Barriers Experienced by Individuals with IDD when Interacting with Digital Technology and Online Content

By

Sandra Kim Law

Submitted to OCAD University in partial fulfilment of the requirements

for the degree of Master of Design in Inclusive Design

Toronto, Ontario, Canada, 2023

Creative Commons Copyright Notice

Abstract

Prior to the pandemic there was clear evidence that people with intellectual and developmental disabilities (IDD) had less access to digital technologies and services than other groups of individuals with disabilities, and mainstream users. The expectation seemed to be that the transition to online delivery would be relatively seamless and that essential (e.g., e-health services like online appointments and therapy sessions) services would be easy to access. However, that is not the experience of all individuals with disabilities, particularly individuals with IDD, as that population retains a preference for face-to-face delivery of certain services during the pandemic.

There are existing accessibility guidelines that designers can use to create content or software, for example, the Web Content Accessibility Guidelines (WCAG) 2.1. These guidelines focus primarily on the needs of a population of individuals with a single disability and most often those with a sensory (e.g., visual, hearing) or mobility issue. Relying solely on standards like the WCAG 2.1 seems unlikely to address the needs of people with IDD, a very heterogeneous population.

The first stage of this research project was a scoping review of literature published between 2007 and the present that dealt barriers that individuals with IDD had using Information and Communication Technology (ICT). The second part involved consultations with six individuals with an IDD around their ICT use. The third part of the project involved the creation of a decision tree. The decision tree is intended to act as a tool that can be used by designers and others when they make decisions about how to create ICT that supports users with IDD.

Keywords: intellectual and developmental disabilities, IDD, barriers, ICT, pandemic, accessibility guidelines, scoping review, decision tree, case studies

Acknowledgements

I would like to thank Dr. Peter Coppin who was the Principal Advisor of my project and provided guidance on the field of design and challenged me to consider how different types of designs could foster autonomy for a population that is often seen as less able to operate independently in society. I would also like to thank Barry Isaacs and Lisa Carter from Surrey Place who provided valuable guidance to me at the outset of the project, and who provided feedback on the final version of the scoping review and insights into the population that is meant to be served by the work that was done for this project. I would also like to thank Carolyn Elias, who is also with Surrey Place, who facilitated all the consultations as well as providing feedback on my ideas around the connection between existing WCAG 2.1 guidelines, the experiences of people with IDD, and for her own insights into the data coding process. I would like to thank members of the Perceptual Artefacts Lab (PAL) that is overseen by Peter Coppin as the individuals who are members of that group provided feedback to me at various stages of my project. Funding for the project was provided by Surrey Place (Dr. Barry Isaacs) through their project grant entitled *Usability of Digital Information and Information Technology for People with Intellectual and Developmental Disabilities (IDD)* from Accessibility Standards Canada, Advancing Accessibility Standards Research program.

Table of Contents

List of Tables

Table of Figures

Introduction

Background and Purpose

Individuals with IDD face a variety of challenges accessing technology and online content. Sometimes these challenges are related to other's perception of their abilities to operate safely and autonomously in the online environment, and sometimes they relate to other people's beliefs around their understanding of and proficiency with technology. The existing guidelines, the WCAG 2.1 guidelines, generally do not consider the needs of individuals with IDD, they are primarily focused on the need to provide alternative forms of content and modes of interaction for those with visual, hearing and mobility challenges.

With the advent of the COVID-19 pandemic and the restrictions it brought, it became increasingly clear that everyone needed to have access to ICTs and online content to complete daily functions, receive essential services (e.g., education, healthcare), to attend school, go to work (in office-based contexts), and to operate as a fully enfranchised member of society. Prior to the pandemic some work was done on assessing the barriers that people with IDD faced when trying to use computer-based technologies, the Internet and to access online content. However, the needs of people with IDD were often only considered as part of the wider population of people with disabilities. The needs of those with IDD are not univariate as they often have multiple conditions, in addition to their diagnosis of IDD. Accessibility guidelines were designed to address the needs of people with one disability, possibly two, not individuals who faced multiple challenges such as troubles reading and comprehending text, problems articulating words, issues with typing, learning, etc.

This project was meant to identify the barriers and challenges faced by individuals with IDD when they try to use ICTs and access online content. The project members were also tasked with coming up with a series of recommendations as to how to improve existing accessibility guidelines in terms of their consideration of the needs of people with IDD. Another goal was to provide support to people working

as designers, digital content creators, web and software developers, who are trying to design more inclusively.

Problem Statement

To date there has been very little consideration of the barriers that individuals with IDD face when trying to use ICTs and access online content. There seems to be only sparse research available on the barriers faced by the IDD population in the published, peer-reviewed literature. This project will attempt to determine what the barriers are, based on the published literature, and whether, in fact, there is a gap in the literature on this subject and whether there is a need for additional research to address any gaps. It will also look at the alignment between what the literature states are the barriers to ICT access faced by individuals with IDD and what those individuals identify as barriers, based on consultations with them.

Research Questions

- Does the experience of individuals with IDD regarding digital technology use align with the findings of the scoping review?
- How can the experiences of individuals with IDD who use digital technologies inform the decision-making process around the design of that technology and content?

Literature Review

It has long been assumed that the needs of all individuals with disabilities can be addressed by existing web accessibility guidelines such as the Web Content Accessibility Guidelines (WCAG). However, this assumption has not been adequately tested in the case of individuals with intellectual and developmental disabilities (IDD), an umbrella term for individuals with unique diagnoses and needs who often have comorbidities that can complicate the process of providing them with the services they need. Intellectual and developmental disabilities are disorders that are generally present at birth, and which affect an individual's physical, intellectual and/or emotional development. These conditions often impact multiple bodily systems. Intellectual disabilities start prior to a child turning eighteen and are characterized by differences in intellectual functioning and intelligence, including the ability to reason, learn, solve problems and adaptive behaviour such as social and life skills (National Institutes of Health, 2021). They may require support in various areas to ensure that they are able to fully participate in all aspects of life (Shogren, Luckasson & Schalock, 2014; Thompson, Bradley, Buntinx, Schalock, Shogren & Snell, 2009; van Loon, Claes, Vandevelde, Van Hove & Schalock, 2010; Wehmeyer et al., 2008). Developmental disabilities are a larger category of conditions associated with lifelong challenges that can be intellectual, physical or both intellectual and physical (National Institute of Healths, 2021).

With the advent of the pandemic, it became increasingly important to determine whether there was a gap between the kinds of access that individuals with IDD currently had to Information and Communication Technologies (ICT) and online content, and whether that access was hampered by technological (e.g., inaccessible hardware and software, inaccessible content) or other types of barriers. The opportunity to explore the issue arose when Surrey Place, an organization that serves the needs of individuals with IDD, approached OCAD University to partner in a project on the accessibility of ICTs to the IDD population. The project was focused on investigating any ICT barriers that were encountered by the IDD population. However, there was some overlap between what was classed as a technical barrier

(e.g., troubleshooting problems with installation of new application) and what was a non-technical barrier, such as not having the necessary skills or opportunities to use ICTs, which could translate into inadequate supports, such as inadequate help (e.g., inaccessible help features on websites of software manufacturers' websites) in addressing problems with technology or learning new technology. This literature review focused on

- technical barriers (e.g., inaccessible software and hardware interfaces),
- types of supports that individuals with IDD needed to become proficient and confident users of ICTs, and
- significant non-technical barriers that may represent a primary barrier to ICT access (e.g., rural or remote locations (no broadband or Internet is available), financial cost, no government support).

Technical Barriers

Most studies that were discovered during the literature review were observational, that is, they involved observations of individuals with IDD interacting with technologies, and focused on how those technologies could be used to support a particular goal, such as, the teaching of daily living skills (Alquatani & Schoenfield, 2014; Naslund & Gardelli, 2013). They provided no insight into what aspects of the technology were inaccessible to the IDD population (e.g., buttons on the interface were too small and presented a barrier to individuals with fine motor skill deficits) (Kagohara, 2010). There were a small number of studies that discussed technical barriers directly. These were generally usability studies of a particular technology that was designed specifically for the IDD population.

Technical Supports Needed by IDD Population

Like members of the non-disabled population people with IDD require training to use technology (ongoing), as do those in their lives that support their technology use. These supporters are often family

members, friends or teachers (Abu Alghayth, 2019). Most individuals with IDD will require a support person(s) to facilitate their use of technology, to a greater or lesser extent. These individuals should also be able to access training in ICT use, as needed. However, as the primary concern in this project was with ICT accessibility to people with IDD this review focused on what the literature said about the quality of training available to, or whether training was even offered to, people with IDD. There were many studies that used ICTs as training tools to teach daily living skills. Only rarely was training provided in how to use ICTs (Carey, Friedman, Bryen, & Taylor, 2005; Li-Tsang, Yeung, Chan, & Hui-Chan, 2005) and the ICTs that individuals were trained on generally technologies developed for the IDD population, such as, Endeavor, an accessible version of Facebook (Davies et al., 2015), rather than commonly available applications like word processing programs, meeting software, or various forms of social media.

Non-Technological Barriers

Many non-technological barriers were identified in the literature and included:

- costs associated with ongoing access to the Internet or to Wi-Fi-enabled mobile devices (Hoppestad, 2007; Hoppestad, 2013; Palmer, Wehmeyer, Davies, & Stock, 2012),
- age of individual with IDD, for example, older persons are less likely to have access to the Internet (Caton & Chapman, 2016),
- gatekeeping of access to technology by support workers, parents, and others based on preconceptions about abilities of users with IDD as well as concerns about their online safety (Buijs, Boot, Shugar, Fung, & Bassett, 2016; Chadwick, Quinn, & Fullwood, 2017; Lofgren-Martenson, Sorbring, & Molin, 2015; Lough & Fisher, 2007; Sorbring, Molin, Lofgren-Martenson, 2017),

- fears of people with IDD around revealing themselves online, specifically concerns about their written communication (Williams & Cendon, 2020),
- fears of people with IDD around the technology itself (e.g., fear of batteries running out of power, getting a computer virus, software not functioning in expected ways) (Palmer, Wehmeyer, Davies, & Stock, 2012; Williams & Cendon, 2020), and
- differential access to technology based on living situation, for example, living independently in one's own home, in a group home or their family's home (Scholz, Yalcin, & Priestly, 2017).

The costs associated with Internet access and certain devices can lead families providing support to members with IDD to make the decision not to have regular Internet access or to enable wireless access on devices like smartphones.

Methodology

This project pursued a mixed methods approach. The first part of the project was a scoping review that began with a series of meetings in the fall of 2021 with individuals at the partner organization that provides services and support to individuals with IDD. These meetings introduced the uniqueness and extensive variability within the population of individuals with IDD. The nature of the needs of this population were explored in discussions with experts and staff at weekly Teams meetings and during informal discussions with parents of individuals whose children had IDD. Insights gained through these meetings helped inform the initial stages of the scoping review.

The second part of the project involved three different consultation sessions with individuals with IDD and their supporters (if needed) involving interviews with each of the participants multiple times about different aspects of ICT and barriers associated with their use. The methodology used for each part of the project will be discussed.

Scoping Review

A set of inclusion criteria were developed to determine which articles to include or exclude in the scoping review, based on the specified goals of the project. Articles that were included in the scoping review had to

- directly reference the experience of individuals with intellectual disability (ID), or the combined category, IDD, which did not individuals with cognitive disabilities who did not have IDD (e.g., dementia/aging, acquired disability, learning disability) or those whose specific disability was not provided (i.e., placed in a generic category called disability).
- directly address technological or content-related barriers (e.g., issues with the interface or website structure (e.g., layout of a website, navigation elements, interactive components) or difficulties

comprehending content (e.g., due to complexity of content, reading level of text-based content)) that users with IDD encounter.

- be available as full-text journal articles or conference papers published in English.
- be published between 2007 and 2022 given that earlier studies were more likely to reference technologies that were no longer in use or that had changed so substantively that the results would not be applicable in the contemporary context.

There were several criteria not considered relevant to this project that were not used to eliminate articles from the review. One of the rationales for not including these as inclusion/exclusion criteria was that the experts from the partner organization who were consulted from the beginning of the project suggested that the amount of literature on the topic of the ICT accessibility for people with IDD was extremely limited and using these criteria to exclude (e.g., focusing on particular methodology) articles might mean relevant material might be missed.

Articles were excluded from the scoping review if they addressed concerns beyond technological barriers or issues with content (textual, visual, interactive) contained within an application, or website. Examples of such concerns include the cost of purchasing devices or having ongoing access to the Internet, gatekeeping of access to devices or the Internet by caregivers or others, a lack of training on effective use of technology or a lack of technical support.

Search Strategy

Table 1 provides a listing of the search terms that were used in multiple searches, in different databases, covering a range of topic areas, and disciplines that were considered relevant to the project. The first set of terms were designed to identify articles relevant to IDD; the second set of terms narrowed to search to IT issues; the third set of terms searched for literature on specific topic areas and the fourth set of terms identified papers focusing on accessibility. Following a review of the articles

collected from searches of various databases in relevant disciplines, a series of Google Scholar searches were undertaken using the search terms used in the original searches and listed in Table 2.

Table 1. *Keywords Used to Search for Articles*

Terms for condition	Intellectual disability, developmental disability, intellectual and developmental disability, IDD
Internet and technology terms	Internet, ICT, digital technologies, mobile phones, social media, computer, information technology, assistive technology, computer-mediated communication, social network, technolog*
Specific areas of interest	Financial or money management, education and training, online shopping, life skills, daily living skills, e-health, online health, digital health, telehealth, healthcare, mental health, psychological assessments and services, social inclusion, sexual and romantic relationship seeking, socialization, identity formation, gaming/games, transit/transportation, wayfinding
Access to technology terms	Barriers, challenges, digital divide, digital exclusion, computer literacy or efficacy, marginalization, accessibility, usability

Table 2. *Disciplines and Databases Searched*

Discipline	Databases
Communication Studies	• Academic Search Complete • Communications and Mass Media Collection • Ebsco Open Dissertations • Directory of Open Access Dissertations • eCampus Ontario Open Library • ProQuest Dissertations and Theses • Google Scholar
Education	• Academic Search Complete • Ebsco Open Dissertations • EdITLib • Education Full Text • Education Search Complete • ERIC • ProQuest Dissertations and Theses • Google Scholar
Interdisciplinary Studies	• Academic Search Complete • Ebsco Open Dissertations • EThOS

	• OASIS • Taylor & Francis Online • ProQuest Dissertations and Theses • Google Scholar
Nursing and Health Studies	• Academic Search Complete • ProQuest Dissertations and Theses • PsychINFO • PubMed Central • PLOS • Google Scholar
Psychology	• Academic Search Complete • Networked Digital Library of Theses and Dissertations • ProQuest Dissertations and Theses • PsychINFO • PubMed Central • Google Scholar
Sociology	• Academic Search Complete • Directory of Open Access Journals • eCampus Ontario Open Library • Networked Digital Library of Theses and Dissertations • Open Research Online • SOCINDEX with Full Text • Social Sciences Citation Index via Web of Science • ProQuest Dissertations and Theses • Google Scholar

The searches of discipline-specific databases, general databases and Google Scholar allowed for the identification of fifteen articles that represented some kind of review, such as, systematic, literature, scoping, or technology-based (Ali, Hassiotis, Strydom, & King, 2012; Boot, Owuor, Dinsmore, & MacLachlan, 2018; Brandt, Jensen, Sorberg, Andersen, & Sund, 2020; Borgstrom, Daneback, & Molin, 2019; Caton & Chapman, 2016; Desideri, Lancioni, Malavasi, & Gherardini, 2021; Glencross, Mason, Katsikitis, & Greenwood, 2021; Henni, Mauru, Fuglerud, & Moen, 2022; Larco, Enriquez, Lujan-Mora, 2018; Louw, Kirkpatrick, & Leader, 2020; Mechling, 2011; Morash-Mcneil, Johnson, & Ryan, 2018; Oudshoom, Frielink, Nijs, & Embregts, 2020; Vasquez, Jenaro, Flores, Bagnato, Perez, & Cruz, 2018; Williams & Shekhar, 2019). Although these articles were not used as direct sources of data, they did provide value as they listed original research articles, in the references section, that provided access to

other articles that discussed original research on ICTs. Most of the articles identified through the search process could be described as single interventions on the part of a researcher or research team, and a few studies (N=4) involved inclusive research or participatory design projects that directly involved individuals with IDD (Bayor, 2018; Cumming, Strnadova, Knox, & Parmenter, 2014; Fisher & Sullivan, 2002; Lazar, Woglom, Chung, Schwartz, Hsieh, Moore, Crowley, & Skotko, 2018; Politis et al., 2017).

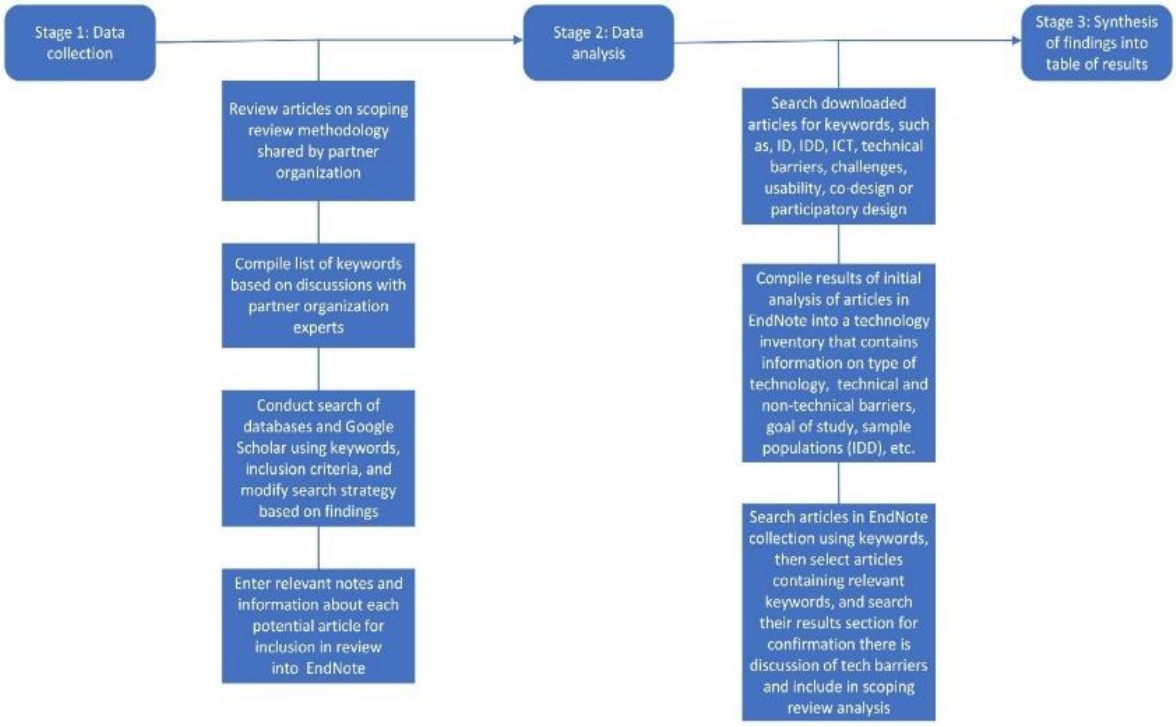
Most systematic reviews on the topic of barriers or digital inequities did not directly reference the technological barriers that the IDD population faced and referred instead to a generic category of individuals with disabilities most often focusing on the needs of individuals with sensory (e.g., visual) or mobility impairments. This led the researcher to modify the search strategy to concentrate exclusively on technological and usability barriers associated with digital devices, services, and online content. The following section discusses the data collection methods used in the scoping review and the evolution of the search strategy over the course of the project based on stated requirements of the project, and feedback from the experts at the partner organization.

Data Collection

The stages in the data collection process for the scoping review are illustrated in Figure 1. Articles were collected as PDF files and then linked with their entry in EndNote. There was a total of 248 articles in the final collection of articles that had potential to be a source of data on ICT barriers encountered by individuals with IDD. On further review, using keyword searches of all the articles in the EndNote collection, most of the articles were excluded from the final review leaving a total of 24 articles.

The first stage involved compiling a list of articles in EndNote that met the criteria for inclusion in the study. To be included in the review articles needed to focus exclusively on the experiences of individuals with a diagnosis of intellectual and developmental disabilities or simply an intellectual disability and on the use of ICTs, the Internet or virtual services.

Figure 1. *Stages of Data Collection, Extraction and Analysis*



A preliminary analysis of the articles (based on the data entered EndNote, such as, the abstract, notes discussing themes around usability or challenges associated with ICT use) revealed that many articles in the EndNote collection did not directly discuss technical barriers associated with the use of digital technologies by the IDD population nor any issues members of this population had with accessing digital content. Most articles discussed a variety of other types of barriers (not related to technical issues users had accessing technology or content) which were summarized in the Literature Review section entitled 'Non-technological Barriers' (e.g., cost of technology, gatekeeping behavior of caregivers, etc.).

Consultations with Advisors with IDD

This section discusses the methodology that was used in the second part of this project which was focused on exploring the experiences of individuals with IDD (these individuals will hereafter be referred to as Advisors) in the context of their use of both ICTs and online content. Included are brief descriptions of the recruitment and consent processes (which were undertaken by the partner

organization), the makeup of the sample population, the techniques by which data was collected, the instruments used to collect the data, as well as the processes and tools that were used to analyze the data.

Recruitment Process

Advisors were recruited from three Toronto-based organizations (Surrey Place, Community Living Toronto, the Centre for Addiction and Mental Health (CAMH)), and one national organization, Inclusion Canada. Recruitment information was sent by the Surrey Place research team to the coordinators of the self-advocacy groups, and the executive directors of each organization and these groups were asked to distribute the recruitment flier (Appendix A) to people with IDD and when appropriate to the caregivers of individuals with IDD. The student researcher did not take part in the recruitment process.

Ethical Considerations

Copies of the consent forms that were completed by each of the advisors who were described as independent ICT users (Appendix C) and for the supported users and their supporters (Appendix B). The student researcher did not participate in gathering demographic data from the advisors nor did she introduce the consent forms or complete them with the advisors (independent and supported) and supporters. This task was completed by the researchers at the partner organization during the first ten minutes of the first consultation sessions and covered all subsequent sessions. The student researcher was admitted to each of the interviews after the consent forms were completed by each of the advisors and supporters.

The participants in the consultations were provided with an honorarium which was paid after the last consultation. The decision to pay an honorarium was made by the partner organization and they oversaw the process. The student researcher did not provide any incentives to the participants. Though the original plan was for four consultations, there were only three, given deadlines around completion

of the project. All the questions asked related to the participant's ICT use and any barriers they encountered while trying to access ICT or online content.

Study Participants

Data about the advisors and supporters who participated in the second stage of the project was gathered during the consultations. Only information that seemed relevant to the discussion of ICT use in the IDD population was included in the information gathered about the advisors who were interviewed for the project. The advisory group consisted of six individuals (N=6) with an IDD diagnosis. Two were male and four were female. Five of the advisors were from Toronto and one was from Newfoundland. All the advisors could speak English and were able to read and write (to some extent) in English. All had access to some kind of technology which they used on a regular basis prior to their participation in this project. Two of the individuals were still in school, one was in high school and the other was aged 12. The other four advisors were over 18, three of them worked and one was retired. Only one of the individuals who worked indicated that she used ICTs as a regular part of her job. There were two supporters involved in the interviews: one supported the retiree who was his life partner, and the other was the parent of the child in primary school. The supporters helped their family members, if required, to answer interview questions or to respond to requests from the primary interviewer for additional information. The supporters also provided insights into the kinds of technology the person they were supporting used, their comfort level with technology, and any barriers they encountered while using that technology. All the advisors had some experience with ICTs, either with devices they owned, or those they used in the context of their work, or schooling. The list of devices (not exhaustive) that were owned by advisors included:

- laptops/netbooks,
- desktop computers,
- mobile phones (e.g., iPhone),

- drawing tablets,
- gaming platforms, and
- virtual assistants (e.g., Siri, Google Mini).

Advisors had differing levels of experience and expertise with a variety of software related to their interests (e.g., Adobe Illustrator (drawing/painting), gaming, entertainment), the technology they owned (e.g., mobile phones (downloadable games)), and their stage in life (e.g., working (MS Office Suite, TurboTax), attending school virtually (e.g., Zoom, Google Classroom)). The pandemic gave the researcher a unique opportunity to explore ICT use in the IDD population given that all the advisors in the study were compelled to use virtual services (e.g., virtual schooling, physical or mental health services, virtual shopping, virtual communication with friends and family) due to the restrictions that the pandemic imposed on their daily lives. Their experience prior to the pandemic might have been substantially different as they likely had less exposure to a variety of technologies that the pandemic necessitated (e.g., meeting software, virtual learning environments, such as learning management systems).

Data Collection

There were six interviews in the first consultation, three in the second set of consultations and five in the final set of consultations. There was one focus group in the second set of consultations that involved three advisors and one of the supporters. Copies of the interview questions for all three of the consultations are provided in Appendices D, E, and F. The student researcher virtually attended thirteen of the fifteen (two were missed due to scheduling conflicts) interviews/focus groups. The interviews were recorded in the MS Teams environment as video which was transcribed using Otter.ai software, a task performed by the partner organization's personnel. These transcribed videos were 'cleaned up' by the research team at the partner organization. The names of the advisors were removed from the transcripts, then anonymized by the partner organization's research team (e.g., from individual first

names to numbers, Participants 1 through 6). The six advisors and two supporters (number assigned to the supporter was based on number assigned to the participant they supported, e.g., Supporter of Participant 5) were referred to by the same anonymized identifier in the transcripts in each of the consultations (i.e., all three). The transcripts were also reviewed and edited to ensure that they were accurate and that mistakes in the transcription of the interviews were corrected. The recorded videos were not accessible to the student researcher. The transcriptions of the consultations were accessible to the student researcher for the duration of the project and, like the videos, were stored securely. They were made available to the student researcher in the Files section of the partner organization's Teams site that was created for this project.

The student researcher contributed to the development of the question of the semi-structured interview questions and asked some questions during the live interviews, as did other interviewers. A maximum of three researchers (generally the primary investigator (or his designate) and an additional researcher) from the partner organization participated in the consultations, depending on availability, and a maximum of two individuals from the OCAD University team (i.e., student researcher and on occasion, her MRP advisor) participated in the live interviews, depending on their availability. The student researcher had access to transcribed copies of the interviews which she reviewed after each interview with each participant. The first and second consultations were formally coded, using an inductive coding approach. The results of the first consultation were coded separately by the student researcher and members of the partner organization's research team. The student researcher began coding the contents of the interviews by hand. She then met with members of the partner organization's team to compare the results of their separate coding efforts. After one meeting they had a preliminary set of codes. The student researcher and researchers at the partner organization met one more time to compare codes and to derive a set of standard codes. After that the student researcher imported the transcribed interview files from the first consultation into a qualitative data analysis tool

called Dedoose and coded them using the standardized set of codes that were developed. The interviews from the second set of consultations were uploaded directly into Dedoose for analysis. Some minor modifications of the codes were made by the student researcher based on that second data set. Once content from the first two consultations was coded it was exported from Dedoose as MS Word files. The student researcher removed extraneous information from the exported files. The interview transcripts from the third consultation were coded using Dedoose using a modified set of codes. The third set of consultations was a more focused set of interviews meant to examine how the advisors navigated and searched websites and whether they found accessibility features on the partner organization's website helpful.

Results

The results for both the scoping review and the consultations are discussed in this section. The results of the Scoping Review are discussed first, as they provide information about the kinds of barriers that were identified in the published literature. They also act as a point of comparison between what the experts in the field of ICT design and use in the IDD population found to be barriers and what individuals with IDD within the Canadian population identify as barriers. The codes (i.e., themes around barriers and challenges faced by IDD population around ICT use) that were developed for the first and second set of interviews are shared in this section. The barriers that are identified by members of the Canadian IDD population are compared to those identified during the scoping review.

Scoping Review Analysis

Table 3 provides a summary of each of the twenty-four studies that were selected for inclusion in this scoping review. Each of the articles met the inclusion criteria, that is, they were published after 2007, dealt primarily with the direct experience of individuals who have been diagnosed with IDD, ID or DD, and focused on the technological, and online content-based barriers. It provides information on the participant sample (number of participants), participant demographics (e.g., age range of participants) and characteristics, the aims of the study and related research questions, the methodology used in the study, the type of intervention or approach used in the study (e.g., including information about whether it was specifically a usability study, or involved individuals with IDD in research or codesign processes), the specific technology, online service or platform that was developed or used in the study, and any usability issues identified by people with IDD or those providing direct assistance to them (in a very few cases). In some studies, which were more broadly focused on how ICT users with IDD used the Internet or a set of digital services, rather than a particular technology or software application, the researchers identified a wide range of issues with ICTs, rather than a few.

Barriers Experienced by ICT Users with IDD

The first step in defining the barriers that ICT users with IDD experienced was the coding of the findings to determine major themes. Codes that were derived from an analysis of the consultations with advisors with IDD are provided in Table 4. The codes were derived inductively from the responses given by the advisors to the questions they were asked, and in some cases provided by their supporters. The codes captured the challenges and barriers that individuals indicated they faced when operating ICTs and accessing online content. The analysis also revealed that advisors demonstrated varying levels of independence with respect to how they faced challenges with technology or content. For example, some users were willing to search for solutions from a variety of sources (e.g., YouTube videos, error codes on support sections of software manufacturer websites) while others gave up quickly when faced with a problem that required troubleshooting. All individuals owned a device (e.g., mobile phone) and most owned more than one device and at least four of the advisors had access to additional devices in educational or work settings. They expressed definite preferences for certain devices they owned, or software and websites they used to pursue their hobbies and interests.

Table 3. *Studies that document accessibility or usability issues with hardware, software, or online content*

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
Alfredsson Agren et al. (2020)	N=15 (13-25 years) Mild or moderate intellectual disability.	To explore and describe access to the Internet and how it is used among adolescents and young adults with mild and moderate intellectual disabilities in everyday lives.	Observations and interviews	Internet accessible devices (e.g., smartphones, laptops, desktops, game consoles, tablets)	Frequent updates and security features on Internet-enabled devices impacted usability.
Amor et al. (2021)	N= 582 (<21-45+ years) IDD	To explore the perceptions of Spaniards with IDD during the lockdown with respect to four topic areas: access to information, emotional experiences, effects on living conditions, and access to support.	Survey questions	Online education during pandemic (living experiment)	Almost half of students surveyed were unable to follow online education though more than half received educational supports, professional supports were lacking.
Auger et al. (2014)	N=5 (20-54 years). Two participants had IDD.	Aim of study was to identify the essential features	Semi-structured interviews, usability testing,	Mobile shopping applications: AbleRoad and Jaccede.	The Touchpad method of locating stores made the application more difficult

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		in content and usability of mobile applications, with the goal of ensuring needs of individuals disabilities (including those with communication or cognitive disabilities) are met.	questionnaires (e.g., usability)		to use. Terminology used could be difficult to understand (e.g., multi-level access). Use of different rating scales was confusing (e.g., dichotomous (yes/no), nominal, ordinal, numerical, ratio scales all used). Preferred large text options, 'easy to read' formats. Too many steps are required to achieve a goal.
Barlott et al. (2020)	N=10 (21-58 years) All had ID.	The purpose of the study was to investigate the experiences of people with ID using ICTs. Research Questions 1) What are the experiences of people with ID using mainstream ICTs? 2) In what ways do ICTs foster social	Semi-structured interviews. A pictorial guide of ICT devices was used during interview.	A variety of devices were discussed. Seven respondents used a mobile phone (five a smart phone, two basic phone), three used a tablet (only one had Internet connection). Cameras, video game consoles, and radios were used by a third of participants, only one or two participants used MP3 players or laptops. No identifiable differences	Technical factors impacted independent use of technology. Interfaces too complex, too great a reliance on text-based communication to communicate with others through social media, for example. Having to learn new technology was also a barrier. May be related to fact that most respondents were not primary users of

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		connectedness for people with ID?		in use existed based on age or sex of respondent.	technology, nor were they owners, so they had fewer opportunities for practice. Also lacked training on technology use. Supports (people) often did not help person with IDD learn to use technology or guide them through challenging aspects, instead they did tasks for them (e.g., downloading music).
Bridges et al. (2020)	N=3 (19-36) Moderate to severe IDD.	To examine the effects of using AR to improve independence in completing daily living skills: ironing, bed making, and setting an alarm clock. Research Question: Does the use of AR increase the percentage of steps completed independently	Task analysis.	Augmented reality (e.g., video modeling for daily living skills delivered on mobile devices using HP Reveal app)	Larger font required by some participants. Issues with activation of video models if individual stood too close or far from target on floor. Issues with time over which device had to be held to view entire video. Some issues transferring knowledge of how to set alarm on test device (iPad) and individual's own device (phone) resolved with practice.

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		for individuals with IDD in completing daily living tasks?			
Chalghoumi et al. (2017)	N=6 (41-58) IDD.	The aim of this study was to explore the attitudes and behaviors of persons with IDD about their privacy when using IT.	Series of semi-structured focus groups.	Internet, app, and device use (e.g., tablets)	Participants had difficulty understanding what a "password" was in fact. Most used term for a security feature (e.g., passwords) can have negative impact on usability of technology. Participants were more familiar with terms like "PIN" or "code." Passwords were usually saved on their devices, leading to issues when they wanted to access applications or services online when away from home. Caregivers tended to set up security features on devices. Appears people with IDD have limited autonomy re: IT use, specifically in area of protection of personal information.

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
Cumming et al. (2014)	N=4 (only data on age was that sample limited to older women) ID.	Aim of the project on research skills training was to identify the level and nature of support needed by aging women with IDs to actively participate in a research team.	Inclusive research skills training and use of device as a research tool by people with ID to enable them to participate in research more equitably.	iPad (e.g., basic functions, keyboard, iBooks app, Pages app, tactile navigation, making and listening to recordings, storing, and editing photos, camera, iTalk, etc.)	One researcher with ID discontinued use of iPad over two-year period of project while other three increased their use. One participant refused to use the stylus, even though it was recommended, given she had fine motor skill difficulties. The device cover also made it difficult for her to use the iPad.
Davies et al. (2015)	N=12 (20-45) ID.	Purpose of this study was to describe the development and initial testing of a prototype interface for Facebook called Endeavor Connect, designed to support independent Facebook use by people with an intellectual disability.	Usability testing using touchscreen computers.	Endeavor Connect/Facebook and common tasks. Applied best practices to development of Endeavor Connect (e.g., use of audio prompts, familiar voices, uncluttered interfaces, consistent design, error minimization techniques, options for user customization). Eleven participants completed all five Facebook tasks when using Endeavor Connect. Only four participants	There was some confusion as to which button to push to complete a task based on ambiguous verbal messaging. More assistance was required when text information was involved (e.g., typing a post). Fewer issues when participants were able to audio record their voices and listen to playback from posts in Endeavor Connect.

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
				used mainstream Facebook interface.	
Havousha (2016)	N=12 (>21 years) IDD.	Research Questions 1) What are the usage features of *Net Haver* as expressed in collaborative activities performed by residents with IDD in terms of duration and modules of operation? 2) Do residents with IDD report *Net Haver* to be usable in terms of their interest and enjoyment, perception of competence, choice, tension, and pressure? 3) Do residents with IDD report *Net Haver* to be usable in terms	Usability testing, questionnaires (Intrinsic Motivation Inventory (IMI), System Usability Scale (SUS)), and interviews.	*Net Haver* – accessible social media platform	Participants had limited attention spans and their interest in the interface faded over time, leading to frustration, and a desire to move on and do other things. Users with IDD had difficulty composing messages even with ready-made utterances. Navigation was described as 'awful' by some communication aides. Other communication aides found it difficult to follow the sequence of events in message threads as they could not see previous message threads, and there was no listing of date/time a message was submitted. Another communication aide indicated that the icons were small. Reliance on typing to interact with system was considered problematic

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		of its usage requirements? 4) How do residents with IDD perceive *Net Haver* in terms of the usage experience for communication purposes?			by another aide who said she did all the typing while the person with IDD told her what to type. One resident noted that the platform did not work well with other assistive technology she used. She typed her comment on her own device and her communication aide retyped it on *Net Haver*.
Kumin et al. (2012)	N=10 (19-29) Trisomy 21 form of Down syndrome.	The aim of the study was to conduct a usability evaluation of multitouch devices by individuals with Down syndrome.	Demographic questionnaire, observations, user testing.	Multi-touch tablet computer using Facebook, email, etc.	The virtual keyboard presented challenges when the user switched from uppercase to number mode. Security features problematic (e.g., passwords) Reliance on typing was a barrier (given slow typing speeds of some and variation in typing styles, e.g., all fingers on both hands, a few fingers on both hands, use of a single finger on one hand, or using different fingers for different roles

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
					[e.g., one finger dedicated to striking spacebar]). Lack of familiarity with interface inhibited use
Kydland et al. (2012)	N=12 (20-56) ID.	The aim of the study was to examine the experiences of people with intellectual disabilities who learned to use the selected social media tool, Flickr. Research questions include 1) What are the activities people with disabilities become engaged in when using Flickr? 2) What supports do people with intellectual disability require to engage in use of Flickr?	Semi-structured interviews.	Flickr was used in the study along with supports around logging in, uploading pictures, adding pictures to a group, commenting, and searching for photos.	Language was a barrier for those who could not read English. Participants also had issues logging in and searching for photos (around the specificity of their searches).
Lake et al. (2021)	N=9 (29-42) IDD.	The aim of the study was to	Semi-structured interviews.	Online mental health services	Online information about COVID was too

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		explore the health and well-being of adults with IDD, including supports that would be most helpful during the pandemic, from their perspective.			plentiful and too difficult to understand for those with limited reading ability (e.g., big words). The information could also cause distress. One participant suggested using pictures to convey information. There was also a general desire for information to be customized to the individual's needs.
McClimens et al. (2008)	N=3 ID.	Aim of the study was to examine the means and methods by which participants with ID were able to manage their online and offline personas in blogging applications.	Interactionist ethnography	Blogging applications	Users had issues with the applications' reliance on the writing ability of user.
Ramsten et al. (2020)	N=11 (22-31) Mild to moderate ID.	Aim of study was to describe the use of ICT from the perspective of young adults with ID.	Semi-structured interviews.	Variety of applications	Inadequate support led to less frequent and varied use of devices. For some reliance on traditional literacy skills (reading) made use of

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
					devices problematic (e.g., Internet searches).
Rocha et al. (2012)	N=10 (19-44) Mild to Moderate ID.	Aim of study was to highlight the importance of an easy identification of selectable contents (text and images) on the web pages for people with ID.	Usability testing (i.e., direct observation, video recording, eye tracker device)	Researchers built two websites based on W3C accessibility guidelines. One website used an image navigation menu (INM), the other a text navigation menu (TNM). Participants were broken into two groups and performed two tasks, one on the INM website, one on the TNM website.	The TNM did not capture the participants' attention. Cartoonish navigation images were looked at and selected more than text only menu items. Those participants with limited reading ability had difficulty using the TNM. Audio help was very valuable for individuals with limited literacy. Participants also had difficulty handling the mouse.
Rocha et al. (2017)	N=20 (19-44) Mild to moderate ID.	The aim of the study was to investigate the factors affecting usability, by comparing the user-web interactions in two different search engines (Google and SAPO) and documenting the	Case study comparing usability of Google to SAPO search engine.	Testing of usability of two search engines (Google and SAPO). Technology used included an HP computer and keyboard, optical computer mouse, headphones with a microphone, and an eye-tracking device called Tobii Eye-Tracker X50, camera, and Clear View 2.5.2 software.	The SAPO search engine was confusing to use for participants who often got lost (could not locate search field) and were even unable to find tools to repeat a search. This interface also provided too much information, resulting in visual clutter. Users with better literacy (but not more tech

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		difficulties encountered.			experience) performed better on SAPO. Participants had a harder time completing the tasks using the speech-based application than the keyboard. May be attributable to issues with speech recognition software. Although interaction with the keyboard was never autonomous and users required help to replicate keywords written on paper. Popup advertisements were seen as distracting.
Setchell et al. (2021)	N=10 (23-58) ID.	The aim of research was to enhance understandings of the relationships people with ID form with technology by critically analyzing the underlying assumptions of	Post-qualitative theory driven research on cultural significance of emotion as method of data analysis. Uses data collected from previous research conducted by one of the authors that explored experienced of	Variety of devices with Internet connection (e.g., mobile phone, computer)	Literacy levels of some participants made it difficult to interpret results of searches. Specific issue was use of 'complicated words.' Connecting hardware (game consoles) to the Internet was another issue that prevented use. Another user who never had a computer struggled to turn one on.

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		inclusion practices. Research Questions 1) For people with ID, how do feelings attach to technology? 2) How are experiences with technology affected by the fit between a person with ID and their ICTs?	people with ID in context of ICT use.		
Shpigelman & Gill (2014)	N=58 (all 18+) ID (e.g., Down syndrome).	Aim of study was to collect information on how users with ID use Facebook to connect with family and friends and how to make social networking sites more accessible to such users.	Online survey consisting of 52 questions about how participants use and perceive of Facebook.	Survey directed to people with ID on how to develop an accessible Facebook	Issues with requirement for literacy Frequent updates made software less usable. Privacy settings impacted usability.
Spencer et al. (2021)	N=10 (all 18+) ID.	Aim of study was to discover how postsecondary students with ID	Semi-structured interviews that were conducted over Zoom	Postsecondary education interrupted by pandemic with rapid transition to online learning.	Too little support provided to learners around technology use

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		adapted to online learning during pandemic.			with transition to online delivery with pandemic.
Sumner et al. (2020)	N=22 (intervention group) (22-36 years) Mild to moderate ID.	The aim of the study was to assess the effectiveness of providing mainstream intelligent personal agents (IPAs) to people with ID. Research Questions 1) What are the experiences and opinions of individuals with ID who are given IPA technology. 2) Do IPAs lead to quantitative changes in sense of agency and wellbeing?	Semi-structured interviews on device use and daily life were conducted with individuals with ID.	Intelligent personal agent (IPA) in relation to individuals with ID in terms of use in daily life.	Issues with intelligibility of speech and remembering IPA phrases (but issues could be overcome with practice, time)
Tanis et al. (2012)	N=180 (< 17-40+ years) IDD.	Aim of study was to gather information from people with IDD about their ICT	An online survey program called QuestNet was used to collect data. Questions were	Online survey system designed to address needs of IDD population.	Among current computer users the two most cited barriers were: lack of support (specifically a dedicated

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
		through use of a cognitively accessible, Internet-based, multimedia self-report survey system.	presented one at a time and could be answered by choosing from several icon-driven options. Questions were formatted in large font sizes with the option of having the question read aloud. Auditory and visual cues are provided to help IDD user navigate the survey.		support person) using the computer and maintenance issues. Among non-computer users who indicated a need for a device the complexity of the device or interface and knowledge on how to make it work was cited as a barrier.
van Holstein et al. (2021)	N=15 (people with ID) Mild to moderate ID.	Aim of study was to show that while digitization of services has offered new opportunities to people with disabilities it has also resulted in new barriers to their inclusion.	Two components: the first semi-structured interviews with ten people with ID, in addition to professional groups supporting these individuals, and the second component consisted of quarterly conversations with a group of research advisors with ID.	Digitization of services (i.e., digital pay systems, public transit e-ticketing, and public library digitization) and impact on people with ID	Issues with contactless payments given bank sends text messages to user (with frequent small purchases) which may be difficult for user to understand and interpret given limited literacy skills making it harder to manage money (as compared to paper-based account book). Application process for transit passes requires that user go online, print

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
					out a form, fill it out, then post it online. The use of digital library services is also problematized by their complexity and the sharing of personal information with librarians if a user with IDD requires their assistance. Authors suggest that digitization of paper-based forms adds layer of complexity for users with limited literacy skills, like those with IDD. Security of personal information was seen as better served by password management software on personally owned devices (which not all respondents had). Digital content services were also an issue as they required sign up by user and interfaces were often a challenge (small type, navigation challenges).

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
					Self-service check-out machines in libraries reduced f2f interactions between users with IDD and library staff making use of library services less easy.
Vereenooghe et al. (2021)	N=12 (30-59) Mild to moderate ID.	The aim of the study was to explore the acceptability of online mood management websites originally designed to address needs of general population to people with IDs.	The study used a cross-sectional qualitative study design using interviews with adults with IDs and observation of these individuals as they used an online mental health intervention. Interview guides focused on six themes: critical appraisal of structure, design, and content of intervention in terms of website login areas, website navigation, website interaction, personal	Mental health applications moodgym and iFightDepression	Text-based aspect of the applications an issue specifically the amount of text, use of technical terms, foreign words (study conducted in Germany), and long words. There was better comprehension when text was read aloud by support worker, so providing audio equivalent for text or formatting text for accurate translation from text to speech recommended. Users expressed preference for easy reading formats, but some still found font sizes too small.

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
			preferences, and required support.		Users demonstrated a preference for realistic pictures in the depiction of emotions rather than generic drawings or symbols (e.g., photos of people with specific expressions or showing body language). Users demonstrated preference for video alternatives to text-only content. Cognitive demands (i.e., attention required) of the programs limited frequency of use. One respondent said he could not use it more than twice a week for two hours. Users experienced varying levels of difficulty empathizing with the virtual characters' problems. Some had a high level of investment in virtual characters, others did not. Related to the demonstrative tone used (e.g., use of

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
					unfamiliar colloquialisms, personal affect that seemed 'too positive' for someone seeking help). Users had differing levels of computer efficacy and familiarity with technology. Some users had difficulty navigating the site (i.e., had problems moving between pages and clicking on text fields). User ability to orient themself on the site varies (i.e., track their progress on various modules). One user suggested that the program could provide a summary to help users orient themselves (to remind them where they stopped during their previous session). Several participants did not understand the purpose of the program. Some attributed this to their difficulty reading

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
					the content. These difficulties lead to reduced motivation to explore the program. A specific demotivator, the fact most information was delivered in text-only format.
Wu et al. (2021)	N=34. Twelve had IDD.	The primary aim of the study was to determine whether people with IDD require different design considerations than people without IDD.	The study used an experimental approach to evaluate user performance across different visualization designs along with semi-structured interviews to determine user preferences. There were two phases to study. The first phase examined time series data framed as budgetary analysis, followed by interviews. Second focused on proportion data	Created data visualizations and evaluated their accessibility to people with IDDs, Psychiatric experts specializing in IDD and self-determination identified two important data types to ground the study: time series budgetary data and proportion demographic data. They asked users to perform four tasks related to these data types: trend estimation and extrema identification in time series data and value estimation and comparison in proportion data.	People with IDD struggled to estimate quantities with pie charts and were more than twice as accurate with stacked bar charts. Bar charts were seen as more visually appealing than line graphs by IDD users. One user described the 'rising bars as like steps and stairs, helping them to see where it goes'. Described by authors as preference for systematic progression through values in data visualization. The preference for the pie chart by IDD users was related to parallel

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
			framed as demographic analysis, followed by interviews with users. There were four independent variables: chart type, chart embellishment, data continuity, and ability level. And two dependent variables: task completion accuracy and response time, across all four analysis tasks. Each visualization was constructed using a configuration of one of the five target chart types (two time series - line graphs and bar charts and three proportion charts – pie charts, stacked bar charts, tree	The authors used chart embellishments to test the effects of semantically meaningful pictorials including icons and chart junk, compared to classic marks. Also examined how visualizations did or did not support working memory and spatial reasoning by comparing continuous (stacked bar graph) to discrete (stacked isotype) marks. Examples of imagery used to test embellishments included cartoon-style scalar vector graphics (SVG). US dollar signs were used for time series data (all participants lived in US) and for proportion data simplified human silhouettes were used. Abstract marks had no embellishments. For example, bar charts contained only bar marks. Chart junk consisted of single colour background image aligned with basic	imagery in real world, for example, the pie chart was seen as easier to interpret because it resembled a pizza or clock with different colours, separated into slices. Despite preference for pie chart, users with IDD had difficulty estimating quantities from pie charts. Visual embellishments could add interest and increase engagement but could also overwhelm the user. For example, when icons were used in visualizations error rates increased marginally in estimations of extrema. Users with ID perceived embellishments positively, while those with autism tended to prefer abstract visualizations over embellished ones (e.g., preferred visual simplicity). Users

Study	Participant #/Age/Diagnosis	Study Aims/Research Questions	Methodology	Technology/Intervention	Usability/Accessibility Issue(s)
			maps), three embellishment types and two continuity types. Each participant was allowed to see all thirty visualizations twice.	meaning of data, for example, green cartoon stack of dollars labeled with a dollar sign for financial time series. Icons consisted of dollar signs or human silhouettes scaled to match the size of the abstract marks. Plain language was used in providing instructions to users during the testing phases. For example, a question about extrema was 'Which year has the highest spending?'	performed better when visual information was chunked (e.g., presented as bar graphs in which users were able to count points in bars with close values that helped them compare values that were further apart). However, use of this approach may encourage users to second-guess their first response.

Table 4. *Parent and Child Codes Derived from Analysis of First Consultations*

Parent Code	Child Code(s)
Digital Autonomy	• Independence or lack of • Online Activities • Hardware Setup • Technology Problems • Troubleshooting Technical Issues • Updating, Changing, or Installing Software
ICT Self-Efficacy	• Confidence/Comfort • Lack of Confidence or Comfort
Internet Access	• Limitations to Access
Assistive Technology/Accommodation	• Challenges • Coping Mechanisms • Overcoming complexity (e.g., layout, content, navigation, task) • Literacy • Negative Online Experiences • Preferences (text vs. visual vs. audio) • Task Complexity • Typing
Devices	• Owned/Not Owned • Preferences (for specific devices) • Task Specific Use (e.g., iPad for art)
Solutions	• Technical solutions / workarounds (arrived at by IDD ICT Users)
Online Activities	• Banking/Challenges • Communication/Challenges • Information Seeking/Challenges • Shopping/Challenges • Work/Challenges • Entertainment • Health and Safety • Recreation
Security-Related Concerns	• Device Shutting Down • Hacking • Malware Issues
Specific Support	• External Support (e.g., companies, professional) • Internal Support (e.g., partners, family, friends, support workers) • Technical Help (e.g., vendor website)
Training	• Type (e.g., software)

These codes were a result of the work that was done independently by the student researcher and later verified by the research team at the partner organization.

The student researcher had slightly different goals than the partner organization so kept certain codes that they discarded, refined other codes (adding additional child codes), or added additional parent codes during the second round of coding that took place after the completion of the second set of consultations. The codes that resulted from this second set of consultations are summarized in Table 6. They represent the themes that arose from the second set of consultations with the advisors about the challenges they faced while using ICTs.

The challenges that were identified by advisors in consultations one and two were combined and included:

- challenges with a variety of online activities (e.g., searches, communication, shopping, reading),
- poorly designed interfaces and content,
- task complexity,
- problematic software updates/installations,
- limited availability of content in preferred alternative formats, and
- difficult to manage security features.

The challenges associated with searches include:

- frequent spelling mistakes that required a spell check feature as part of browser, or use of a third-party tool (may or may not be assistive technology) like Grammarly,
- fact that most relevant information was not displayed first in the search results, according to advisors,

- inability at times to find the right search term, and
- struggling to use speech-to-text software given issues with pronunciation of certain words.

Challenges with shopping were mainly associated with advisors not understanding certain numerical values like decimals, or portions of a larger unit (like kilograms) and not wanting to make mistakes and thus, avoiding online shopping because of concerns around making errors.

The third set of challenges was related to reading content online and struggling to:

- read text-based information as the font sizes were too small,
- understand certain words (e.g., long words, specialist terms),
- read poorly formatted content (e.g., too much text in long paragraphs), and
- find a text-to-speech software (built-in or an add-on) that they liked and was affordable.

Challenges with online communication related to use of the chat feature in certain meeting software like Zoom, and challenges around navigating changes to the interface when the user needed to use the software as part of their job or education.

Poor design was another factor that negatively impacted the usability of ICT and the accessibility of online content. Examples of poor design could be found in the navigation elements and hampered the advisor's ability to orient themselves on a website and find the information they wanted, relatively quickly. There were certain design elements they felt would improve their experience of navigating a website or application, such as, uniform approaches to navigation between different applications and consistent navigation within an application. Another example of poor design that was frequently cited was text that was densely packed, that was not chunked, nor separated by enough white space.

Another type of barrier faced by the advisors related to tasks that involved too many steps, such as, completing one's taxes, or trying to purchase and install software, such as anti-virus software, a

process that could involve many steps (e.g., such as asking the purchaser whether they wanted to add additional products to their order) that were hard to follow. Complications could arise, such as having the email from the software manufacturer being sent to the spam folder. There were a variety of issues with software updates and installations for example:

- receiving them in non-preferred formats (as downloads rather than a physical object like a CD).
- being inundated with irrelevant information when purchasing software online.
- struggling to become used to changes to the interface that could be disorienting (e.g., changes in the colour scheme or location of controls).

All the advisors were able to read and create text to a greater or lesser degree, but most struggled with some elements of both reading and typing. They preferred to access content that was in alternative formats to text, such as images, or audio. Content presented as video was problematic for at least two individuals who indicated that they had to view video repeatedly to fully grasp the content. Having the ability to pause the video and review it was a valuable feature. When conducting online searches many advisors chose to use speech-to-text software (e.g., through virtual assistants like Siri) rather than type text into a search window.

Security-related issues and features constituted another type of barrier for some advisors. Concerns about encountering viruses on websites could cause someone to curtail a search. Having to enter in a security code to recover access to an account could also negatively impact access to the online environment, given the complications that could arise, such as, requesting a password reset multiple times because the email containing the reset code or link to reset a password was sent to the Spam or Junk folder. This might lead the advisor to use the wrong code (given that multiple emails were sent). The two-part authentication process was also found to be cumbersome by at least one of the advisors.

Table 5 contains the codes that were developed as part of the final data analysis process following the third consultation. That consultation focused on the advisors completing a series of tasks that included:

- commenting on the usability of an accessibility tool kit that was embedded on the partner organization's website,
- finding specific items (e.g., specific terms, location of search icon) on the partner organization's website,
- identifying any barriers they encountered on the partner organization's website, and
- sharing any barriers encountered while searching for jobs and understanding content on a job bank site (e.g., Indeed.ca, Government of Canada job bank).

The advisors who were still in school were asked to lead a walkthrough of a site that they commonly visited, and they were asked to discuss the features of the site that they liked and why they liked the feature or the site.

Table 5. *Revised Parent and Child Codes from Third Consultation*

Parent Code	Child Code
Computer Self-Efficacy	• Performs regular maintenance (e.g., delete files, empty trash) • Manages updates/installs • Troubleshoots before seeking support
Accessibility Aids	• Types of aids used • Challenges associated with using accessibility features or tools • Reasons for not using accessibility features or tools (including non-technical)
Searches	• Challenges (e.g., typing in search words, finding right word, spelling mistakes) • Individual solutions
Reading	• Challenges (e.g., website content, understanding technical terms, jargon, etc.)
Communication	• Challenges (e.g., setting up audio, video, getting into meeting (URLs))

Parent Code	Child Code
Ineffective Design	• Navigation • Layout • High cognitive load (e.g., multiple steps associated with a single task) • Content formatting
Task Complexity	• Multiple steps required to complete task
Content Format Preferences	• Audio • Visual (e.g., video or images)

Table 6 contains the results of the analysis of the data from the third set of consultations. This set of consultations focused on issues with website structure, navigation, and content along with the effectiveness of assistive technology built into the partner organization's website. This data set was only available (as transcribed files) during the last week of April 2023 and though coded in Dedoose using the codes listed in Table 6, was completed rather quickly out of necessity. The results of the analysis in Table 6 are aligned with the findings in the analyses in the other two consultations.

Table 6. *Barriers, Design Issues, and Related Solutions in Consultation Three*

Barrier or Design Issue	Detailed Issue	Potential Solution(s)
Searches on websites are difficult and do not yield expected results	• Problems understanding terminology (e.g., meaning of 'remote' in context of job search) • Search does not yield expected results	• Use plain language guidelines, or create curated experiences for different types of users • Offer users curated content view (to increase relevance of results)
Reliance on text-based inputs	• Frequently misspell words during searches • Limited vocabulary makes searches challenging • Support use of other input options (e.g., audio)	• Provide error correction or contextual help and provide good integration with consumer-level tools (e.g., Grammarly) • Provide contextual help (e.g., predictive text)
Accessibility aids	• Speech-to-text results not accurate, errors are introduced • Text-to-speech reading speed too fast • Provide definitions of terms • Difficult to find on websites	• Improve accuracy of translation and provide pronunciation help • Offer user control of reading speed • Provide contextual help

Barrier or Design Issue	Detailed Issue	Potential Solution(s)
		• Display in a more prominent location on website
Functional elements on website hard to find (e.g., search engine)	• User searches through browser, not website search engine • User not clear on which function an icon is associated with	• Place search feature in more prominent location • Use icons that are common in software design
Design Issues	• Reading level of resources on website too high • Website contains too much content causing confusion • Navigation scheme is complicated causing users to become disoriented • Navigation or layout is unfamiliar, not commonly used • User struggles to read content due to formatting issues (e.g., font size) • Provide content in alternative formats	• Follow plain language or easy-to-read guidelines and provide contextual help to provide definitions of words • Increase white space, chunk content, streamline interface • Offer simplified navigation schemes (e.g., site or image maps) and use HTML code to provide cues about location • Provide more content in visual or audio formats
Task complexity	• Require users to create a new account (e.g., job search) to use most features on website	• Allow users to log in with an existing account (e.g., Google, LinkedIn, Facebook)

Discussion

The first part of the discussion focuses on the results of the scoping review. The top seven barriers identified in the scoping review (based on the number of authors who cited them) will be discussed in more detail in this section and are summarized in Table 7. They are listed in descending order of importance, based on the number of articles that cited the barrier. The second part of the discussion focuses on the results of the consultations with ICT users who have IDD. It also compares the barriers that were identified by the scoping review with those that were identified by the ICT users with an IDD diagnosis. The final part of the discussion explores how designers might use the findings of this study to inform their work. Specifically, a decision tree was developed that determines whether the most significant barriers faced by the IDD population around ICT use can be addressed by using existing guidelines, such as the WCAG 2.1 guidelines, and whether there are gaps in the guidelines that need to be addressed through development of additional guidelines, or improvements of existing guidelines.

Barriers Identified in Scoping Review

Seven main barriers were identified in the scoping review analysis:

- reliance on text-based content, and input options,
- security-related concerns,
- complexity of interfaces, websites, and content,
- unfamiliar technology,
- reliance on fine motor skills, coordination, and strength,
- inadequate training and technical support, and
- high cognitive load.

These seven primary barriers are taken from Table 7, and they represent a summary of the results contained in Table 3, the scoping review data analysis.

Reliance on Text-Based Content, and Input Options

The most identified barrier in the articles that constituted the primary data sources for the scoping review was the reliance on the use of text in interface elements (e.g., text-based navigation menus), content areas, and in the types of inputs that were expected from users by websites, forms, and interfaces. This over-reliance on text-based information was problematic because many individuals with intellectual disabilities struggle with reading and writing. If there is no effort to provide content in other format types (e.g., images, video, animations, text formats easily interpreted by screen readers or text-to-speech software), as alternatives to text-based content, many individuals with ID will be unable to fully access online content or interact with interfaces that rely on text, such as text-based navigation menus. Users with IDD had the same access issues when they were confronted with an interface or website that required them to create text (e.g., blogging sites, or website forms) and did not provide alternatives to text input.

Security-Related Concerns

Security-related barriers were the second-most cited in the articles that served as primary data sources for this review. Users with IDD often struggle to recall information like a password or code from memory when using a device outside of their home environment, an environment in which passwords can be safely stored on devices, without representing a security issue. When individuals leave their homes there is a high likelihood that they will be prompted for a password or code to access devices that may be used by multiple individuals. For example, a learning platform on a shared device at a school, or a file on a shared device in the workplace.

Table 7. *Summary of Specific Barriers Identified in Scoping Review*

Accessibility Barrier	Studies Referencing Barrier(s)
Security features associated with devices, software or subscriptions impacted usability (e.g., passwords, codes, captcha images).	Alfredsson et al. (2020); Buehler et al. (2016); Chalghoumi et al. (2017); Kumin et al. (2012); Kydland et al. (2012); McDonnell et al. (2020); Shpigelman & Gill (2014); van Holstein et al. (2021)
Applications or online service do not work well with the user's assistive technology presenting a barrier to use.	Havousha (2016); Rocha et al. (2017)
Presentation of substantial amounts of information in text-based formats (e.g., health information) impacted accessibility. Specifically, the use of long words, technical terms, foreign words or phrases, and colloquial expressions.	Auger et al. (2014); Barlott et al. (2020); Bridges et al. (2020); Chalghoumi et al. (2017); Davies et al. (2015); Kumin et al. (2012); Lake et al. (2021); McClimens et al. (2008); Ramsten et al. (2020); Rocha et al. (2012); Rocha et al. (2017); Setchell et al. (2021); Shpigelman & Gill (2014); van Holstein et al. (2021); Vereenooghe et al. (2021)
Applications or online services that relied on typing as primary input and method of interaction presented accessibility issues.	Havousha (2016); Kumin et al. (2012); Kydland et al. (2012); Rocha et al. (2017)
Providing too little content in alternative formats like audio, video, images, or as interactives presented barrier to IDD population.	Davies et al. (2015); Vereenooghe et al. (2021)
Not providing images that have a connection to the real world had potential to impact accessibility. For example, photorealistic images were preferred over drawings or symbols in certain contexts.	Vereenooghe et al. (2021); Wu et al. (2021)
Font sizes used on websites or in applications were often too small, reducing readability for members of the IDD population.	Auger et al. (2021); Bridges et al. (2020); van Holstein et al. (2021); Vereenooghe et al. (2021)
Over reliance on the user's manual dexterity (e.g., fine motor skills or coordination) resulted in usability issues. For example, reliance on keyboarding skills.	Auger et al. (2014); Bridges et al. (2020); Cumming et al. (2014); Havousha (2016); Kumin et al. (2012); Rocha et al. (2012)

Accessibility Barrier	Studies Referencing Barrier(s)
Exclusive use of text-based navigation menus presented barriers to IDD users with low literacy levels.	Rocha et al. (2012); Rocha et al. (2017); Vereenooghe et al. (2021)
Complexity in information presentation (whether text or images), or providing too much information, can lead to accessibility issues.	Barlott et al. (2020); Davies et al. (2015); Havousha (2016); Rocha et al. (2017); Tanis et al. (2012); Vereenooghe et al. (2021); van Holstein et al. (2021); Wu et al. (2021)
Lack of user training and inadequacy of technical supports negatively impacted accessibility of technology.	Amor et al. (2021); Barlott et al. (2020); Davies et al. (2015); Ramsten et al. (2020); Spencer et al. (2021); Tanis et al. (2012)
Cognitive requirements associated with technology were too onerous for some users which caused accessibility issues (e.g., locating controls, operating controls that had more than one function, tasks requiring too many steps, user issues with orienting themselves in application).	Auger et al. (2014); Barlott et al. (2020); Setchell et al. (2021); Sumner et al. (2020); Vereenooghe et al. (2021); Wu et al. (2021)
Lack of user control over content display like audio or video playback caused accessibility issues.	Bridges et al. (2020);
An application or service that cannot retain user's interest may cause frustration and prompt user to move on to other activities.	Havousha (2016)
Limited customizability of an application or interface, to address user-specific needs, can reduce usability.	Lake et al. (2021)

Complexity of Interfaces, Websites, and Content

Another barrier identified during the data analysis process were the struggles people with IDD had with complexity, such as the complexity of a navigation scheme that had extensive drop-down lists, that could cause the user to become lose their bearings on a website or interface. Often the term complexity referred to text-based content (e.g., the amount of text on a site, unbroken by white space, or the reading level of text-based content, or the reliance on text-based navigation menus) although one article did reference the complexity of data visualizations, such as graphs. The IDD population is diverse and has different comorbid conditions (e.g., learning disabilities, problems with fine motor skills), in addition to their IDD diagnoses (which may vary from mild to severe). However, many individuals with the diagnosis seem to struggle with reading and interpreting textual content which means that interfaces or information sources (e.g., websites) that rely too heavily on text-based content to present information represent a significant barrier to ICT users with IDD. Add to that the use of technical jargon or specialist terminology, or content that is placed in long paragraphs and not chunked, and the difficulties faced by the IDD population, are magnified.

Unfamiliar Technology

Unfamiliar technology was the fourth-most cited barrier (based on the number of articles that referenced it) to technology use by the IDD population. Some members of the IDD population may be inherently apprehensive about technology use (identified as a non-technical barrier in the literature) and when faced with having to familiarize themselves with new technologies or with recently updated software, they may struggle to learn new interface features, and must resort to seeking help rather than acting independently. If they have a very customized setup on their devices, they may require the assistance of someone else, such as a supporter (i.e., family member, friend, or technical support person), to help navigate the new interface. If their support person is a family member or support worker in a group home, they may not have the necessary technical skills, inclination (i.e., interest in

technology), or the time to help. As a result, technology users with IDD may simply decide to opt out of using newer versions of software, or postpone purchasing new hardware, and continue to use older devices and versions of software with which they are familiar. This is problematic because it means that ICT users with IDD do not gain the benefit of the resolution of software bugs, or improvements in functionality, offered by an updated version of software. Additionally, older versions of software may become unsupported, and when that happens the individual may no longer be able to use their device.

Reliance on Fine Motor Skills, Coordination, and Strength

The fourth most cited barrier in the analysis of the articles included in the scoping review was a reliance on manual dexterity. In an intervention discussed in the scoping review whose goal was to teach individuals with intellectual disabilities daily living skills through an augmented reality application it was found that certain users had difficulty activating the explanatory video associated with objects in the environment because they had difficulty orienting themselves to the right distance from the object to bring up the video associated with the object (Bridges et al., 2020). Another issue identified in Bridges et al. (2020) by one participant involved their struggle to hold up a tablet on which the videos were displayed for the duration of playback, due to lack of strength. Auger et al. (2014) identified issues with two mobile applications that functioned as real-world shopping aids (providing information on location of stores in a mall, distance between the user and the store, selection of items in the store, etc.) specifically with the touch-based keyboard and with buttons that were smaller than the fingertips of the users. Cumming et al. (2014) also identified problems that users with IDD had with the iPad's touch features given their limited fine motor skills and pointed to problems individuals with coordination issues had using the stylus. Havousha (2016) found that participants with IDD expressed a preference for virtual keyboards or other input options like joysticks, adapted keyboards, and text-to-speech software as substitutes for the devices used in the study. Some users found the small size of application icons on the interface unmanageable due to fine motor skill and coordination problems. In documenting the

keyboarding skills of users with Down Syndrome while performing various tasks (e.g., entering a term in a search engine). Kumin et al. (2012) found that the keyboarding techniques of users were quite variable. Only one user used all fingers on their hands like a conventional typist, most individuals used one to three fingers per hand, others used specific fingers for specific keys. Which meant that the reliance of many online applications on the user's keyboarding skills would lead to a mismatch between the skill level expected by an application for optimal use, and the skill level of the user. So, applications or processes that require high levels of skill in keyboarding may present a barrier.

Inadequate Training and Technical Supports

Amor et al. (2021) identified the restrictions during the pandemic as one of the reasons that students with IDD were struggling to keep up with their peers as they had not received adequate support for working in the online learning environment. Students with IDD were left without any support from the school system during the switch to online learning. All the support they received was provided informally by family members. Non-disabled students were able to cope better in the absence of support than students with IDD who had received educational supports in face-to-face contexts prior to the pandemic from paid support workers provided by the school. Half of the students with IDD were unable to continue with their education during the pandemic even when they did receive informal support from family.

High Cognitive Load

Various technologies placed too heavy a cognitive load on users. In one study the issue was that users struggled to locate the controls on a device. However, the issue of too heavy a cognitive load was more complex than users struggling to find essential controls (like on/off switches). One study found that ICT users with IDD had problems with controls that had more than one function. In some studies usability testing of specific interventions, like augmented reality instructional videos on how to perform daily tasks, lead to the revelation that tasks that required too many steps (without providing some

reinforcement in the form of reminders, or the ability to replay interactives or videos without restriction) lead to accessibility issues. And in online services with an educational or self-development component, there were issues when the interface did not provide the user with a means to orient him or herself when returning to a session or module that remained uncompleted either due to the session ending or the user going to another area of the site or application. There are various approaches to solving this issue such as providing breadcrumbs to the user. A user suggested remedy in one article was to provide summaries of where the user was just prior to logging off.

Summary

The results of the data analysis show that many of the issues faced by people with IDD are also faced by the general population of technology users. For example, the ability to retain a complex and unique password in one's memory for several different applications and online services is a challenge that most face. There are workarounds that are used by both IDD users and non-disabled technology users (e.g., saving passwords and pins on personally owned devices, writing passwords down). Over-reliance on text-based formats to present information to users has issues for users other than those with IDD, for example, blind or low vision users, or individuals with dyslexia. Websites that do not follow broadly recommended design principles, such as those recommended by the W3C or organizations focused on usability, can result in digital content or services that are difficult to navigate and use. This is true for both the IDD user and the user without IDD. However, the user with IDD is more disadvantaged as he or she has generally had less access to technology over their lifetime than their non-disabled peers, they have less access to Internet-enabled devices specifically, and they may rely much more on others to enable their use of ICTs. Family members and supporters of people with IDD may deliberately limit their access to the Internet due to concern around their vulnerability. There is also evidence that there is not a good fit between the assistive technologies that individuals with IDD might use (e.g., text-to-speech software) in their daily life and mainstream technology and online services. It is hoped that

this review will provide the governments, institutions, and individuals (e.g., designers, decision-makers within organizations) with the guidance they need to ensure that their products, services and content are also accessible to individuals with IDD.

Comparing Barriers Identified in Scoping Review with Those Identified in Three Consultations

Table 8 compares the findings of the scoping review with the barriers that were identified in the sessions with advisors in the first and second consultations. There appears to be alignment between the findings of the scoping review and those from the analysis of the first consultation. One of the main barriers identified in the scoping review and by advisors in the consultations is the considerable reliance on text-based content and inputs of many applications and websites (e.g., completing forms,

Table 8. *Comparison of Barriers Identified in Scoping Review and Identified by Users with IDD*

Type of Barrier	Scoping Review Findings	Findings of Consultations with Advisors
Security	Security features impacted access to technology and content (e.g., passwords, codes) on part of multiple advisors in cited studies.	Security features were discussed with all advisors at some point. Only one individual identified barriers associated with security features rather than concern around online threats to security (e.g., fraud). The one person who talked about barriers to access presented by security features spoke about resetting passwords and two-part authentication. He noted that he sometimes missed emails with security codes as they were in spam folder, leading to him entering the wrong code, if he requested the reset password option multiple times.
Assistive technology (AT)	Literature noted poor integration between user's AT and the technology or service with which it was used.	Most advisors did not explicitly use assistive technology though they had personal workarounds to address challenges (e.g., using zoom feature in browsers to increase font size, or Grammarly to check spelling), exception being those individuals still in school where use of AT was required by the school. Use of technology mandated by others (e.g., schools) was resisted by one participant.

Type of Barrier	Scoping Review Findings	Findings of Consultations with Advisors
Reliance on text-based content	Many of the participants cited in studies struggled with comprehending text-based content (e.g., long words, technical terms, long paragraphs of text).	Most advisors identified reading online as an issue. Reading levels varied between individuals (due to age and other differences). Some preferred speech-to-text options when searching online.
Requirement for text-based input	Many of the participants in cited studies struggled to generate text.	Most participants cited issues with generating text-based content. At least three identified issues with spelling as significant barriers. A few identified issues with coming up with the right word but had strategies for dealing with that.
Not enough content provided in formats other than text (e.g., graphical images, photos, video, animation)	This issue came up in a variety of articles cited in scoping review. A desire for content in formats like audio, video, still images, or even interactives was cited in articles.	A desire for alternative content formats on websites (other than typing) was expressed by all advisors. However, dynamic (e.g., animations) content was identified as distracting by at least two advisors.
Font sizes used on websites too small, impacts readability	This issue came up in multiple articles.	Multiple advisors indicated that they wanted the option to increase font size (and did so using zoom features in browsers) as it helped with readability
Navigation elements problematic	Results of scoping review revealed that text-based menus were challenge for some users with low literacy.	A variety of navigation issues were identified by advisors. All expressed a desire for consistency between applications, and preferred familiar navigation schemes. Some found multiple tabs or long drop-down menus (with many options) confusing.
Lack of training/inadequate tech support	Identified as issue in several of the articles cited in the scoping review.	Most of the advisors indicated they required some support (from family, or external sources) but many attempted to solve technical problems before requesting help. None identified training as a gap, unless prompted.
Cognitive requirements associated with operation of technology presented barriers	Cited issues included difficulty locating and operating controls, specifically those with more than one function, tasks that required too many steps, users becoming disoriented on a website or in an application.	Most of advisors were quite independent in terms of their use of technology, however some indicated they had trouble with functions that had too many steps, became lost in applications with complex navigation schemes (multiple tabs) or had difficulty returning to main interface or home page

entering content in forums, as text). One potential approach to improve the understandability of text-based content on websites and text-based interface elements would be to follow a set of guidelines that was developed by Moreno, Petrie, Martinez, and Alarcon (2023). They refer to their guidelines as cognitive accessibility design patterns. Their guidelines, if followed, could address many of the issues with text that the advisors identified in the consultations. A selection of the guidelines created by Moreno et al. (2023) that could help address issues with text-heavy websites include:

- ensuring users can find the most important content easily.
- using common words.
- using simple tense.
- using literal language
- being precise and concise.

Some advisors used alternative input methods, such as speech-to-text input for searches, which was not something discussed much in the articles in the scoping review, though the review did identify the reliance on text-based input as problematic given struggles with reading of the IDD population. Another common barrier cited in both the scoping review and by the advisors in the consultations was that complex navigation that could cause the user to become disoriented in an application or on a website. An example cited by one user was that of tax preparation software, which allowed for multiple tabs to be open at once. The number of options available to users (e.g., in terms of tax forms, most of which did not apply to users with IDD, given their taxes are relatively simple) was also an issue identified by a few different advisors.

Design Recommendations

The decision tree was developed using the findings of the scoping reviews, consultations with users with a diagnosis of IDD, and discussions with the research teams from both OCAD University and the partner organization. The first step was to develop draft versions of the decision tree in the ideation tool MIRO. The second was to examine the existing web accessibility guidelines (WCAG 2.1) to determine whether they could address some or all the issues that were identified by the scoping review, and the consultations with ICT users with IDD. Tables 9 to 11 look at the alignment between various WCAG 2.1 guidelines and associated success criterion, and the barriers that were identified by ICT users with IDD.

Table 9. *WCAG 2.1 Guideline 1. Perceivable - Addresses Barriers Faced by Individuals with IDD*

WCAG 2.1 Guideline or Success Criterion	Explanation	Findings in the Consultations
1.4 Distinguishable.	Make it easier for user to see and hear content, including distinguishing foreground from background.	One user indicated that she sometimes inverted the text and background colours (background made black, font white) for greater readability. Majority of advisors were most comfortable with black text on white background.
1.4.4 Resize Text	Coding allows user to resize text.	At least three advisors indicated it was important to be able to resize the text (increase font size or zoom) to increase comprehensibility of text-based content.
1.4.8 Visual Presentation	Allow users to select foreground and background colours. Allow for resizing of text without assistive technology up to 200% in way that does not require user to scroll horizontally to read a line of text.	More than one advisor indicated that they use the zoom feature in browsers to aid in understanding text-based content.
1.4.12 Text Spacing	Addresses line height (spacing), spacing following paragraphs, letter spacing, and word spacing.	Some of the advisors in the consultations commented on the fact that many websites had inadequate white space and

WCAG 2.1 Guideline or Success Criterion	Explanation	Findings in the Consultations
		looked cluttered, which negatively impacted their understandability.

Table 10. *WCAG 2.1 Guideline 2. Operable - Addresses Barriers Faced by Individuals with IDD*

WCAG 2.1 Success Criterion	Explanation	Findings in the Consultations
2.4.2 Page Titled	Helps users to find content and orient themselves within a site by ensuring each web page has a descriptive title	Provides some redress for individuals who stated that they had difficulty orienting themselves on a website or within an interface. But relies on textual information.
2.4.3 Focus Order	Ensures that when users navigate sequentially through content, they encounter information in an order consistent with the meaning of the content. Can help individuals who have challenges reading, as they can become disoriented when tabbing takes focus to a place they did not expect.	Could address some of the needs of users who indicated they become disoriented on websites due to complex layouts and navigation.
2.4.4 Link Purpose	Purpose of the link can be determined by the link text alone.	Addresses some of the barriers that advisors indicated they face when orientating themselves within a software interface. Still relies on text-based information.
2.4.5 Multiple Ways	There is more than one way to locate a particular web page or topic within a website. For example, as a site map that provides an overview of a site or through a search feature.	Advisors indicated that they had difficulty navigating complexly laid out sites. This is one approach to addressing that barrier. The site map could be an image map that provides both image and text to the user as cues as to the kind of information or function associated with the image and/or text.
2.4.6 Headings and Labels	Help users understand what information is contained in web pages and how it is organized.	Can help those using text-to-speech software as that software uses headings to indicate structure and hierarchy

	Clear and descriptive headings are recommended.	of a site. Though text-based, they can be converted to audio by screen readers.
2.4.7 Focus Visible	Helps to orient the user by, for example, giving the active tab or text field focus, by displaying a vertical bar in the field or using some other kind of emphasis.	
2.4.8 Location	This feature provides information to the user about their location within a website, for example a site with multiple tabs (e.g., tax preparation software)	More than one participant indicated they experienced disorientation on websites, mostly on sites with complex navigation or architecture.
2.4.9 Link Purpose (Link Only)	Addresses issues that users might have when navigating a website or set of pages or an application.	Addresses user disorientation on a site (identified as an issue by more than one participant) and with having to deal with content in which they are not interested (again an issue identified by more than one person).

Table 11. *WCAG 2.1 Guideline 3 Understandable - Addresses Barriers Faced by Individuals with IDD*

WCAG 2.1 Success Criterion	Explanation	Findings in the Consultations
3.1.3 Unusual Words	A mechanism for identifying specific definitions of words or phrases used in an unusual way, such as idioms or jargon.	The issue of unfamiliar or technical terms was raised by more than one participant. Different advisors had different levels of comfort with technical terms that need to be understood when troubleshooting problems with hardware or software.
3.1.5 Reading Level.	Textual content requires a reading ability more advanced than lower secondary education.	Many people with IDD struggle with reading to some extent. The reading level cited in guidelines is probably too advanced for many with IDD. So, guideline does not fully address the barrier.
3.2 Predictable	Websites should appear and operate in predictable ways.	All advisors in consultations expressed a preference for websites and software applications whose layout and functionalities with which they were familiar.

WCAG 2.1 Success Criterion	Explanation	Findings in the Consultations
3.2.1 On Focus	Ensures that functionality is predictable as the user navigates their way through a website or document.	Advisors in the consultations indicated they didn't like unexpected actions or shifts in focus to new pages. This prevents that to some degree.
3.2.2 On Input	Changing the settings of any user interface component does not automatically cause a change of context unless the user has been advised of the behaviour before using the component.	Advisors indicated they do not like unexpected actions. This feature could be used to give them some warning when something is going to happen, such as a new window opening in a multi-form interface like a tax preparation software.
3.2.3 Consistent Navigation	Recommends consistent navigation and layout on a set of web pages (e.g., corporate or institutional site).	Advisors indicated a preference for sites that were familiar to them, software that was familiar to them. However, this feature does not prevent submenus, which is something (lengthy drop-down menus) that can make a site more difficult to navigate for this population.
3.2.4 Consistent Identification	Ensures that there is consistency in functionality of components (e.g., navigation) that are used on multiple pages within a website or throughout a software interface.	The importance of consistency and familiarity was discussed by all advisors. It is important for people with IDD to reduce cognitive load by being able to assume that the functionalities they learn on one page are the same throughout a website or application. For examples, icons that signify search or save on one page should be used consistently throughout a website or application.
3.3.1 Error Identification	If an input error is detected automatically, the error is identified and described to the user in text format	Important for the advisors as multiple individuals mentioned concern around making errors, such as misspelling words, or using improper abbreviation for a province.
3.3.2 Labels or Instructions	Provides the user with instructions or a label that helps identify the kind of data that is required in a form. Provides cues to user.	Helpful to advisors with IDD to avoid errors when completing forms (some indicate they need help when completing forms or that they find forms difficult to complete without assistance).

WCAG 2.1 Success Criterion	Explanation	Findings in the Consultations
		However, the solution provided still relies on text-based data though it could be read out with text-to-speech software.
	Provides the user with a suggestion as to how to correct an input error.	Advisors indicate they would like assistance in avoiding and correcting errors. However, it may be difficult for them to understand how to correct the error, if language is overly technical.
3.3.4 Error Prevention (Legal, Financial, Data)	Ensures that users avoid serious consequences when submitting legal and financial data by allowing for submissions to be reversed, having inputs checked for errors and allowing user to correct them, and allowing user to review and confirm accuracy of data, prior to final submission	Advisors in consultations indicated that they avoided certain activities like online shopping, or banking because of concerns around making errors. However, the feedback they receive is text-based which is not an adequate solution in case of all individuals with IDD.
3.3.5 Help	Context-sensitive help is available to user to help prevent mistakes.	Advisors indicated they would like such a feature when they are struggling to spell a word (or understand it) when completing a form or inputting text in another context (e.g., forum posting).
3.3.6 Error Prevention (All types of forms)	Ensures that users avoid serious consequences when submitting data by allowing submissions to be reversed.	Error avoidance was important to all advisors in the consultations as some were challenged with issues of spelling, finding the right word, etc.

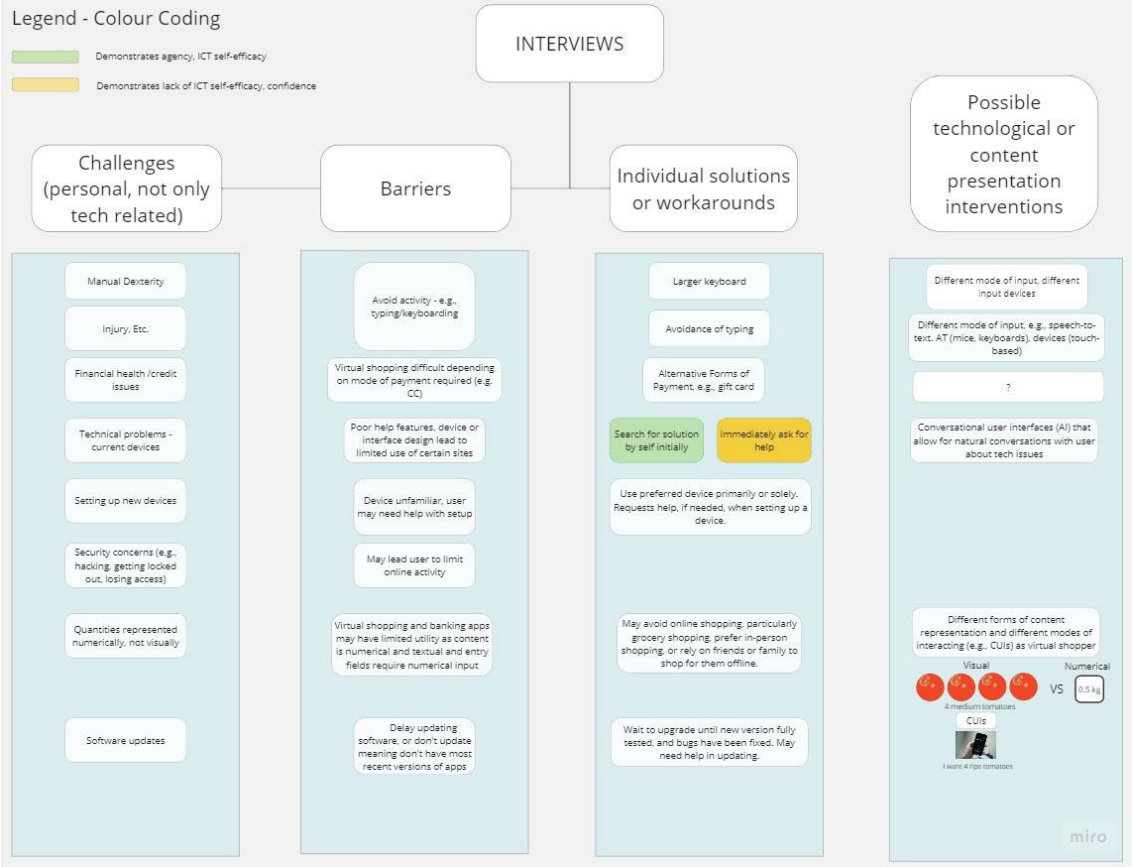
People with IDD are generally not addressed in the WCAG 2.1 guidelines though generic reference is made to individuals with some ‘cognitive, language and learning disability’ in the explanations of, and examples provided for, each of the guidelines or criterion. The guidelines tend to consider cases where an individual only has one or possibly two conditions that need to be addressed through recommendations, however individuals with IDD might have multiple conditions, such as an intellectual disability, a learning disability, a speech disability (e.g., around articulation or pronunciation of words),

and possibly some physical or mobility related issues (e.g., fine motor skill or coordination issues). The guidelines developed by the W3C do not seem able to address the needs of people with complex diagnoses. The consistent recommendation that text should be substituted for images, video and audio is problematic given that text-based content or requirements for text-based inputs are difficult for people who may have issues with reading, spelling, word pronunciation and comprehension, and text creation (in addition to issues with typing). Users with IDD will likely need content in a variety of formats and access to systems that consistently provide guidance and error correction whenever there is an interactive component (e.g., form field) on the site or application. WCAG 2.1 does provide some guidance on the importance of consistency of interface layouts, navigation schemes and icon use, but it does not really consider the needs of people who require alternate formats other than text (e.g., audio, visual).

A process of ideation that led to the development of the decision tree began with a review of the results of the scoping review, and consultations with people with IDD. Certain themes emerged from that analysis such as the fact that most of the recommendations that came out of the scoping review and the consultations indicated that what was lacking in the design of ICT and online content was the consistent application of effective design principles and existing WCAG 2.1 guidelines, where applicable. Figure 2 is an early attempt at organizing the themes that emerged from interviews and focus groups into some kind of decision-making guide. The final version of the decision tree , depicted in Figures 3 and 4, is meant to guide content creators, software developers and web designers in developing materials and interfaces that align with the needs of people with IDD. An accessible form of the decision tree is provided in Appendix F.

The decision tree is divided into two main parts, one that addresses deficits in how content is formatted and presented and the other that looks at issues with technologies (software specifically) that present barriers to the IDD population. Under the content heading the questions that designers need to

Figure 2. *Challenges, Technical Barriers, Personal Workarounds and Possible Design Solutions*

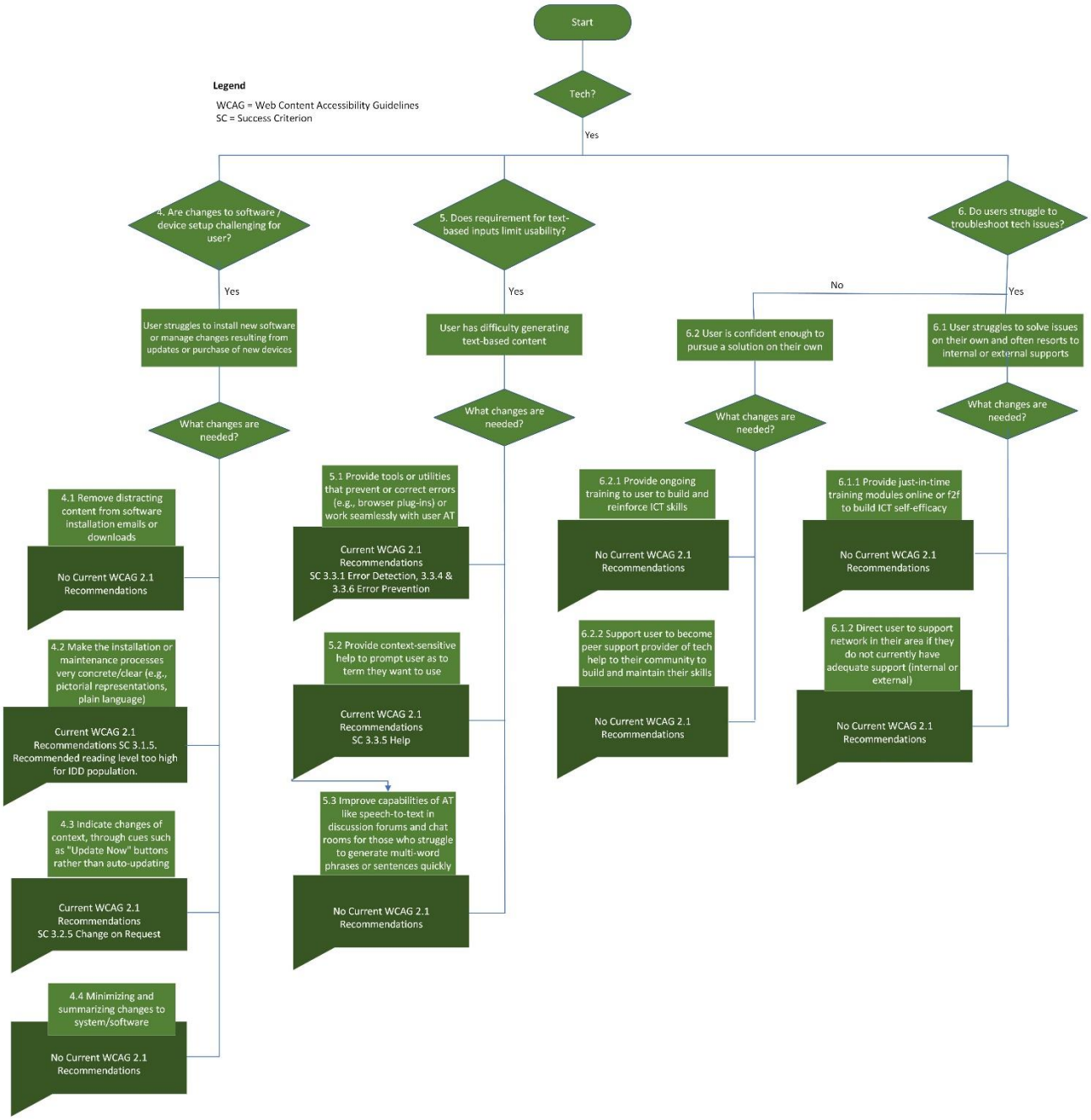


ask are whether barriers encountered by IDD users relate to the formatting of content, the organization of content, or the comprehensibility of content, or to all three categories. Under the formatting category the recommendations are to:

- ensure that text spacing can be adjusted by the user.
- allow for user to increase the font or type size or provide an option for the user to increase the size of the text through assistive technology or zoom features in common applications like browsers.
- provide the option for user to change background / foreground (text) colours or format the content in a way that it works seamlessly with assistive technology.
- provide visual or audio alternatives to text-based content.

Figure 3. *Content portion of decision tree, a tool for designers of ICTs*

Figure 4. *Technology portion of decision tree intended as tool for designers of ICTs*



The first three recommendations are supported by the WCAG 2.1 guidelines and the specific guideline or success criterion that is referenced in the decision tree is listed in both the graphical and accessible versions of the tree. The fourth item under formatting is not part of the WCAG 2.1 guidelines as those guidelines tend to focus on the barriers that are encountered by individuals with vision, hearing or mobility impairments, not individuals with IDD. The most common alternative format recommended by the WCAG 2.1 is text-based. However, textual content presents challenges to many individuals with IDD given that significant numbers struggle with comprehending text-based content and generating it (e.g., typing or keyboarding), so the recommended alternative formats for the IDD population are visual (images, animations, videos) or auditory.

The second category under the heading 'content' is site organization. Designers need to determine what aspects of current interfaces or websites with which users struggle. The design recommendations under the category 'site organization' in the decision tree include:

- importance of including visual cues (placing emphasis on active area of a website or interface).
- need for simplified navigation menu structures.
- ensuring that URLs are clearly labelled so that the likelihood that user will become confused as to their current location is reduced.
- using titles for pages.
- Importance of providing a consistent look and feel across the site.

All the design recommendations under the site organization category are dealt with, to some extent, by the WCAG 2.1 guidelines. However, two of the recommendations rely on text-based information to provide the IDD user with cues as to which page is currently open or active on a website or in an interface. This approach might not be optimal for most IDD users and finding a means other than or in

addition to providing page titles might increase the likelihood the user can figure out where they are on a site without asking someone else for assistance.

The third category under the heading 'content' is understandability which deals with the user's ability to understand (and receive necessary support) and to generate text-based content. The four design recommendations under the category understandability are.

- to use specialist terms and jargon sparingly and if they're used, to ensure a definition is immediately accessible.
- to chunk content (i.e., to not use complex sentences or long paragraphs), to use plain language, and to write for reading levels that are close to upper primary not lower secondary.
- to not require that users rely solely on text-based inputs when interacting with others online or to completing tasks online but to allow them to use other types of inputs (e.g., visual, auditory).
- to provide text-based supports (e.g., glossaries, contextual help) when the user is required to rely on text-based inputs for interaction with others or with elements of an interface (e.g., interact with chat bot, enter text into a discussion forum).

All the recommendations have support within WCAG 2.1 except for the third point that deals with not requiring users to use text-based inputs to interact with others or the system. This recommendation demonstrates the bias of WCAG 2.1 towards those with visual disabilities as that population needs text alternatives to visual content. The opposite is often true of individuals with IDD, who need concrete visual representations or auditory descriptions (following plain language principles) to perceive and understand content.

The first category under the heading ‘technology’ is focused on the barriers users face when performing tasks associated with maintaining and updating existing devices and setting up new devices. The four design recommendations under this topic include:

- exclusion or removal of distracting content from software installation emails or downloads.
- ensuring that the installation or maintenance processes are concrete and clearly explained (e.g., by providing pictorial representation of actions, a list of steps, using plain language).
- providing clear messaging, notifications, or cues to the user about the changes that have been made to the system or notifying them that they need to make changes to the system (e.g., “update now” buttons or links).
- ensuring that minimal changes are made with each update (or ensuring that users have the option to limit changes) as well as providing easy to understand summaries of the changes that have been made to the user’s system or software.

The first three recommendations are supported by one or more WCAG 2.1 guidelines or success criterions. However, the last recommendation is not covered by the WCAG 2.1 guidelines but is of importance to users with IDD given that both the scoping review findings and the accounts given by people who contributed to the consultations indicated that users preferred the familiar and would sometimes delay updates consequently. In addition, they might find the changes made during auto-updates confusing, or struggle to troubleshoot updates that were not complete. The comfort level with updates varied from individual to individual in the consultations. Advisors had differing degrees of ICT self-efficacy and comfort with troubleshooting technology problems.

The second category in the decision tree under the heading ‘technology’ was user difficulty generating text-based content (e.g., completing forms, entering in search terms, posting on forums, etc.). Recommendations associated with this category include:

- ensuring that an application was structured in such a way as to prevent or correct errors or to work seamlessly with assistive technologies that supported the user in avoiding or correcting errors (e.g., correcting spelling, prompting user to correct a mistake).
- providing context-sensitive help to the user (e.g., if they need help spelling a word correctly, or finding the right word to use in a search).
- improving the capabilities of assistive technology like speech-to-text software used in conjunction with online searches, or chat room posts, if the user struggles to generate multi-word phrases, or whole sentences quickly.

All the recommendations in this category except for the last (i.e., improving the capabilities of assistive technology like speech-to-text software) are supported by a WCAG 2.1 guidelines or success criterion. At least half of the advisors in the study used speech-to-text software as an alternative to entering text into search windows, for example. However, the accuracy of the translation from the spoken word to text was often poor, possibly due to issues that at least two of the individuals who used the software had with articulating words clearly. This is another example of how the needs of the IDD population are more complex than other groups with disabilities, and how what seems a solution, such as using voice over features offered by commercially available devices like virtual assistants, instead of a keyboard, may not work as expected.

The third category under the heading ‘technology’ is focused around whether systems and organizations adequately support IDD users when they take the initiative to solve technical issues themselves. The design recommendations here are that users be provided with just-in-time training (digital or face-to-face) to increase their ICT self-efficacy and that they be given access to supports in

their area, if they currently do not have support (e.g., family or friends, or access to support provided by an agency). These recommendations are not really discussed by the WCAG 2.1 guidelines except under the generic category of 'help'. Virtually all the advisors who took part in the consultations (interviews) had sources of support in their lives (either support workers or family members who could provide support), whom they could access, if they could not solve a problem on their own.

The final category deals with design recommendations around support systems involving users who seem confident enough to pursue solutions on their own most of the time. Some of the advisors in the study were quite knowledgeable and skilled and could, if interested, act as peer support for others. The final recommendation states that organizations that provide services to people with IDD should develop training and support programs to help build and reinforce ICT skills in already skilled individuals with IDD, and help them, if they are interested, to become peer support providers to others. There is no WCAG 2.1 guideline around providing support to individuals with disabilities, or IDD, on a systems level, nor is there any suggestion that these individuals be offered the opportunity to act as peer supporters for those who are less technically able or inclined. However, given the fact that some members of the IDD population currently have no ongoing support, providing them with peer support, along with other forms of assistance, might be helpful.

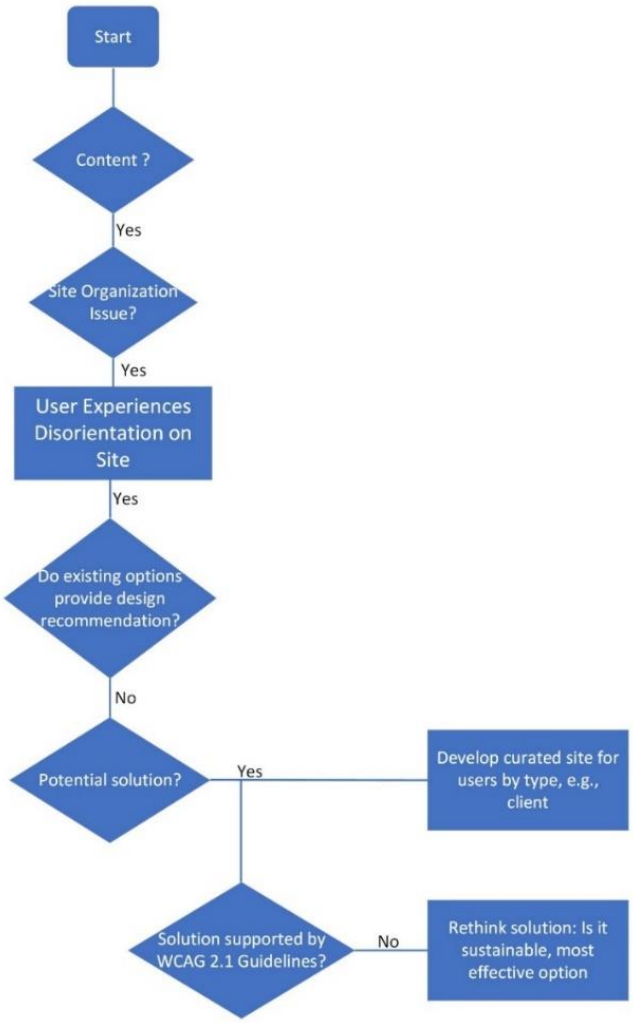
Case Studies

This section explores the effectiveness of the decision tree by evaluating it with a series of case studies that address different barriers that are encountered by individuals with IDD when interacting with online content, software, or accessing and using their devices. The subjects of the case studies range from how to support users with IDD who struggle with reading, to how to support users who avoid certain online activities, such as shopping, given problems they encounter with interpreting numerical information, or concerns about making mistakes when submitting orders or spending money on something they don't need or need in different quantities than ordered.

Case 1: Curate Content for Different Types of Users of the Same Website or Interface

Advisors in the consultations indicated that they often struggled to find content that was directly relevant to their needs and interests on websites. This could be addressed by ensuring content areas on an organization's website or within an interface were targeted to specific categories of users, if multiple types of users are known to frequent a website or use an application. For example, if specialists, clients and members of the public or media, are all expected to access the same site, then an option might be to create specific areas or curated views for each of these types of user groups. Figure 5 describes how to use decision tree to find solutions to issue of need for curated content.

Figure 5. *Flow chart of decisions related to curated content/views for different audiences*



For individuals with IDD who are clients of a service provider, the service provider's website could provide a specific area for them around the services they are likely to need and in which they have an interest. There is still the possibility that the content will be too generic, and individuals may become disinterested and stop engaging with the site, if they feel that the information they encounter is not relevant to them.

The proposed solution is not supported by WCAG 2.1 guidelines. Recommendations around providing access to people with disabilities have traditionally not recommended providing alternative sites for users with disabilities. However, this approach has been used by organizations if they have very different groups of individuals engaging with content on the same site. They are still able to access all the content on the site if they choose the view associated with a different user group.

Case 2. Create Online Shopping Experience with Alternative Representations of Numeric Quantities

The consultations with individuals with IDD revealed that they had varying levels of comfort with online shopping. Some were comfortable shopping on certain sites and bulk ordering specific items on those sites but almost all adults who participated in the consultations had some issue with shopping online. Concerns that were expressed by the individuals with IDD who were consulted about the challenges they faced with online shopping included:

- limited payment options provided on websites, particularly for those who lack a credit card (it is quite difficult for members of the IDD population to obtain a credit card as some do not work, they may have poor credit, or they may not understand the concept of credit),
- not understanding how much of something is being ordered, given struggles many had with certain mathematical concepts, such as, decimals,
- use of variety of units of measure on a single site and with the same type of item, such as, canned or packaged goods (e.g., ounces, kilograms, grams, liters, milliliters), and

- potential poor quality of the items they would receive (e.g., bruised or moldy fruit, etc.).

In this case study we will focus on the concerns around how much of something the user is ordering and how numerical quantities can be represented in a way that is easy to understand. Figure 5 shows that the decision tree provides a potential design recommendation for this case that focuses on providing alternative representations of numerical information. The alternative mode of representation used in this case is graphical. In Figure 6 the item is represented as an image (e.g., photograph or realistic drawing of the item) and the numerical information is portrayed by repeating the image multiple times in sequence in the quantity selected by the shopper.

Figure 6. *Decision tree recommendation on approaching issues of numerical representation*.

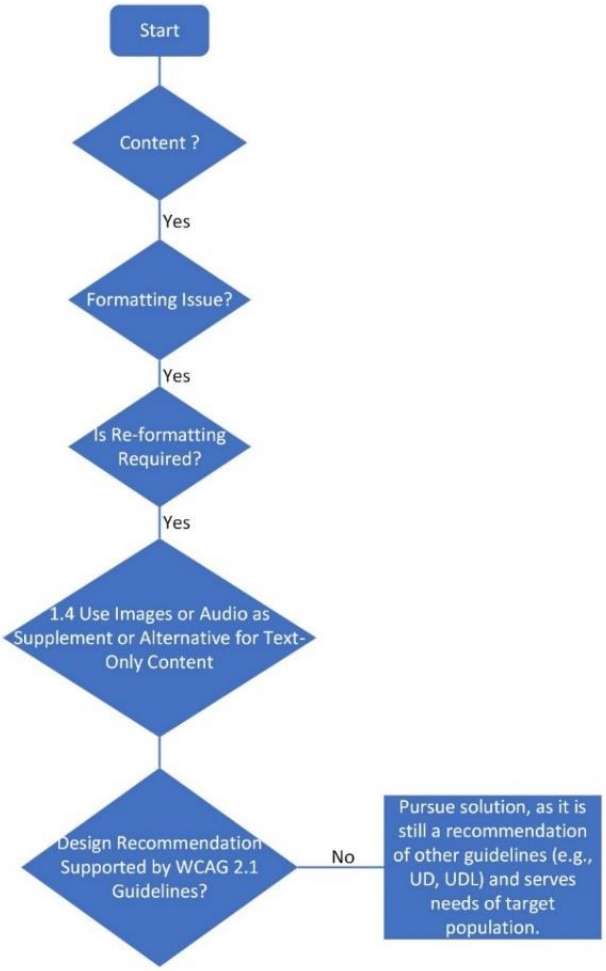
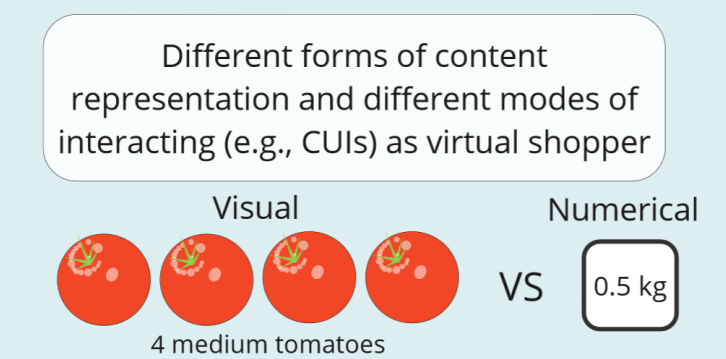


Figure 7. *Using visual representations of objects and quantities in shopping interface*



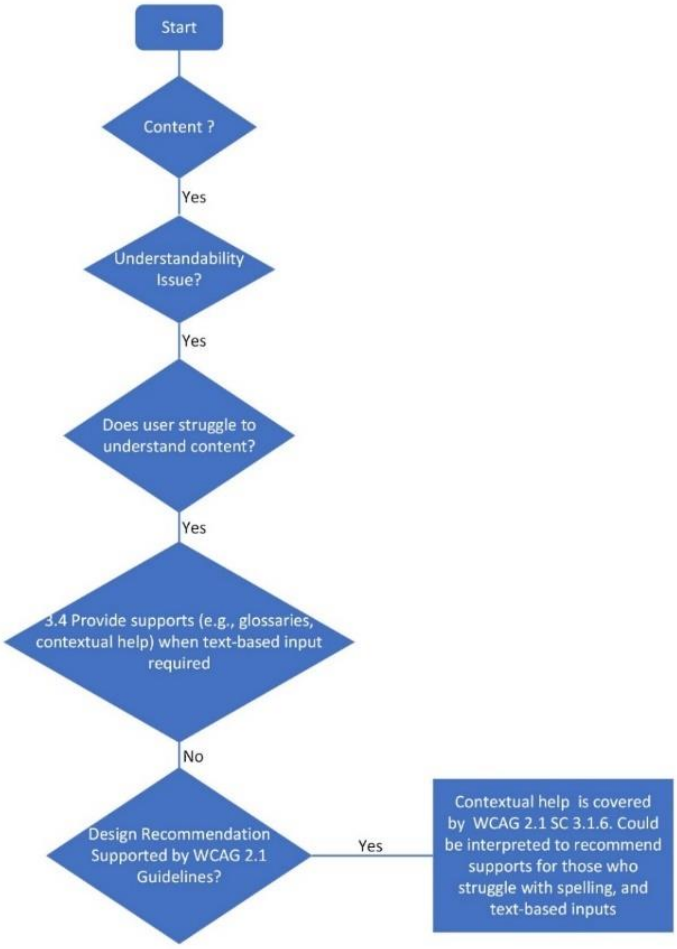
There are also issues with consistency in terms of how information is presented to the user which might be confusing to a user with IDD. Specifically, around the use of decimals or fractions of units (0.5 kg) in some cases, and whole numbers in other cases. Different units of measure may also be used on shopping sites (likely dependent on store's inventory and whether it includes items that are measured in imperial units like ounces as well as metric units) which might also be confusing for ICT users with IDD. The principle of consistency is addressed in another part of the decision tree which deals with consistency in navigation. But the principle could be applied to online content as well as given the use of different units of measure on shopping sites. The findings of Wu et al. (2021) in the scoping review indicated that individuals with IDD preferred concrete representations of objects in visual representations of statistical values. Figure 6 demonstrates this approach.

Case 3. Provide Contextual Help to Improve Comprehension of Textual Content

This case addresses instances in which the user with IDD struggles to understand the meaning of certain technical terms or lengthy words. Contextual help could be provided in the form of definitions of words that appear above the word, when the word is touched (if content is displayed on a table) or when a mouse rolls over it. Or the contextual help could be feedback that pops up if a user seems to be taking too much time to complete a particular task, such as filling out a form, entering content into a discussion forum or submitting an assignment through an online assignment drop box. Contextual help could provide guidance to the user as to how to move from the step they are currently struggling with,

to the next step. This contextual help could be in the form of a text-based chat bot, a short instructional video, or a conversational user agent that could provide the user with auditory feedback. Figure 8 depicts how the decision tree could be used to help designers come up with solutions to user issues around spelling.

Figure 8. *Using decision tree to find solutions for users needing help with spelling*

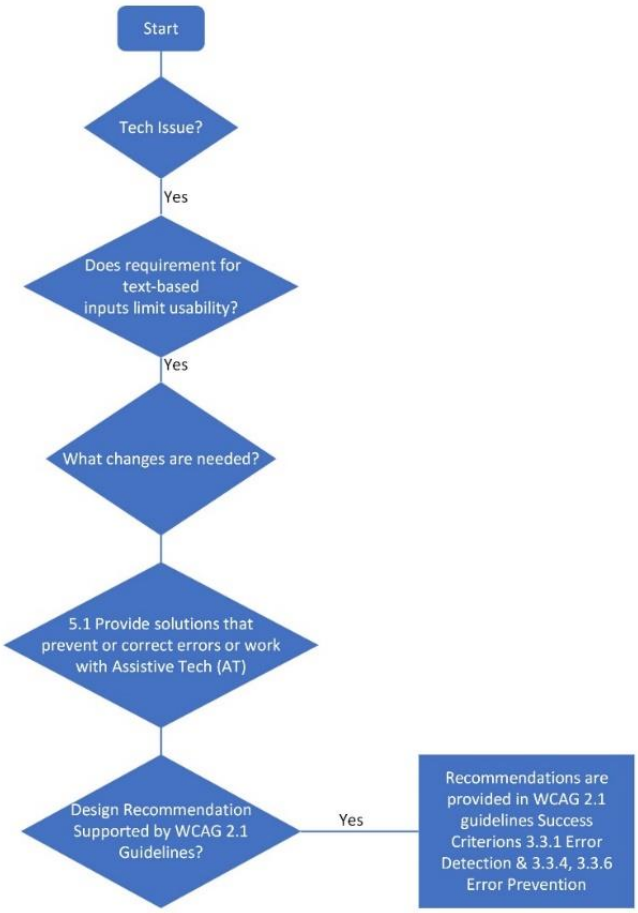


This kind of help can also be provided by certain types of assistive technology, which allow the user to highlight passages to have them read out and which may provide definitions for unusual words. Which means that it is important to design content in accordance with accessibility principles so that it can be easily converted to semantically correct speech translations of text-based content.

Case 4. Support User to Avoid Input Errors

This case addresses the concerns that individuals with IDD who participated in the consultations had about performing functions online that may have financial, or legal consequences. These concerns were expressed explicitly by at least three individuals who took part in the consultations. A few individuals expressed concerns around the possibility of fraudulent behaviour of which they might become a victim. Having a review process built into the form completion or payment process by financial institutions might alleviate that concern.

Figure 9. *Error prevention and avoidance in completion of online tasks requiring text input*



Though the individual with IDD might still require help to complete forms, it might be easier for a support person to guide them, if there are discrete steps involved, and a final review process is one of those steps. Of course, having interfaces and forms that are more error resistance will not help the

individual if they are being targeted by someone with ill intent. Figure 9 shows how the decision tree can be used in situations where designers and developers need a solution that helps users avoid textual or numerical input errors.

Other advisors with IDD were concerned about the consequences of making mistakes when submitting, for example, an order online (e.g., grocery shopping, some other kind of financial purchase, for example, of software) and ordering too much of something, or something they did not intend to order, because of difficulty understanding numerical quantities, or because they were encouraged to add additional items to their order on checkout (which adds an additional, and not essential step to the process).

Conclusions

This section discusses the conclusions that were reached at each phase of the project, starting with the scoping review findings about the barriers that people with IDD experienced around the use of ICT. These findings only addressed the barriers identified in the literature, but they did inform the next phase of the project, the consultations with the advisors with IDD. And the findings from both the scoping review and the consultations informed the development of the decision tree. Next steps will also be discussed at the end of this section, to explore what future developments might emerge from this project.

Scoping Review Conclusions

The scoping review was the first part of a project meant to increase the independence of individuals with IDD and their quality of life by making improvements to the usability of digital devices, services, and content. The scoping review focused exclusively on the kinds of barriers that individuals with IDD experience in a variety of settings (e.g., educational, financial, social, workplace) with regards to obtaining access to digital technology and services, effectively using that technology or service, and comprehending online information. Different individuals with IDD might find the same technology to have quite different levels of usability which is not surprising given that they experience varying levels of challenge (mild to severe IDD), unique individual needs (due to comorbidities such as sensory impairments or learning disabilities), distinct demographic characteristics (e.g., older individuals generally have had less access to digital technologies, less experience using them, and caregivers may have lower expectations of their need for and interest in using these technologies), and differential reading comprehension issues.

It was quite challenging to locate articles that directly discussed the challenges that individuals with IDD experienced using technology and accessing and understanding online content. Given the pandemic resulted in the push for online service delivery in a variety of areas it was surprising that there

were not more studies focused on technological barriers that users with IDD have encountered over the period from late 2020 to 2022. Many studies focused on the barriers experienced by people with disabilities more generally, but most often people who had sensory limitations (sight or hearing loss) or mobility issues. These were not included in the data collection or analysis, but they were used as sources of original studies (i.e., their references or literature cited sections).

Having access to more studies focused on the usability of digital technologies, services and content would have helped to provide more data for this review. The most significant finding of this review is that applications or websites that rely on users having at least a lower secondary reading level can represent a significant barrier given many people with IDD struggle in that area. Readability of content is an important component of accessibility, given that 25 percent of the adult population has not reached even minimal levels of literacy, after nine years of formal education (Nomura, Nielsen, & Tronbacke, 2010). The issue is even more critical for the IDD population as remediation (through additional tutoring) may not improve reading scores. Even if individuals with IDD do have adequate reading and writing skills, they may have fine motor skill or coordination deficits that make tasks that rely on those skills quite difficult (e.g., tasks that require a lot of keyboarding, or applications on touch screen enabled devices that have overly small buttons). Another area of significant challenge for users with IDD is dealing with the security features that grant access to various devices and to online services (e.g., publisher/library websites, streaming video services, transit information platforms, gaming platforms, etc.). The barriers relate to the need to commit passwords and codes to memory, and heavy reliance on using home-based devices on which passwords could be safely stored. Issues arose when the individual with IDD had to use a device or website outside of their home environment on which their passwords were not saved.

Conclusions from Consultations

The second part of the project, the consultations with individuals living with IDD revealed that there was variability in the types of challenges they faced. The individuals who were surveyed represented a broad spectrum of ages from school age to retired individuals. Some of the technologies they used were the same (e.g., meeting software like Zoom), some were unique to their stage in life (e.g., Google Classroom) and others expressed their personal interests (e.g., online games, arts-based activities). Most participants seemed to struggle with reading online (e.g., pronouncing words, understanding the meaning of certain words (jargon, long words), and interpreting long, unwieldy passages of text, uninterrupted by whitespace) or inputting text-based content (e.g., spelling, entering multi-word phrases into search windows). Everyone seemed to have developed their own strategies for negotiating online activities that required that they create text, such as commercially available tools, like virtual assistants (e.g., Siri, Google Mini, Alexa), that allowed them to convert speech to text for their searches. However, virtual assistants were limited in terms of their ability to translate the speech of certain individuals who struggled to articulate words clearly. One of the recommendations of the WCAG 2.1 Guidelines is that videos either be captioned and/or transcripts be provided. Captions are still text-based content and though they represent another and more accessible channel of information for other types of ICT users with disabilities (e.g., deaf or hard of hearing), captions may not lessen the challenge associated with viewing video. The advisors consulted in this project had differing preferences for video, with some using it as an information source for technical issues they faced, while most others struggled to follow the content contained in videos, stating that they would often view a video multiple times to fully comprehend it.

Some of the issues that were most cited in the scoping review did not constitute a technical barrier for most of the individuals who were interviewed. For example, though individuals cited concerns with the security of their information and devices, which could constitute a non-technical

barrier to access (if they decided not to go online because of this concern), only one individual spoke specifically about security features, such as passwords (resetting them), and two-step authentication requirements, as a barrier to access. Other elements that seemed to be problematic for individuals with IDD based on the interviews involved filling in forms.

General Conclusions

One of the main findings of this study is one that was noted by Goggin and Newell (2007) on the relative nature of accessibility. Specifically, that what is accessible to one group of people (e.g., users who are blind or partially sighted) may be inaccessible to others. The alternative format most often suggested by the WCAG 2.1 guidelines is text, which is easily read by screen readers (assuming it is properly formatted in a document, or on a website) but often not easily understood (for several reasons) by the IDD population. Goggin and Newell (2007, 160) state that "the binary between 'accessible' and 'inaccessible' technology is part of the problem that needs to be addressed." They suggest it is better to ask 'how' and 'why' Internet technologies are accessible or not. This was the finding of the student researcher as well, given that people with IDD have very different diagnoses and unique challenges with text-based content (e.g., spelling, comprehension, limited vocabulary, issues with how content is formatted and presented). In part the issue is with the assumptions that designers of technology or content make about the populations for whom they are designing. Designers are constrained by employers and others, by budget and scope, so they are often driven to make pragmatic decisions about which aspects of accessibility on which to focus. Viewing inclusive design through the lens of accessibility alone leads to a 'tick-box culture' that does little to serve the needs of users with disabilities (Kennedy et al.,2011). The analysis of the alignment between the WCAG 2.1 guidelines, and the barriers that advisors reported that they encountered navigating both content and technology revealed that the guidelines are not enough to ensure the removal of barriers that individuals with IDD face.

Sevilla, Herrera, Martinez, & Aldantud (2007) proposed a set of guidelines for easy navigation design that could help address some of the issues faced by users with IDD around becoming disoriented on websites, and being unable to navigate to a specific page, or the main page on a website. They focused on three areas:

- content and navigation,
- supports and help, and
- design and style.

Under the content and navigation topic they suggested grouping content to avoid too much information, providing linear navigation (forward, backward, and home links), and stable navigation menus. The supports they propose mirror those in the WCAG 2.1 Guidelines, to some degree, as they suggest approaches around error prevention and correction, and providing alternatives to text-based content (e.g., images). Their recommendations also mirror some of the comments made by advisors in the consultation sessions, for example, around avoiding distractions (e.g., too many animated figures, providing control over multimedia elements, by allowing user control), and providing an interface with a lot of white space on which text is clearly visible.

This project represents a starting point for the work that needs to be done to ensure that people with IDD have the same access to ICT and online content as groups with others. The unique and varied needs of individuals with IDD make it a challenging group to develop guidelines and recommendations for, given the fact that the solution most proposed by the W3C in its guidelines, to provide text-based alternatives to visual content, contradicts the needs and preferences of the IDD population. Which is to have access to multiple types of content (e.g., visual, audio, textual), and to allow for inputs other than text-based ones, that rely on people being able to type accurately and quickly.

Though autonomy is a laudable goal when considering the needs of those with disabilities in the design process, ideally through co-design, the idea that someone can only be considered truly independent if they operate fully autonomously does not seem feasible for many with an IDD diagnosis. They may need some kind of support throughout their lifespan in their use of technology. In fact, most users of technology, including those without disabilities, require some kind of assistance to be effective users, whether that is through the help of peers, or through training programs or help files. The goal when considering the needs of people with IDD should be to ensure that they have the help they need to use technology to better their access to services, and to increase their quality of life. If individuals with IDD do not have access to a support system, their access to ICTs will likely decrease (Barlott, 2020). This support system needs to include support from organizations that provide services to individuals with IDD. There seems to be little organizational support for ICT use, particularly for those in municipal social care (Ramsten, 2017). There were instances in which pandemic organizations responded to the needs of this population by creating user guides to commercially available software like Zoom (Paiewonsky & Cooney, 2020).

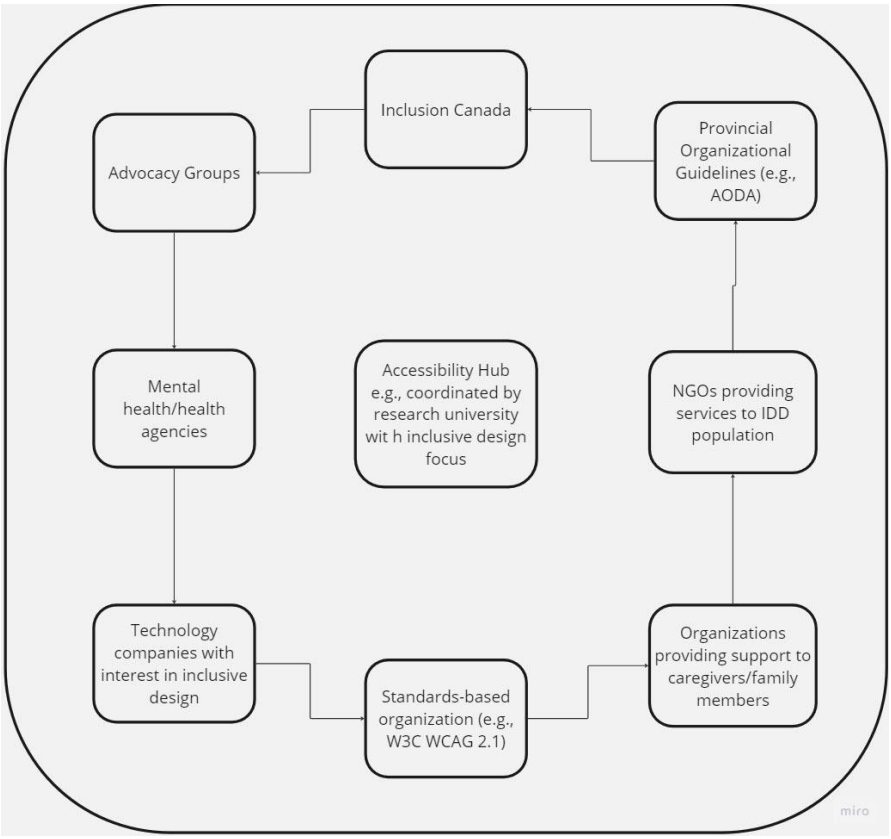
Next Steps

One potential long-term outcome of this project is the formation of an accessibility hub which may include members from:

- post-secondary sector involved in research in area of inclusive design,
- advocacy groups,
- caregiver/family groups,
- provincial organizations that have developed their own guidelines around accessibility (for example, the AODA),
- technology companies with an interest in accessibility,
- standards organizations like the W3C, and

- Inclusion Canada

Figure 10. *Depiction of different organizations that are members of the accessibility hub*



Different members of the hub may be involved in different types of activities. Educational organizations, technology companies, advocacy, and service organizations might all be involved in developing educational modules that can be used by individuals with IDD to gain new ICT skills or retain existing skills. Educational institutions with experience in working in inclusive design who routinely work with partners in industry and in service organizations might form the research centre of the hub overseeing research programs as well as individual research projects. They, in collaboration with advocacy organizations, individuals with IDD, family members of individuals with IDD, and others will define the problems that are most immediate. The educational institution/research hub will likely have a dedicated staff that can monitor the research program and related projects. The research university, along the partner organization involved in providing services to members of IDD community who collaborated in

this project, would likely be involved in evaluating the decision tree (by testing it through co-design projects), and recommending revisions to it over time. Given the diverse needs of the IDD population and the range of barriers they face in accessing ICTs and online content, a range of research problems could be pursued over the next decade.

Limitations

The limitations of each aspect of the project will be discussed, that is, limitations in design, limitations in methodology, and limitations in analysis will be assessed for each component of the project.

Limitations of Design

One of the design limitations of the scoping review was the quite generous inclusion criteria. Specifically, the review did not exclude articles based on

- sample size (ranged from N=3 to N=582),
- IDD diagnosis (e.g., Down syndrome, ASD, FASD),
- peer view (though most were peer reviewed, there were some conference papers included in analysis),
- severity of condition (e.g., mild, moderate, severe),
- methodology (i.e., review included large surveys about technology use, case studies, focus groups, interviews, observational studies, experimental studies),
- type of intervention (e.g., software or hardware usability testing, research study with research assistants with IDD using technology to document their reflections and findings, online educational services during pandemic, online mental health services), and
- area of life intended to be supported by technology (education, daily living skills development, digitized public services (transit and library), financial services).

This meant that qualitative studies were being compared to qualitative ones. Most of the studies included in the scoping review did not include individuals who had severe IDD. Though the papers that were based on large surveys did include individuals with severe IDD. The studies included in the scoping review provided contradictory information about the types of barriers encountered by participants and how severe a barrier a particular ICT represented. For example, individuals with better reading skills

struggled less with digital content that relied on text to convey information than individuals with more limited reading skills. Those with lesser skills in that area struggled more with digital content that was provided as text, and with ICTs that used text-based navigation menus.

The consultations were limited by the small number of participants (N=6). However, even with the small number of participants there was a range in the ages of the participants. The participants in the consultation provided a snapshot of the barriers that each individual experienced in their daily lives. The small sample size and lack of usability testing of a particular approach (technology or content presentation) didn't allow for more in-depth analysis of the barriers that specific groups within the study faced. For example, the kinds of barriers that retirees face, compared to those that secondary school students face, or that working aged individuals face.

Limitations in Methodology

The scoping review was not a systematic review as there was there was a dearth of information on the barriers that are faced by individuals with IDD around their ICT use. The techniques used in a typical systematic review (which the scoping review was not) were not as effective here. More idiosyncratic methods and multiple searches over multiple points in time were pursued.

Limitations in Data Analysis

Generally, more robust scoping and systematic reviews of the literature employ a few independent reviewers to conduct their own research and evaluations of the results of searches. The student researcher worked alone on the project, providing the results of her analysis to the research team at the partner organization. She shared the results of her findings at various stages in the project and revised her approach when gaps were identified. The scoping review was result of a much more iterative process than is generally outlined in the literature describing this type of review.

The last set of data was evaluated over a very abrupt time frame, given it was not fully available until a few weeks prior to the student researcher's project deadline. If more time were available to compare the findings of the first data set through to the final data set, a more robust understanding of the barriers faced by ICT users with IDD might have been gained. The sample size itself was small (N=6) so the study was exploratory. Findings form it will likely provide guidance in future work, such as in co-design projects on the efficacy of the decision tree and potential design solutions that will better address the needs of the IDD population and provide designers (e.g., web, visual, instructional) a better understanding of the needs of this population. It was not possible to say definitively that one barrier was universal to the IDD population, given the small sample size and the diversity of the population.

References

Abu Alghayth, K. M. (2019). *The use of assistive technology with students with severe intellectual and developmental disabilities in Saudi Arabia: Teachers' perspectives*. Florida, University of South Florida: 199.

Alfredsson Agren, K., Kjellberg, A., & Hemmingsson, H. (2020). Access to and use of the Internet among adolescents and young adults with intellectual disabilities in everyday settings. *Journal of Intellectual and Developmental Disability 45(1),* 89-98.

Ali, A., Hassiotis, A., Strydom, A., & King, M. (2012). Self stigma in people with intellectual disabilities and courtesy stigma in family carers: A systematic review. *Research in Developmental Disabilities 33(6),* 2122-2140.

Alqahtani, H. H., & Schoenfield, N. A. (2014). Teaching cooking skills to young women with mild intellectual disability: The effectiveness of Internet websites. *Current Issues in Education, 1(2)7*, 1-10. Retrieved from

Alshammari, M., Doody, O., & Richardson, I. (2018). *Barriers to the access of use of health information by individuals with intellectual and developmental disability IDD: Review of the literature*. IEEE International Conference on Healthcare Informatics, Ireland. pp. 294-298.

American Association on Intellectual and Developmental Disabilities (AAIDD). Frequently asked questions on intellectual disability. Retrieved on June 8, 2022, from https://www.aaidd.org/intellectual-disability/faqs-on-intellectual-disability

Amor, A. M., Navas, M.A., & Crespo, M. (2021). Perceptions of people with intellectual and developmental disabilities about COVID-19 in Spain: A cross-sectional study. *Journal of Intellectual Disability Research 65(5),* 381-396.

Auger, C., Leduc, D., Labbe, D., Guay, C., Fillion, B., Bottari, C., & Swine, B. (2014). Mobile applications for participation at the shopping mall: Content analysis and usability for persons with physical and communication or cognitive limitations. *International Journal of Environmental Research and Public Health 11(12),* 12777-12794.

Barlott, T., Aplin, T., Catchpole, E., Kranz, R., Le Goullon, D., Toivanen, A., & Hutchens, S. (2020). Connectedness and ICT: Opening the door to possibilities for people with intellectual disabilities. *Journal of Intellectual Disabilities 24(4),* 503-521.

Bayor, A.A. (2018). Co-designing with young adults with intellectual disability to develop social life skills. Proceedings of 2nd African Conference on Human Computer Interaction (AfriCHI '18). Windoek, Namibia.

Boot, F. H., Owuor, J., Dinsmore, J., & MacLachlan, M. (2018). Access to assistive technology for people with intellectual disabilities: a systematic review to identify barriers and facilitators. *Journal of Intellectual Disability Research 62(10),* 900-921.

Borgstrom, A., Daneback, K., & Molin, M. (2019). Young people with intellectual disabilities and social media: A literature review and thematic analysis. *Scandinavian Journal of Disability Research, 21(1)*, 129-140.

Brandt, A., Jensen, M.D., Soberg, M.S., Andersen, S.D., & Sund, T. (2020). Information and communication technology-based assistive technology to compensate for impaired cognition in everyday life: A systematic review. *Disability and Rehabilitation: Assistive Technology 15(7),* 810-824.

Bridges, S. A., Robinson, O.P., Stewart, E.W., Kwon, D. & Mutua, K. (2020). Augmented reality: Teaching daily living skills to adults with intellectual disabilities. *Journal of Special Education Technology 35(1),* 3-14.

Brown, I., Wehmeyer, M. L., & Shogren, K. A. (2017). What is meant by the terms intellectual disability and developmental disabilities. In M. L. Wehmeyer, I. Brown, M. Percy, K. A. Shogren, & W. A. Fund (Eds.), *A comprehensive guide to intellectual disability and developmental disabilities* (pp. 3-18). Baltimore: Paul H. Brookes.

Buehler, E., Easley, W., Poole, A., Hurst, A. (2016). *Accessibility barriers to online education for young adults with intellectual disabilities*. W4A '16.

Buijs P. C. M., Boot E., Shugar A., Fung W. L. A., & Bassett A. S. (2016). Internet safety issues for adolescents and adults with intellectual disabilities*. Journal of Applied Research in Intellectual Disabilities, 30*, 416-418.

Carey, A.C., Friedman, M.G., & Bryen, D.N. (2005). Use of electronic technologies by people with intellectual disabilities. *Mental Retardation 43(5)*, 322-333.

Caton, S. & Chapman, M. (2016). The use of social media and people with intellectual disabilities: A systematic review and thematic analysis. *Journal of Intellectual and Developmental Disability 41(2),* 125-139.

Chadwick, D. D., Quinn, S., & Fullwood, C. (2017). Perceptions of the risks and benefits of Internet access and use by people with intellectual disabilities. *British Journal of Learning Disabilities 45(1),* 21-31.

Chalghoumi, H., Cobigo, V., Dignard, C., Gauthier-Beaupre, A., Jutai, J.W., Lachappelle, Y., Lake, J., McHeimech, R., & Perrin, M. (2017). Information privacy for technology users with intellectual and developmental disabilities: Why does it matter? *Ethics & Behavior 29(3),* 201-217.

Cumming, T. M., Strnadova, I., Knox, M., & Parmenter, T.R. (2014). Mobile technology in inclusive research: Tools of empowerment. *Disability & Society 29(7),* 1-14.

Davies, D. K., Stock, S.E., King, L.R., Brown, R.B., Wehmeyer, M.L., & Shogren, K.A. (2015). An interface to support independent use of Facebook by people with intellectual disability. *Intellectual and Developmental Disabilities 53(1),* 30-41.

Desideri, L., Lancioni, G., Malavasi, M., Gherardini, A., Cesario, L. (2021). Step-instruction technology to help people with intellectual and other disabilities perform multi-step tasks: A literature review. *Journal of Developmental and Physical Disabilities, 33,* 857-886.

Fischer, G. & Sullivan, J. (2002). Human-centered public transportation systems for persons with cognitive disabilities: Challenges and insights for participatory design. In Sweden, T. Binder, J. Gregory, and I. Wagner (Eds) *Proceedings of the Participatory Design Conference* (pp.194-198) Malmö University: Palo Alto, CA.

Glencross, S., Mason, J., Katsikitis, M., & Greenwood, K.M. (2021). Internet use by people with intellectual disability: Exploring digital inequality—A systematic review. *Cyberpsychology, Behavior, and Social Networking 24(8),* 503-520.

Goggin, G. & Newell, C. (2007). *The business of digital disability*. The Information Society, 23, 159-168.

Havousha, S. (2016). *Usability of a Hebrew-based social media interface designed for individuals with intellectual developmental disability*. Haifa, Israel, University of Haifa. 99p.

Henni, S.H., Mauru, S., Fuglerud, K.S., & Moen, A. (2022). The experiences, needs and barriers of people with impairments related to usability and accessibility of digital health solutions, levels of involvement in the design process and strategies for participatory and universal design: A scoping review. *BMC Public Health 22(1)*, 1-18.

Hoppestad, B. S. (2007). Inadequacies in computer access using assistive technology devices in profoundly disabled individuals: An overview of the current literature. *Disability and Rehabilitation: Assistive Technology 2,* 189-199.

Hoppestad, B. S. (2013). Current perspective regarding adults with intellectual and developmental disabilities accessing computer technology: Disability and rehabilitation. *Disability and Rehabilitation: Assistive Technology 8(3),* 190-194.

Kagohara, D. (2010). Three students with developmental disabilities learn to operate an iPod to access age-appropriate entertainment videos. *Journal of Behavioral Education, 20*, 33-43.

Kennedy, H., Evans, S., & Thomas, S. (2011). Can the web be made accessible for people with intellectual disabilities? *The Information Society, 27*, 29-39.

Kydlund, F. K., Molka-Danielson, J., & Balandin, S. (2012). Examining the use of social media tool "Flickr" for impact on loneliness for people with intellectual disability. In *NOKOBIT 2012: Proceedings of the 2012 Norsk konferanse for organisasjoners bruk av informasjonsteknologi* (pp. 253-264). Retrieved from: http://dro.deakin.edu.au/view/DU:30062177

Kumin, L., Lazar, J., Feng, J.H., Wentz, B., & Ekedebe, N. (2012). A usability evaluation of workplace-related tasks on a multi-touch tablet computer by adults with Down Syndrome. *Journal of Usability Studies 7(4),* 118-0142.

Lake, J. K., Jachyra, P., Volpe, T., Lunsky, Y., Magnacca, C., Marcinkiewicz, A., & Hamdani, Y (2021). The wellbeing and mental health care experiences of adults with intellectual and developmental

disabilities during COVID-19. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 285-300.

Larco, A., Enriquez, F., & Lujan-Mora, S. (2018). iOS apps for people with intellectual disability: A quality assessment. In Proceedings of the 10th International Conference on Computer Supported Education (CSEDU 2018). 2, 258-264.

Lazar, J., Woglom, C., Chung, J., Schwartz, A., Hsieh, Y.G., Moore, R., Crowley, D., & Skotko, B. (2018). Co-design process of a smart phone app to help people with Down Syndrome manage their nutritional habits. *Journal of Usability Studies, 13(2)*, 73-93.

Li-Tsang, C., Yeung, S., Chan, C., & Hui-Chan, C. (2005). Factors affecting people with intellectual disabilities in learning to use computer technology. *International Journal of Rehabilitation Research 28(2),* 127-133.

Lofgren-Martenson, L., Sorbring, E., & Molin, M. (2015). 'T@ngled Up in Blue': Views of Parents and Professionals on Internet Use for Sexual Purposes Among Young People with Intellectual Disabilities. *Sexuality and Disability 33(4),* 533-544.

Lough, E. & Fisher, M.H. (2016). Internet use and online safety in adults with Williams syndrome. *Journal of Intellectual Disability Research, 60(10)*, 1020-1030.

Louw, J. S., Kirkpatrick, B., & Leader, G. (2020). Enhancing social inclusion of young adults with intellectual disabilities: A systematic review of original empirical studies. *Journal of Applied Research in Intellectual Disabilities 33,* 793-807.

McClimens, A. & F. Gordon (2008). Presentation of self in everyday life: How people labelled with intellectual disability manage identity as they engage with the blogosphere. *Sociological Research Online 13(4),* 1.

McDonnell, M., Dowler, R., & Connolly, I. (2020). *Investigating usability and engagement in a money management application for users with intellectual disability*. 17th International Conference ICCHP 2020, Springer.

Mechling, L. (2011). Review of twenty-first century portable electronic devices for persons with moderate intellectual disabilities and autism spectrum disorders. *Education and Training in Autism and Developmental Disabilities 46(6)*, 479-498.

Morash-Macneil, V., Johnson, F., & Ryan, J.B. (2018). A systematic review of assistive technology for individual with intellectual disability in the workplace. *Journal of Special Education Technology 33(1),* 15-26.

Moreno, L., Petrie, H., Martinez, P., & Alarcon, R. (2023). Designing user interfaces for content simplification aimed at people with cognitive impairments. Universal Access in the Information Society, https://doi.org/10.1007/s10209-023-00986-z

Näslund, R., & Gardelli, A. (2013). 'I know, I can, I will try': Youths and adults with intellectual disabilities in Sweden using information and communication technology in their everyday life. *Disability and Society, 28*, 28-40.

National Institutes of Health (2021, 11/09). *About Intellectual and Developmental Disabilities (IDDs)*. National Institutes of Health. https://www.nichd.nih.gov/health/topics/idds/conditioninfo

Nomura, M., Nielsen, G.S., & Tronbacke, B. (2010). Guidelines for easy-to-read materials. International Federation of Library Association and Institutions (IFLA) Professional Reports, No. 120. 31 p.

Oudshoom, C. E. M., Frielink, N., Nijs, S.L.P., & Embregts, P.J.C.M. (2020). eHealth in the support of people with mild intellectual disability in daily life: A systematic review. *Journal of Applied Research in Intellectual Disabilities 33(6),* 1166-1187.

Paiewonsky, M. and Cooney, L. (2020). Teaching & learning online: strategies for support students with ID. Available at: https://sites.google.com/umb.edu/thinkcollege teachingonline/home?authuser%BC0 (accessed 7 May 2023).

Palmer, S. B., Wehmeyer, M.L., Davies, D.K., & Stock, S.E. (2012). Family members' reports of the technology use of family members with intellectual and developmental disabilities. *Journal of Intellectual Disability Research 56(4),* 402-414.

Parsons, S., Daniels, H., Porter, J., & Robertson, C. (2006). The use of ICT by adults with intellectual disabilities in day and residential services. *British Journal of Educational Technology 37,* 31-44.

Politis, Y., Olivia, L., Olivia, T., & Sung, C. (2017). Involving people with autism in development of virtual world for provision of skills training. *International Journal of E-Learning & Distance Education, 32(2)*, 1-16.

Ramsten, C., Marmstal Hammar, L., Martin, I., et al. (2017). ICT and intellectual disability: a survey of organizational support at the municipal level in Sweden. *Journal of Applied Research in Intellectual Disabilities, 30*, 705-713.

Ramsten, C., Martin, L., Dag, M., & Hammar, L.M. (2020). Information and communication technology use in daily life among young adults with mild-to-moderate intellectual disability. *Journal of Intellectual Disabilities 24(3),* 289-303.

Rocha, T., Bessa, M., Goncalves, M., Cabral, L., Godinho, F., Peres, E., Reis, M.C., Magalhaes, L., & Chalmers, A. (2012). The recognition of web pages' hyperlinks by people with intellectual disabilities: An evaluation study. *Journal of Applied Research in Intellectual Disabilities 25(6),* 542-552

Rocha, T., Carvalho, C., Bessa, M., Reis, S., & Magalhaes, L. (2017). Usability evaluation of navigation tasks by people with intellectual disabilities: A Google and SAPO comparative study regarding different interaction modalities. *Universal Access in the Information Society 16(3),* 581-592.

Schalock, R. L., & Luckasson, R. (2021). Intellectual disability, developmental disabilities, and the field of intellectual and developmental disabilities. In L.M. Glidden, L. J. Abbeduto, L. L. McIntyre, & M. J.

Tassé (Eds.), *Handbook of intellectual and developmental disabilities*. Washington, DC: American Psychological Association.

Scholz, F., Yalcin, B., & Priestley, M. (2017). Internet access for disabled people: Understanding sociorelational factors in Europe. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace 11(1).*

Seale, J. (2014). The role of supporters in facilitating the use of technologies by adolescents and adults with learning disabilities: A place for positive risk-taking? *European Journal of Special Needs Education* 29(2), 220–236.

Setchell, J., Barlott, T., & Torres, M. (2021). A socio-emotional analysis of technology use by people with intellectual disabilities. *Journal of Intellectual Disability Research 65(12),* 149-161.

Sevilla, J., Herrera, G., Martínez, B., & Alcantud, F. (2007). Web accessibility for individuals with cognitive deficits: A comparative study between an existing commercial web and its cognitively accessible equivalent*. ACM Transactions on Computer-Human Interaction, 14(3)*, 1608-1629.

Sheehan, R. & Hassiotis, A. (2017). Digital mental health and intellectual disabilities: state of the evidence and future directions. *Evidence-Based Mental Health 20(4),* 107-111.

Shogren, K.A., Luckasson, R., & Schalock, R.L. (2014). The definition of 'context' and its application in the field of intellectual disability. *Journal of Policy and Practice in Intellectual Disabilities, 11(2)*, 109-116.

Shpigelman, C. N. & C. J. Gill (2014). How do adults with intellectual disabilities use Facebook? *Disability & Society 29(10),* 1601-1616.

Sorbring, E., Molin, M., & Lorgren-Martenson, L. (2017). "I'm a mother, but I'm also a facilitator in her every-day life": Parents' voices about barriers and support for internet participation among young people with intellectual disabilities. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace 11(1)*.

Spencer, P., Van Haneghan, J.P., Baxter, A., Chanto-Wetter, A. & Perry, L. (2021). "It's ok, mom. I got it!": Exploring the experiences of young adults with intellectual disabilities in a postsecondary program affected by the COVID-19 pandemic from their perspective and their families' perspective. *Journal of Intellectual Disabilities 25(3),* 405-414.

Sumner, P., Hedge, C., & Powell, G. (2020). Smart-speaker technology and intellectual disabilities: agency and wellbeing. *Disability and Rehabilitation: Assistive Technology* 15.

Tanis, E. S., Palmer, S., Wehmeyer, M., Davies, D.K., Stock, S.E., Lobb, K., & Bishop, B. (2012). Self-report computer-based survey of technology use by people with intellectual and developmental disabilities. *Intellectual and Developmental Disabilities 50(1),* 53-68.

Thompson, J.R., Bradley, V.J., Buntix, W.H.E., Schalock, R.L., Shogren, K.A., & Snell, M.E. (2009). Conceptualizing supports and the support needs of people with intellectual disability. *Intellectual and Developmental Disabilities, 47(2)*, 135-146.

van Holstein, E., Wiesel, I., Bigby, C., & Gleeson, B. (2021). People with intellectual disability and the digitization of services. *Geoforum 119*, 133-142.

van Loon, J., Claes, C., Vandevelde, S., Van Hove, G., & Schalock, R.L. (2010). Assessing individual support needs to enhance personal outcomes. *Exceptionality, 18(4)*, 193-202.

Vázquez, A., Jenaro, C., Flores, N., Bagnato, M.J., Perez, M.C., & Cruz, M. (2018). E-health interventions for adult and aging population with intellectual disability: a review. *Frontiers in Psychology 9,* 2323.

Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

Wehmeyer, M.L., Buntix, W.H.E., Lachapelle, Y., Luckasson, R.A., Schalock, R.L., & Verdugo, M.A. (2008). The intellectual disability construct and its relation to human functioning. Intellectual disability construct and its relation to human functioning. *Intellectual and Developmental Disabilities, 46(4)*, 311-318.

Williams, P. & Cendon, B.V. (2020). *Smartphones and people with intellectual disabilities: An international comparison of contextual barriers for effective usage*. 11th International Multi-Conference on Complexity, Informatics and Cybernetics (IMCIC 2020). Orlando, FL, USA, IMCIC: 25-30.

Williams, P. & Shekhar, S. (2019). Mobile devices and people with learning disabilities: A literature review. *International Journal of Computer Science and Mobile Computing 8(2),* 34-43.

Wong, A. W., Chan, C.C., Li-Tsang, C.W., & Lam C.S. (2009). Competence of people with intellectual disabilities on using human-computer interface. *Research in Developmental Disabilities 30(1),* 107-123.

Wu, K.., Petersen, E., Ahmad, T., Burlinson, D., Tanis, S., & Szafir, D.A. (2021). Understanding data accessibility for people with intellectual and developmental disabilities. In *CHI Conference on Human Factors in Computing Systems (CHI '21). May8-13, 2021,* Yokohama, Japan. ACM, New York, Ny, USA. 16 pages. https://doi.org./10.1145/3411764

Appendix A: Recruitment Flier

CALL FOR ADVISORY MEMBERS

Surrey Place would like to talk to you about information technology (like computers or the internet). You don't even need to use computers, the internet or smart phones to participate.




WE WOULD LIKE TO HEAR ABOUT

-How easy or hard it is to use different kinds of technology
-How to make information technology easier to use for everyone
-How we can tell other people how to make technology better

HOW LONG WILL IT TAKE?

We would like to speak to you **four (4) times a year, for two (2) hours** each time. You will receive **$400** for speaking with us after our last session. If someone supports you, they will get **$400** at the end of the project.

To find out more or to join in please email **Judy Verseghy at judy.verseghy@surreyplace.ca**

SURREY PLACE

Appendix B: Consent Form for Supported Users and Supporters

Title: Usability of Digital Information and IT for IDD

About the Project

You are invited to be a part of the *Usability of Digital Information and IT for IDD* study. The study team includes researchers from Surrey Place and the Ontario College of Art and Design University:

Dr. Barry Isaacs, Director of Research, Evaluation and Education at Surrey Place. Dr. Peter Coppin, Associate Professor, Faculty of Design, OCADU
Lisa Cohen, Manager, School Support Program, Surrey Place
Sandra Law, (Graduate Student, Faculty of Design, Inclusive Design Program, OCADU) The project is being funded by Accessibility Standards Canada.

In this project we are trying to learn more about how people with intellectual and developmental disabilities use information technology (IT). Examples of IT include:

- Devices like smart phones and computers
- Apps and computer programs
- The internet

What You will be Asked to Do

If you agree to join this study, the research team will ask to take part in some conversations about several topics:

- What it is like for you to use IT? What is hard? What is easy?
- What do you need to improve your experience with using IT?
- Who we should be talking to about this issue and how we should present the information we find?
- What recommendations would we make to improve your experience with IT?

In total we will meet with you 4 or 5 times. Each meeting will be last about 90 minutes. Sometimes meetings might last 2 hours. You will receive $400 for helping us (about $50 per hour).

The first meeting will be with just you and the person that helps you use IT or the person you help to use IT. After that we may meeting in larger groups of up to 5 or 6 people. We will decide together whether we should meet in larger groups or not.

Most interviews will happen online. If you live in Toronto we can meet in person if you like. All the conversation we have with you will be audio and video recorded. Using the recordings, we will create transcriptions. That means we will write down the conversations.

We will not include your name in the transcriptions. When we have everything written

down the recordings of the interviews will be erased. The transcripts will be kept for 5 years after we publish the study.

Everything is Private and Confidential

Everything we talk about will be kept private. Only people working on the project will see it. All the information collected in the study will be kept on a secure server at Surrey Place. Only the research team will have access to it. It is unlikely there will be a problem keeping the information private, but if there is we will let you know. We will not use your name to any reports of our research finding.

How We Will Report the Finding to Others

We will post reports of the findings on social media and websites, and we will provide a report to Accessibility Standards, Canada. Project team member Sandra Law may use some of the information for her major project at Ontario College of Art and Design University. We will submit a paper for publication in a professional journal.

You Don't Have to Take Part in this Study If You Don't Want to

If you decide not to participate in the project that is fine. None of the services, funding or benefits you receive will change. You can also stop participating in the project at any time. You will receive $50 for each hour you spend helping us on the study up until the time you decided to stop.

If you have any questions about this study please contact Barry Isaacs, barry.isaacs@surryeplace.ca

❑ I consent to participating in the *Usability of Digital Information and IT for IDD* research study

❑ I understand what I am being asked to do in this study

❑ The question I have about this study have been answered

❑ I understand that I am volunteering to be part of this study and that I can stop whenever I want to

❑ I understand that what I say in interviews, and all the data collected about me, will be kept private

❑ I consent (agree) to my interviews being recorded.

_____
Participant Name (Please Print)

_____
Date

Appendix C: Consent Form for Independent Users

Title: Usability of Digital Information on IT for IDD

About the Project

You are invited to be a part of the Usability of Digital Information and IT for IDD study.

The study team includes researchers from Surrey Place and the Ontario College of Art and Design University:

Dr. Barry Isaacs, Director of Research, Evaluation and Education at Surrey Place. Dr. Peter Coppin, Associate Professor, Faculty of Design, OCADU

Lisa Cohen, Manager, School Support Program, Surrey Place
Sandra Law, (Graduate Student, Faculty of Design, Inclusive Design Program,

OCADU) The project is being funded by Accessibility Standards Canada.

In this project we are trying to learn more about how people with intellectual and developmental disabilities use information technology (IT). Examples of IT include:

- Devices like smart phones and computers
- Apps and computer programs
- The internet

What You will be Asked to Do

If you agree to join this study, the research team will ask to take part in some conversations about several topics:

- What it is like for you to use IT? What is hard? What is easy?
- What do you need to improve your experience with using IT?
- Who we should be talking to about this issue and how we should present the information we find?
- What recommendations would we make to improve your experience with IT?

In total we will meet with you 4 or 5 times. Each meeting will be last about 90 minutes. Sometimes meetings might last 2 hours. You will receive $400 for helping us (about $50 per hour).

The first meeting will be with just you. After that we may meeting in larger groups of up to 5 or 6 people. We will decide together whether we should meet in larger groups or not.

Most interviews will happen online. If you live in Toronto we can meet in person if you like. All the conversation we have with you will be audio and video recorded. Using the recordings, we will create transcriptions. That means we will write down the conversations. We will not include

your name in the transcriptions. When we have everything written down the recordings

of the interviews will be erased. The transcripts will be kept for 5 years after we publish the study. Everything is Private and Confidential

Everything we talk about will be kept private. Only people working on the project will see it. All the information collected in the study will be kept on a secure server at Surrey Place. Only the research team will have access to it. It is unlikely there will be a problem keeping the information private, but if there is we will let you know. We will not use your name to any reports of our research finding.

How We Will Report the Finding to Others

We will post reports of the findings on social media and websites, and we will provide a report to Accessibility Standards, Canada. Project team member Sandra Law may use some of the information for her major project at Ontario College of Art and Design University. We will submit a paper for publication in a professional journal.

You Don't Have to Take Part in this Study If You Don't Want to

If you decide not to participate in the project that is fine. None of the services, funding or benefits you receive will change. You can also stop participating in the project at any time. You will receive $50 for each hour you spend helping us on the study up until the time you decided to stop.

If you have any questions about this study please contact Barry Isaacs, barry.isaacs@surryeplace.ca

- ❑ I consent to participating in the *Usability of Digital Information and IT for IDD* research study
- ❑ I understand what I am being asked to do in this study
- ❑ The question I have about this study have been answered
- ❑ I understand that I am volunteering to be part of this study and that I can stop whenever I want to
- ❑ I understand that what I say in interviews, and all the data collected about me, will be kept private
- ❑ I consent (agree) to my interviews being recorded.

_____

Participant Name (Please Print)

_____

Date

Appendix D: Interview Questions from First Consultation

Questions for User

1. Can you tell us a bit about your yourself?
    a. Do you have any specific sensory difficulties? (e.g., seeing or hearing)
        i. Do you have something to help you with those (e.g. glasses or a hearing aid)
    b. Do you have difficulties using your hands or fingers to hold, move or touch things?
2. Are you familiar with Information and Communication Technology (ICT), such as computers and smart phones? Do you use ICT?
3. Do you have access to the internet (Wi Fi or data plan)?
4. Is your access limited for any reason?
5. What do you use ICT for?
    a. Entertainment (YouTube, Netflix, etc.)
    b. Recreation and Social
    c. Communication (Email, social media)
    d. Go to websites to look for information
    e. Daily living reminders
    f. Online banking
    g. Online shopping
    h. Health and safety
    i. Online medical and mental health
    j. Appointment reminders
    k. Online food orders (groceries or Skip/UberEATS)
    l. Program registrations
    m. Job searching and applications
    n. At work, school, vocational or day program
6. What works well? What are you really good at when it comes to using a computer smartphone or tablet?
7. What do you find difficult about it?
8. Do you use any tools that help you use your computer, smartphone or tablet? For example, screen readers, Dragon software, large keyboards, etc.
9. Is there anyone that helps you when you need it? How do they help you?
10. Are there things about using computers, smartphones or tablets that you need help with but are not getting?

Question for Supporters

1. How do you support (name of person with IDD) to use IT?
2. What works well?
3. What do you find difficult about it?
4. Is there something you need that would help you support (name of person with IDD) better to use IT?
5. What might help (name of person with IDD) be more independent when using IT?

Appendix E: Interview Questions from Second Consultation

1. Challenges of Design/Layout
    - Multiple tabs within one website
    - Too much information
    - Too much text can/not enough graphic make it difficult to understand information
    - Format (e.g., bullet points)

2. Complexity of Tasks
    - Example: answering or declining a call while on the phone, or setup of the built-in version of a software (e.g., Zoom) or extension.
    - How to make an online payment
    - Complicated toolbars

3. Challenges Searching
    - The information one is trying to find is not showing up/finding the right key words
    - Difficulty entering keywords because of spelling errors
    - Mispronunciation when using speech-to-text

4.Getting Blocked out of an Account
    - Difficulty entering a code that is sent to your email or phone that you need to enter onto a website (often called authenticator). Example of website: online banking or social media account.
    - Not understanding why you can't access your account

5. Challenges with Assistive and Accessible Technology
    - Screen Readers (text-to-speech)
    - Voice Controlled Devices (speech-to-text)
    - Captions

6.Difficulties with Updating Software
    - Auto-updates or manual updates – what are the challenges found?
    - Updates don't go as planned

7.Difficulties with Installing Software
    - Steps are not clear or too complex – e.g., some people find installing from CD easier than downloading from internet because the steps are more straight forward.
    - Install does not complete/go as planned

8. Challenges with the Change of Hardware or Software
    - New phone, laptop or tablet
    - Switching to a different software - e.g., desktop apps to online version of software – MS Word to Google docs

9. Troubleshoot – What do you do when…
   - When a device or digital platform freezes,
   - WIFI won't connect,
   - Hardware won't connect (for example: headphones or camera),
   - Download won't occur or is incomplete

10. Does Lack of Comfort or Confidence with ICT limit your use? Example:
   - A fear of making a mistake in online activities (e.g., buying the wrong things or quantity when shopping)
   - Concerns over online security (e.g., viruses or fraud)
   - Not using ICT because it is too difficult/frustrating

Appendix F: Interview Questions from Third Consultation

1. Do you use a screen reader? Do you use any other accessibility aids (e.g., speech-to-text, special keyboard, text-to-speech, accessibility feature in google).

    - What do you use them for?
    - How do they work? What works well and what are the issues?
    - What would improve them?

2. This is the Surrey Place website; we want to get your thoughts on it. If you were looking for information on Surrey Place, do you think this website would be helpful to you? Why or why not? Website: https://www.surreyplace.ca/

    - If you wanted to find out more about the organization, Surrey Place, would you find this website helpful?
    - If you wanted to find specific information on this website, would you be able to do it. For example:
    - If you needed to find a service, how would you find a service?
    - If you wanted to get a job at Surrey Place, where would you go to find jobs?

3. (**Go to Audiology page**). Can you read this? (**If not, go to accessibility feature question**)

    - Are there any words that you don't understand? What do you think would help when you don't understand a word?

    Probe: For example, hovering over a word and the definition shows up or there is an audio version of the definition?

4. Can you find the accessibility features on this website?

    - **(Go through the accessibility feature first)**

    How would you get the screen to read to you or how would you make the text bigger, is there any other accessibility features that you would find helpful that is not present?

    - **(Enable the screen reader to read to them):**

    Did you understand the text once it was read to you?

    Are there any words that you don't understand? What do you think would help when you don't understand a word?

    Probe: hover over a word and the definition shows up or there is an audio version of the definition

    Do you find the accessibility features helpful?

What would make this website better or easier to understand? (Thinking about the presentation, such as multiple down menus)

5. **Job Banks:** https://www.jobbank.gc.ca/home

   - Could you navigate this page?
   - Then go to next page, would you know what to do here?

   OR

   Indeed: https://ca.indeed.com/

   - Show us how you would find a job and complete the process of applying.
   - Probe as they go through: What do you find difficult with navigating this website?

6. **Searching:**

   - How would you search for a recreational activity for yourself (this could be a swimming course, volleyball league, soccer league, bowling league, and arts class)?

Appendix G: Accessible Version of Decision Tree

Start

Is it a content-related issue?

Yes

Is it a formatting issue?

No

Speech-to-text software can help users to read Word documents, html files, or text files online.

1. Is it a formatting issue?

Yes

Reformatting is required.

What reformatting is needed?

1.1 Text Spacing. Included in current WCAG 2.1 Success Criteria (SC) specifically 1.2 and 1.4 which deal with text spacing, line height, spacing between paragraphs, letter and word spacing.
1.2 Increase font size or type, or provide option to zoom in/out in browser. Included in current WCAG 2.1 Success Criterion 1.4.4 which deals with resizing text and 1.4.8 which deals with visual presentation. Success is achieved if the text can be resized without assistive technology up to 200%.

Supporting References:

- Auger, C., Leduc, D., Labbe, D., Guay, C., Fillion, B., Bottari, C., & Swine, B. (2014). Mobile applications for participation at the shopping mall: Content analysis and usability for persons with physical and communication or cognitive limitations. *International Journal of Environmental Research and Public Health 11(12),* 12777-12794.
- Bridges, S. A., Robinson, O.P., Stewart, E.W., Kwon, D. & Mutua, K. (2020). Augmented reality: Teaching daily living skills to adults with intellectual disabilities. *Journal of Special Education Technology 35(1),* 3-14.
- Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

1.3 Change background and/or text colour on device. Dealt with by guideline 1.4 Distinguishable that is meant to ensure that users can see and hear content and that foreground is separated from background. SC 1.4.8 deals specifically with user ability to change foreground and background colours.
1.4 Use images or audio as supplement or alternative to text. No current WCAG 2.1 recommendation.

Supporting References:

- Rocha, T., Bessa, M., Goncalves, M., Cabral, L., Godinho, F., Peres, E., Reis, M.C., Magalhaes, L., & Chalmers, A. (2012). The recognition of web pages' hyperlinks by people with intellectual disabilities: An evaluation study. *Journal of Applied Research in Intellectual Disabilities 25(6),* 542-552
- Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

2. Is it a site organization issue?

Yes

What changes are needed?

2.1 Include visual cues (e.g., place focus on currently active tab). Included in current WCAG 2.1 Guidelines as SC 2.4.7 Focus Visible.

Supporting References:

- Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

2.2 Simplify menu structure (e.g., don't use lengthy drop down menus). Included in current WCAG 2.1 guidelines as SC 2.4.8 Location information about user's location within a set of web pages.

Supporting References:

- Rocha, T., Bessa, M., Goncalves, M., Cabral, L., Godinho, F., Peres, E., Reis, M.C., Magalhaes, L., & Chalmers, A. (2012). The recognition of web pages' hyperlinks by people with intellectual disabilities: An evaluation study. *Journal of Applied Research in Intellectual Disabilities 25(6),* 542-552

2.3 Clearly label URLs. Included in current WCAG 2.1 guidelines as SC 2.4.4 and 2.4.9. The link purpose can be determined by the link text alone.

Supporting References:

- Rocha, T., Bessa, M., Goncalves, M., Cabral, L., Godinho, F., Peres, E., Reis, M.C., Magalhaes, L., & Chalmers, A. (2012). The recognition of web pages' hyperlinks by people with intellectual disabilities: An evaluation study. *Journal of Applied Research in Intellectual Disabilities 25(6),* 542-552

2.4 Use titles for pages. Included in the current WCAG 2.1 guidelines as SC 2.4.2. Page Titled. Help users to find content and orient themselves by giving each web page a descriptive title.

Supporting References:

- Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

2.5 Provide consistent look and feel across site. Included in current WCAG 2.1 guidelines as SC 3.23 and 3.2.4. Consistent navigation, icons/images used repeatedly, and are consistent.

Supporting References:

- Barlott, T., Aplin, T., Catchpole, E., Kranz, R., Le Goullon, D., Toivanen, A., & Hutchens, S. (2020). Connectedness and ICT: Opening the door to possibilities for people with intellectual disabilities. *Journal of Intellectual Disabilities 24(4),* 503-521.
- Chalghoumi, H., Cobigo, V., Dignard, C., Gauthier-Beaupre, A., Jutai, J.W., Lachappelle, Y., Lake, J., McHeimech, R., & Perrin, M. (2017). Information privacy for technology users with intellectual and developmental disabilities: Why does it matter? *Ethics & Behavior 29(3),* 201-217.
- Davies, D. K., Stock, S.E., King, L.R., Brown, R.B., Wehmeyer, M.L., & Shogren, K.A. (2015). An interface to support independent use of Facebook by people with intellectual disability. *Intellectual and Developmental Disabilities 53(1),* 30-41.
- Kumin, L., Lazar, J., Feng, J.H., Wentz, B., & Ekedebe, N. (2012). A usability evaluation of workplace-related tasks on a multi-touch tablet computer by adults with Down Syndrome. *Journal of Usability Studies 7(4),* 118-0142.
- Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

3. Is understandability an issue?

Yes.

User struggles to understand and to generate text-based content.

What changes are needed?

3.1 Use specialist terms, and jargon sparingly and if used, define. Included in current WCAG 2.1 guidelines as SC 3.1.3 unusual words.

Supporting References:

- Chalghoumi, H., Cobigo, V., Dignard, C., Gauthier-Beaupre, A., Jutai, J.W., Lachappelle, Y., Lake, J., McHeimech, R., & Perrin, M. (2017). Information privacy for technology users with intellectual and developmental disabilities: Why does it matter? *Ethics & Behavior 29(3),* 201-217.

3.2 Complex sentences, and long paragraphs should be replaced with chunked content as per plain language guidelines. Implied in the current WCAG 2.1 guidelines as SC 3.1.5 Reading Level. However, the

stated reading level, lower secondary, is too high for the IDD population so that will need to be modified.

Supporting References:

- Havousha, S. (2016). *Usability of a Hebrew-based social media interface designed for individuals with intellectual developmental disability*. Haifa, Israel, University of Haifa. 99p.
- Lake, J. K., Jachyra, P., Volpe, T., Lunsky, Y., Magnacca, C., Marcinkiewicz, A., & Hamdani, Y (2021). The wellbeing and mental health care experiences of adults with intellectual and developmental disabilities during COVID-19*. Journal of Mental Health Research in Intellectual Disabilities 14(3),* 285-300.
- Ramsten, C., Martin, L., Dag, M., & Hammar, L.M. (2020). Information and communication technology use in daily life among young adults with mild-to-moderate intellectual disability. *Journal of Intellectual Disabilities 24(3),* 289-303.
- Rocha, T., Bessa, M., Goncalves, M., Cabral, L., Godinho, F., Peres, E., Reis, M.C., Magalhaes, L., & Chalmers, A. (2012). The recognition of web pages' hyperlinks by people with intellectual disabilities: An evaluation study. *Journal of Applied Research in Intellectual Disabilities 25(6),* 542-552

3.3 Limit requirement for text only input where possible. No current WCAG 2.1 guideline is available.

Supporting References:

- Lake, J. K., Jachyra, P., Volpe, T., Lunsky, Y., Magnacca, C., Marcinkiewicz, A., & Hamdani, Y (2021). The wellbeing and mental health care experiences of adults with intellectual and developmental disabilities during COVID-19*. Journal of Mental Health Research in Intellectual Disabilities 14(3),* 285-300.

3.4 Provide supports (e.g., glossaries, contextual help) when text-based inputs are required (e.g., search terms, text chat). Included, in part, in the WCAG 2.1 SC 3.1.6 Pronunciation which includes mention of glossaries in the Examples section.

Supporting References:

- Barlott, T., Aplin, T., Catchpole, E., Kranz, R., Le Goullon, D., Toivanen, A., & Hutchens, S. (2020). Connectedness and ICT: Opening the door to possibilities for people with intellectual disabilities. *Journal of Intellectual Disabilities 24(4),* 503-521.
- Rocha, T., Carvalho, C., Bessa, M., Reis, S., & Magalhaes, L. (2017). Usability evaluation of navigation tasks by people with intellectual disabilities: A Google and SAPO comparative study regarding different interaction modalities. *Universal Access in the Information Society 16(3),* 581-592.
- Vereenooghe, L., Turssat, F., & Baucke, K. (2021). Applying the Technology Acceptance Model to Digital Mental Health Interventions: A Qualitative Exploration with Adults with Intellectual Disabilities. *Journal of Mental Health Research in Intellectual Disabilities 14(3),* 318-343.

Is it a technology-related issue?

Yes

4. Are changes to software/device setup challenging for users?

Yes

User struggles to install new software or manage changes resulting from updates to purchase of new devices.

What changes are needed?

4.1 Removal of distracting content from software installation emails or downloads. Implied in the current WCAG 2.1 guidelines as SC 3.1.5 Reading Level. However, the stated reading level, lower secondary, is too high for the IDD population so that will need to be modified.

Supporting References:

- Rocha, T., Carvalho, C., Bessa, M., Reis, S., & Magalhaes, L. (2017). Usability evaluation of navigation tasks by people with intellectual disabilities: A Google and SAPO comparative study regarding different interaction modalities. *Universal Access in the Information Society 16(3),* 581-592.

4.2 Make the installation or maintenance processes very concrete/clear (e.g., pictorial representations, plain language). Implied in the current WCAG 2.1 guidelines as SC 3.1.5 Reading Level. However, the stated reading level, lower secondary, is too high for the IDD population so that will need to be modified.

Supporting References:

- Ramsten, C., Martin, L., Dag, M., & Hammar, L.M. (2020). Information and communication technology use in daily life among young adults with mild-to-moderate intellectual disability. *Journal of Intellectual Disabilities 24(3),* 289-303.
- Rocha, T., Bessa, M., Goncalves, M., Cabral, L., Godinho, F., Peres, E., Reis, M.C., Magalhaes, L., & Chalmers, A. (2012). The recognition of web pages' hyperlinks by people with intellectual disabilities: An evaluation study. *Journal of Applied Research in Intellectual Disabilities 25(6),* 542-552.
- Rocha, T., Carvalho, C., Bessa, M., Reis, S., & Magalhaes, L. (2017). Usability evaluation of navigation tasks by people with intellectual disabilities: A Google and SAPO comparative study regarding different interaction modalities. *Universal Access in the Information Society 16(3),* 581-592.
- Setchell, J., Barlott, T., & Torres, M. (2021). A socio-emotional analysis of technology use by people with intellectual disabilities. *Journal of Intellectual Disability Research 65(12),* 149-161.
- Shpigelman, C. N. & C. J. Gill (2014). How do adults with intellectual disabilities use Facebook? *Disability & Society 29(10),* 1601-1616.
- van Holstein, E., Wiesel, I., Bigby, C., & Gleeson, B. (2021). People with intellectual disability and the digitization of services. *Geoforum 119*, 133-142.

4.3 Indicate changes of context, through cues such as “Update Now” buttons rather than auto-updating. Included in the current WCAG 2.1 guidelines as SC 3.2.5 Change on Request.

Supporting References:

- Alfredsson Agren, K., Kjellberg, A., & Hemmingsson, H. (2020). Access to and use of the Internet among adolescents and young adults with intellectual disabilities in everyday settings. *Journal of Intellectual and Developmental Disability 45(1),* 89-98.
- Shpigelman, C. N. & C. J. Gill (2014). How do adults with intellectual disabilities use Facebook? *Disability & Society 29(10),* 1601-1616.

4.4 Minimize and summarize changes to system/software. No WCAG 2.1 guideline addresses the issue directly or indirectly.

Supporting References:

- Kumin, L., Lazar, J., Feng, J.H., Wentz, B., & Ekedebe, N. (2012). A usability evaluation of workplace-related tasks on a multi-touch tablet computer by adults with Down Syndrome. *Journal of Usability Studies 7(4),* 118-0142.

5. Does requirement for text-based inputs limit usability?

Yes

Users have difficulty generating text-based content.

What changes are needed?

5.1 Provide tools or utilities that prevent or correct errors (e.g., browser plug-ins) or work seamlessly with user Assistive Technology (AT). Included in current WCAG 2.1 guidelines as SC 3.3.1 Error Detection, and 3.3.4 and 3.3.6 Error Prevention.

Supporting References:

- Davies, D. K., Stock, S.E., King, L.R., Brown, R.B., Wehmeyer, M.L., & Shogren, K.A. (2015). An interface to support independent use of Facebook by people with intellectual disability. *Intellectual and Developmental Disabilities 53(1),* 30-41.

5.2 Provide context-sensitive help to prompt user as to the term they want to use. Included in WCAG 2.1 guidelines as SC 3.3.5 Help.

5.3 Improve capabilities of AT like speech-to-text in discussion forums and chat rooms for those who struggle to generate multi-word phrases or sentences quickly. No current WCAG 2.1 guideline deals with this issue.

Supporting References:

- Rocha, T., Carvalho, C., Bessa, M., Reis, S., & Magalhaes, L. (2017). Usability evaluation of navigation tasks by people with intellectual disabilities: A Google and SAPO comparative study regarding different interaction modalities. *Universal Access in the Information Society 16(3),* 581-592.

6. Do users struggle to troubleshoot technical issues?

Yes

6.1 User struggles to solve issues on their own and often resorts to internal or external supports.

What changes are needed?

6.1.1 Provide just-in-time training modules online or f2f to build ICT self-efficacy. Dealt with only partially by WCAG 2.1 SC 3.3.5 Help.

Supporting References:

- Barlott, T., Aplin, T., Catchpole, E., Kranz, R., Le Goullon, D., Toivanen, A., & Hutchens, S. (2020). Connectedness and ICT: Opening the door to possibilities for people with intellectual disabilities. *Journal of Intellectual Disabilities 24(4),* 503-521.

6.1.2 Direct user to support network in their area if they do not currently have adequate support (internal or external). No current WCAG 2.1 guideline deals with this topic.

6. Do users struggle to troubleshoot technical issues?

No

6.2 User is confident enough to pursue a solution on their own.

What changes are needed, if any?

6.2.1 Provide ongoing training and support to user to help build and reinforce their ICT skills. No current WCAG 2.1 guideline deals with training needs.

Supporting References:

- Barlott, T., Aplin, T., Catchpole, E., Kranz, R., Le Goullon, D., Toivanen, A., & Hutchens, S. (2020). Connectedness and ICT: Opening the door to possibilities for people with intellectual disabilities. *Journal of Intellectual Disabilities 24(4),* 503-521.

6.2.2 Support users to become peer support provider of tech help to their community to build and maintain their skills. No current WCAG 2.1 guideline deals with training needs.