible curricula, and accessible delivery and evaluation methodology.

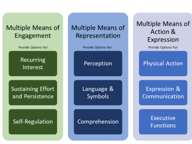
Offices to assess and implement accommodations for learner diversity are found on campuses across Canada, and demand for such services has increased. The Higher Education Quality Council of Ontario found registrations for such services within Ontario colleges and universities increased by nearly 80% between 2013-14 and 2020-21. The growth in demand for accessibility accommodations has been accompanied by increased complexity of the supports required, as well as an increasing number of students presenting with multiple disabilities (Lanthier et al, 2023). Institutions also provide specific support options for CLD students, but these are generally focused on housing or accommodation, legal and financial aid, opportunities for networking, mentorship, and meeting other students (EduCanada, n.d.).

The OHRC requires institutions to ensure accessible curricula, and accessible delivery and evaluation methodology for *all* forms of diverse learners, and yet, the evidence around the success of these initiatives for CLD learners is mixed at best. Many of these CLD students face major barriers to success due to challenges with oral and written expression within an academic context. Additional factors that can dramatically alter learning for CLD students are a cultural gap around understanding the purpose and mechanisms of group work, the implicit expectations relating to assignments, the reliability of sources and ways to access them, as well as the etiquette around communication with instructors (Fovet, 2019).

As the instructor of a Career Success class at a major Ontario College, the learning experience in Canada for CDL learners is a topic of *personal* curiosity and some frustration. The class this semester is 100% comprised of students for whom English is not a first language and includes students from predominantly South Asian countries, including India, Nepal, and the

Philippines. In the previous semester, the percentage of CDL learners was 95%. From a first-hand perspective, the struggles to access and navigate written and verbal curricula in an academic environment for these students is evident. From reluctance to actively participate in learning, and a tendency to not seek clarification, to misinterpreting written text and rubrics for assignments, I witness weekly that we are not serving these students well. On reflection of one's own skills and abilities as an instructor, there is certainly much to learn, but also, there may be significant opportunities within the curriculum itself which, with altered design measures, could improve student engagement and outcome success for CDL students. Framing the issues of linguistically diverse learners in higher education *within* the context of accessibility and course design emphasizes the importance of creating inclusive environments and educational practices that cater to diverse linguistic backgrounds.

Universal Design for Learning (UDL) as an Instrument to Address All Diversity



The design of programming and curricula in education involves a comprehensive understanding of the learners' characteristics, the instructional environment, and any additional factors that could influence the learning outcomes for these students. While there are many commonalities among learners within higher education, individual student preferences, abilities, and experiences, introduce enormous variability among these populations (Gronseth et al, 2021).

Learner diversity has become the norm, rather than the exception, and thus curriculum designers must incorporate classroom delivery and assessment in a way that will optimize the capacity to learn for all. Universal Design for Learning (UDL) is a scientifically based framework for developing curricula that support diverse learners. The Center for Applied Special Technology (CAST) asserts that UDL is based on brain-structure research, which incorporates multiple means of instruction, action, and expression, and engagement (CAST, 2011), and was developed to identify and address student diversity within the classroom (Doran, 2015).

UDL was originally established as a sustainable pedagogical framework to enhance the inclusion of students with disabilities in post-secondary classrooms, and there is a distinct lack of research on the use of UDL within the context of CDL learners in higher education (Fovet, 2019, 2020). However, CAST (CAST, 2011) now maintains that UDL has relevance for students of all profiles, not just learners with disabilities. Fovet (2019) purports that as the UDL framework has an intentional focus on the user experience, without relying on medical model perspectives, it has also shown significant promise regarding the inclusion of international students, Indigenous students, and first-generation students.

Similarly, Rao, (2015) notes that UDL can provide supports that are useful for CLD students who are learning a second language and are assimilating to new cultural systems and educational expectations. Bradshaw (2020) suggests that UDL can benefit students with identifiable *and* unidentifiable disabilities and suggests that some of these "hidden" disabilities include perceptual and language challenges. Using UDL as an instructional design framework, educators can proactively assess, address, and support learner variability, and reduce barriers for students in higher education environments (Evmenova et al, 2024).

Practical Implementation of UDL Practices for CDL Learners

Designing courses that support linguistically diverse learners in higher education involves thoughtful consideration of how content is presented, and assessed, and the interactions within the course content and structure. This can include incorporating best practices in course design, affording faculty flexibility in providing alternatives and options for interactions and assessments, and professional development for faculty and teaching staff to best support learning in these students.

A myriad of authors provides classroom-based suggestions for best meeting accessibility standards for CDL students, including using clear and simple language in course materials and instructions, providing lecture notes or slides in advance, multimodal content delivery, offering language support resources, promoting peer interaction and support, and pairing linguistically diverse learners with native speakers (Cumming & Rose, 2022; Doran, 2015; Gronseth et al, 2021; Rao, 2015, 2019; Ralabate & Nelson, 2017; Saha-Gupta et al, 2019). Utilizing technology and accessibility tools can support linguistically diverse learners as well, for example, by providing transcripts or captions for audiovisual materials, using bilingual dictionaries or translation tools, and ensuring that online platforms are accessible and user-friendly for students of varying language backgrounds (Doran, 2015; Ralabate & Nelson, 2017). Instructors can commit to providing timely feedback and clarification, develop and offer alternative assessment methods, and afford flexibility in assignments and activities. Institutions should offer training and professional development opportunities for faculty and teaching staff on effective strategies for supporting CLD learners. This includes understanding the challenges these students face and designing and implementing inclusive teaching practices to address these challenges and enhance learning outcomes (Doran, 2015; Ralabate & Nelson, 2017).

Has UDL Solved Accessibility Issues for All Learners?

In North America, there has been early pressure through legislation to improve accessibility measures for students with disabilities (Fovet, 2019); diverse learners within other areas have not received the same attention, and inclusive provisions for CDL students are considered best practices but do not represent a legal obligation. While the benefits of UDL in higher education have become increasingly obvious, the push for UDL implementation has nonetheless slowed in many ways. In the realm of higher education, UDL-related research is somewhat limited and hampered by competing definitions, resources, goals, and constructs (Fornauf & Erickson, 2020). Student outcomes are invariably considered a gold standard of success of the implementation of new processes and procedures, and yet, Capp's (2017) metanalysis cites that UDL, while an effective teaching methodology for all students, has an impact on educational outcomes that could not be demonstrated.

A common methodology to meet UDL standards for linguistically diverse students is to provide captioning. In a study from Venturi et al (2022), in the context of a UDL-designed classroom, the captions provided were found to benefit learners only if their English language proficiency was high enough; when language proficiency was poor, however, the captions were detrimental, and performance was worse than having no captions. The authors caution that institutions with a commitment to UDL understand that not one type of caption suits all, and highly recommend testing captioning systems with diverse learners, to better understand what factors are beneficial for whom and when.

Appropriate training and supervision in the implementation of UDL are key to its efficacy. In a review of current literature on the application of UDL as an accessibility tool for higher education, Cumming and Rose (2022) found that instructors implementing UDL principles in coursework reported that UDL improved their teaching; however, it was also noted students perceived UDL elements to be more useful than faculty members, and that a key barrier to UDL efficacy was instructor attitudes. Evmenova (2014) notes that while all the participant instructors recognized the value of UDL and were eager to implement it in their learning environments, they also strongly recommended additional professional development on the UDL framework and specific technologies. In Kennette and Wilson's (2019) comparative study, the literature cites a need for appropriate staff training and awareness of the advantages of UDL for it to be beneficial to students. While instructors who were aware of student needs reported that they wanted more training, and responded positively, those who felt that they did not have enough information on student needs, undervalued UDL frameworks and were more likely to believe students with accommodations had unfair advantages (Black et al, 2015).

With regard to curriculum development, Gronseth et al (2021) note that course designers and instructors can be self-referential, reflecting their own needs, experiences, and preferences in their designs rather than factoring in those of the learners themselves. Institutions should offer training and professional development opportunities for faculty and teaching staff on effective strategies for supporting linguistically diverse learners, including an understanding of challenges faced by these students and implementing inclusive teaching practices to enhance learning outcomes.

Conclusion

With the significant increases in enrollment of international students over the past decade, the diversity found among Canadian students in higher education is expanding exponentially. With this growth, comes a broad spectrum of challenges for these institutions, in the attempt to meet the unique needs and provide inclusive and accessible learning to students who have an inherently high degree of variability of individual preferences, abilities, and lived experiences. When physical barriers and classroom accommodations are the focus of inclusiveness, students with cultural and linguistic diversity are often excluded from discourse involving accessibility issues. These students face substantial challenges, especially with regard to accessibility matters directly related to curricula, delivery, and evaluation methodologies. By framing these issues of CDL learners within the lens of accessibility and course design, higher education institutions can better address the needs of linguistically diverse learners, promote equity in education, and create environments where all students can thrive academically and socially. Providing resources, instructor training, and policy development and potentially legislation around the standardized application of Universal Design for Learning frameworks in this respect may help to mitigate the pedagogical barriers faced by culturally and linguistically diverse students. Regardless of the approach, it is clear that educators and scholars must continue to strive to transform curricula and methodologies across campuses to effectively address the diverse essential needs of all learners. We are not there (yet!)

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Using Technology to Achieve Differentiated Instruction and Improve Accessibility

MAGGIE MCELENEY

Introduction

Accessibility for all students is an ongoing discussion in elementary classrooms as teachers attempt to meet the diverse needs of each of their students. In Ontario, teachers are guided by the Ministry of Education's (2010) *Growing Success and Learning for All* documents, which encourage using Universal Design for Learning (UDL) and differentiated instruction (DI). These instructional design strategies recognize that equal treatment is not the way to achieve equity and that student readiness, preferences, and interests should be factored into an individualized approach (Ontario Ministry of Education, 2010). UDL and DI overlap in their approach to varying the way students are engaged in learning through materials and the environment, as well as how they represent their learning and express themselves (Ontario Ministry of Education, 2013). DI takes individualization further by seeking ways to tailor instruction to each student's needs to target their Zone of Proximal Development (ZPD). The ZPD is based on research by Lev Vygotsky, who identified a key space for learning beyond what a student already knows that they can reach with assistance to learn something new (Ontario Ministry of Education, 2013). This requires knowledge of each student as an individual learner with specific details about their intersectionality, as categories do not account for how their specific abilities, disabilities, oppression, etc., overlap.

The Ontario Human Rights Commission (n.d. *b*) identified a lack of individualization as one of the main barriers to accessibility for students with disabilities. This barrier exists because policy and funding approaches rely on rigid standards or categorization to provide accommodations (Ontario Human Rights Commission, n.d.). There are a number of reasons why categories are being used and why individualization is not being implemented effectively in classrooms. Issues include a lack of time, funding, resources, training, and ableist mindsets, which don't see the value of accessibility for all (Bondie et al., 2019). DI is widely taught in teacher training as a form of individualization and is supported by Ontario curriculum materials; however, the reality of its application is challenging for teachers and, therefore, cannot be assumed to be universally applied. Technology has been identified as a potential tool for addressing the individualization barrier, and many applications have been developed for elementary classrooms. Specifically, one-to-one technology use in the classroom has increased differentiation for students (Harper & Milman, 2016). This critical analysis will review how a lack of individualization creates a barrier for students with disabilities and issues that arise when attempting differentiated instruction to meet individual needs. It will also look at the potential use of technology to provide improved differentiated instruction in elementary classrooms.

Barriers

Lack of Individualization

The Western education system is based on the idea that students must meet defined curriculum standards to pass school. These curriculum expectations are the same for all students regardless of their interests, strengths, or growth areas. Due to the standardized nature of the curriculum, teaching the curriculum can sometimes be implemented as a blanket approach with the idea that what works for one will work for most others (Latz et al., 2008). In addition to the standard curriculum, there is also the issue of standard timelines as schools follow a rigid school year structure within which curriculum must be accomplished. Students with disabilities or learning differences face challenges in being successful under standardized conditions (Baron et al., 2019).

In some cases, students with identified disabilities are given modified expectations or timelines to accommodate their needs (Ontario Ministry of Education, 2013). These types of intervention pose a potential threat to inclusion in that by modifying or reducing expectations, a deficit mindset may be created, which minimizes the view of what these students are capable of (Östlund & Hanreddy, 2020). Östlund & Hanreddy (2020) further highlight that removal from regular classroom settings can lead to lost learning opportunities and a shift to life skills rather than achieving the curriculum through other means. A lack of options for individualization in the classroom means that students with accessibility needs are being disadvantaged and not given the same learning opportunities as others (Ontario Human Rights Commission, n.d. *b*).

To avoid creating stigma and lowering expectations for students with disabilities, there has been an increased push for inclusive classrooms, which include students of various learning differences and abilities (Östlund & Hanreddy, 2020). The complex needs of these classroom populations necessitate differentiation so that students receive the instructional support they require to succeed (Baron et al., 2019). Without differentiation, this inclusion policy might turn into a policy of discrimination. In Ontario, educators must accommodate students with exceptionalities, and the process outlined in the Education Act includes the creation of an Individual Education Plan (IEP) (Ontario Human Rights Commission, n.d. *a*). Although designed to ensure students are receiving the resources they require, the reality of updating and completing these each year holds students with learning exceptionalities back each year (Ontario Human Rights Commission, n.d. *a*). In response to the 2001 Safe Schools Act, the Ontario Human Rights Commission (n.d. *a*) highlighted that students with disabilities can present as disobedient or disruptive when their learning needs are not being met. They noted that the Act does not account for their right to accommodations based on a disability as part of mitigating factors contributing to an act for which they might be suspended (Ontario Human Rights Commission, n.d. *a*). A student ending up suspended or expelled because of a lack of individualization is a major potential barrier for students with disabilities.

Solutions

Instructional Design Solution: Differentiated Instruction

Differentiated instruction is an approach to individualizing education because it recognizes each learner as an individual with unique characteristics and strives to adapt instruction to match the learner (Ontario Ministry of Education, 2013). In her seminal writing on differentiation (2004), Carol Ann Tomlinson identified readiness, interest, and learning preferences as key factors for differentiation to be effective. Teachers can utilize these factors to implement differentiated instruction by tailoring their teaching methods, materials, and assessment techniques (Tomlinson, 2004). For example, in literacy instruction, teachers may use leveled reading groups where students engage with texts that match their reading proficiency, ensuring each child is challenged yet capable of succeeding (Ontario Ministry of Education, 2013). This aligns with the DI standards of working within a student's zone of proximal development and requires the educator to know the student's exact level. Having accurate information about each student and implementing it through DI can be challenging for teachers and requires support. Duquette (2016) highlighted the important role that education professors play in modeling DI for teacher candidates. School administration also plays a role in implementing differentiation within the classroom since it influences the attitudes and opinions of the teaching staff (Hertberg-Davis & Brighton, 2006). Additionally, peer coaching can effectively support DI integration because it allows for mentorship, modeling, and constructive feedback (Latz et al., 2007). If DI can be implemented to its full potential, all students could receive individualization that meets their accessibility needs.

There are some critiques of DI that are important to consider when discussing its implementation for inclusion. Bannister (2016) warns that differentiation could create social ordering within the classroom, perpetuating deficit thinking. This is similar to Östlund and Hanreddy's (2020) concerns that students with disabilities could be seen as less capable and, therefore, not given the tools necessary to achieve the same learning as their peers. This isolating individualization is not what is needed to address accessibility. Bannister (2016) also makes a specific link between race and social class inequities, which are important factors to consider when planning for teaching. DI, like all instructional strategies, can fall into normalized patterns of oppression, so it is critical for educators to understand and account for it.

Digital Solution: Technology for Differentiation

Technology is being proposed for many educational uses, but one of the most beneficial uses could be differentiating instruction for students through customized learning opportunities. In the study by Johler and Krumsvik (2022), teachers reported that digital technologies significantly enhance their ability to provide differentiated instruction. Observations and interviews revealed that teachers use various adaptive software to tailor instruction to individual student needs (Johler & Krumsvik, 2022). For example, adaptive learning technologies allow teachers to customize content and provide real-time feedback, enabling students to work at their own pace and level (Johler & Krumsvik, 2022). A study by Baron et al. (2019) demonstrated that educational technology, such as Lexia Core5 Reading, can effectively differentiate instruction for various reader profiles. Key adaptive features of this software included auto-placement, instructional branching, and targeted instruction for poor decoders, poor comprehenders, mixed deficit readers, and typical readers (Baron et al., 2019). The software has automated DI strategies, such as creating reader groups by type, and provides individualized instruction. While poor decoders and comprehenders had lower accuracy in the standard instruction, they improved over the academic year due to more time spent in guided and direct instruction activities (Baron et al., 2019). Additionally, Haymon and Wilson (2020) studied a similar technology-based reading program called Achieve 3000, which aims to advance the reading achievement of middle school students. This program differentiated instruction by providing challenging texts that personally aligned with each student's reading level (Haymon & Wilson, 2020).

In the studies above, students benefitted from the differentiated nature of the program, and they underscore the importance of leveraging educational technology, which can dynamically adapt to the strengths and challenges of each student (Baron et al., 2019). Specifically, using multimodal resources, such as digital books and interactive platforms, allows teachers to present information in diverse formats (Johler & Krumsvik, 2022). Customization is particularly effective for students with learning disabilities, as it reduces the stigma associated with pull-out support and enables continuous participation within the mainstream classroom (Johler & Krumsvik, 2022). It can also address the educational requirements of advanced learners, suggesting that technology can play a crucial role in bridging the gap in reading proficiency among high-achieving students (Haymon

& Wilson, 2020). Baron et al., 2019 highlight that students with mixed learning deficits, as termed in their study, still struggled more than other groups. They suggest that tech interventions be used in addition to teacher-led interventions (Baron et al., 2019). Johler and Krumvik (2022) also warn that it should be used as part of a balanced approach, as overuse can take away from the overall education experience and learning traditional skills. Individualization based entirely on technology could lead to isolation and potentially lead to behavior outcomes similar to when individual needs are not met.

Although technology has the potential to address some barriers, it comes with several challenges of its own. Despite the rapid increase in the number of devices and funding available for technology post-pandemic, it cannot be assumed that every student has equal and sufficient access to technology for these purposes (Ontario Human Rights Commission, n.d. *a*). As Harper and Milman (2016) discussed, differentiation is increased through one-to-one technology implemented with effective planning, which might not be the case. To receive their own devices, students may need a diagnosis recognized by the school board first, limiting or delaying their potential access to devices (Ontario Human Rights Commission, n.d. *a*).

Beyond having access to technology, there are limitations to implementation that arise from inconsistent training and application. For each new technology tool, teachers require training and guidelines for implementation (Harper & Milman, 2016). Harper and Milman (2016) found that when teachers were resistant to integrating technology, it was often because they required significant learning and were not provided professional development. The next barrier could be the effective and consistent technology implementation, even if adequate training is provided. The success of technology-based programs like Achieve 3000 and Lexia Core5 heavily relies on them being used as directed and over a long period, so students become familiar with them and see progress

(Baron et al., 2019; Harper & Milman, 2016). This level of consistency is not always possible in schools, especially when it is being used as a supplement to other instruction, and it may be left aside when time is limited (Baron et al., 2019). Despite these challenges, integrating digital tools appears to facilitate more collaborative and communicative learning environments, ultimately supporting the diverse needs of elementary students (Johler & Krumsvik, 2022). It is worth exploring these options as we attempt to meet accessibility needs by increasing individualization.

Conclusion

A lack of individualization continues to be a main barrier to education for Ontario elementary schools, and addressing this barrier will require a multifaceted and radical approach to inclusion. In the meantime, programs in the featured studies, such as Lexia Core5 and Achieve 3000, have shown significant potential for addressing these barriers by providing adaptive learning experiences specific to individual student profiles (Baron et al., 2019; Harper & Milman, 2016). These technologies enable real-time content customization, foster student engagement, and facilitate continuous assessment. Despite its advantages, the implementation of educational technology is not without challenges. Issues such as the digital divide, inconsistent access to devices, and inadequate teacher professional development can hinder the effectiveness of technology-enhanced differentiated instruction for individualization.

Additionally, the reliance on technology must be balanced with traditional teaching methods to ensure a full educational experience. Effective technology integration requires comprehensive planning, sustained implementation, and ongoing support for educators. By implementing these strategies, elementary schools can create more inclusive and effective learning environments that cater to the diverse needs of all students, thereby enhancing overall outcomes for students.

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Core Readings

Chapters on accessibility standards, barriers to accessibility, and developing accessible teaching and learning resources.

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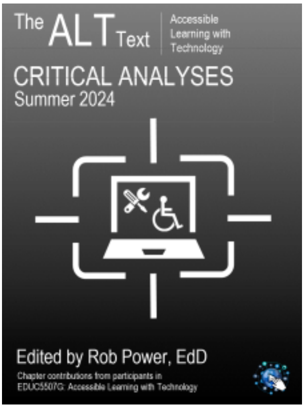
Critical Analyses Chapters

Chapter contributions from course participants.

Summer 2024



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