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# Twenty Years Into the 21st Century – Tech-related Accommodations for College Students with Mental Health and Other Disabilities

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**Abstract**

Virtually all North American two- and four-year colleges provide accommodations to their increasing numbers of students with disabilities. To explore technology and non-technology related accommodations for these students we surveyed 118 Canadian two- and four-year college students who self-reported at least one disability, including a mental health related disability, and indicated that they had registered for access services from their college. Seventy-four students without disabilities were included in some analyses. Our findings reveal emerging issues such as non-binary gender and multiple comorbidities, in addition to more targeted recommendations concerning technology use. For example, over half of our sample self-reported multiple disabilities; there is a large number of students with mental health related disabilities (e.g., anxiety disorders, mood disorders), many of whom have comorbid disabilities; binary (male, female) gender designations are outdated; and exam and classroom accommodations without technologies are still the most popular. Grades of students with and without disabilities did not differ. Similarly, the number of different types of accommodations in two- and four-year colleges did not differ. Students generally had high technology related self-efficacy and they saw the substantial benefit of technologies, especially of writing tools. Students with mental health related disability used somewhat fewer technologies for reading, writing and time management. Self-efficacy and perceived benefit were highest for writing technologies. General use technologies such as Microsoft Office and Google Docs that were reported by most students in this study are increasingly used as adaptive aids. In future, use of technology related accommodations is likely to include showing students how to use general use software.

**Keywords:** accommodations, college, disability, mental health, technology, self-efficacy, benefits of technology

## 1. Introduction

Between 17% and 34% of post-secondary students in American (Canadian University Survey Consortium, 2020, 2021) and Canadian post-secondary institutions (Fichten et al., 2018, 2019a) have a disability. As in many other countries, Canadian four-year and two-year college students with disabilities are eligible for and utilize services and accommodations to provide them with an equal opportunity to demonstrate mastery of course materials. These involve making alterations to the delivery of services so that these are accessible to more students. While a decade ago a larger proportion (70%) of students with disabilities enrolled in two-year colleges (Newman et al., 2011), currently this trend has reversed, with four-year colleges enrolling a larger percentage of students with disabilities (4.55% vs 3.30%) and with four-year colleges granting more accommodations than two-year institutions (Cohen et al., 2020; Weis & Bittner, 2021).

### *1.1 Canadian Regulations*

Although accommodations are modeled on American standards, the Canadian Human Rights Act (1985), the Canadian Charter of Rights and Freedoms (1982), and various provincial regulations (see Harrison et al., 2020) inform the provision of disability related services in Canada. As noted by Wenc (2021), Canada does not have a national definition or a standardized approach outlined by policies and procedures for documentation requirements that permit access to accommodations and services for students with disabilities.

In Canada, different provinces and, indeed, different post-secondary institutions use varying criteria for providing

accommodations. In Quebec, the second largest of Canada's ten provinces, as well as in several other provinces, including Alberta (Wenc, 2021), the medical model (see Burgstahler et al., 2020) is prominent, with accommodations only accessible when there is a report from a professional such as a physician or a psychologist to justify the provision of disability related services. Another concern related to accommodations is how an institution determines what accommodations are suitable for which students; this is especially problematic in the case of a mental related disability (Condra et al., 2015).

In response to such problems the Association on Higher Education and Disability (2012), which provides recommendations about matters related to students with disabilities and post-secondary education in America, proposed that, "A student's narrative of his or her experience of disability, barriers, and effective and ineffective accommodations is an important tool which, when structured by interview or questionnaire and interpreted, may be sufficient for establishing disability and a need for accommodation" (para. 5). Banerjee et al. (2020) noted that, "not all colleges adopted this guidance, and the problem a decade later is the lack of uniformity and/or agreement among postsecondary disability service providers regarding self-reported information in making accommodation decisions" (p. 33). The same is true of what is determined to be appropriate documentation (Weis et al., 2021). Nevertheless, the result has been that in the U.S., AHEAD's guidelines have largely been adopted, with only 22% of schools requiring formal documentation (Weis & Bittner, 2021).

### *1.2 Nature of Accommodations*

In North America, exam-related accommodations are common - such as permission to use a computer and extended time for exams - as well as classroom accommodations, such as access to notetakers and permission to use digital recorders (Malcolm & Roll, 2017a; Paskins, 2018; Sokal & Wilson, 2017). Providing accommodations can be costly as it is, "an ad hoc process of retrofitting, repeated each semester, for each course, for each individual student making a request, and as such is a highly costly and consumable process" (Fovet & Mole, 2013, p. 124). Although it has been suggested that Universal Design for Learning can be used to minimize academic accommodations (Gidden & Jones, 2021), there is little data to suggest that this is actually feasible in many institutions. Moreover, data show that fewer than 50% of students with disabilities register to receive accommodations both in Canada (Fichten et al., 2018; 2019a) and America (Cohen et al., 2020; McGregor et al., 2016; Newman et al., 2016; Parsons et al., 2021). There are a variety of barriers to registering, as reviewed by Toutain (2019). The results of registration for access services is mixed, with studies that have shown that registered students have both worse (Parsons et al., 2021) and better (Abreu et al., 2017; Mamiseishvili & Koch, 2011) academic outcomes.

### *1.3 Assistive Technology*

Many post-secondary students with disabilities who are registered for accessibility services use assistive technology accommodations (e.g., Malcolm & Roll 2017a; Fichten et al., 2019b). This remains true despite the fact that the lines between general use and assistive technology are blurring (Fichten et al., in press; McNicholl et al., 2019). Nevertheless, data show that receiving assistive technology accommodations improved performance (Blasey et al., 2022; McNicholl et al., 2019; Satterfield, 2020) and also increased satisfaction with reading, writing, note-taking, test-taking, and studying among post-secondary students with disabilities (Malcolm & Roll, 2017b; 2019).

The U.S. Department of Education (2021) identified the following possible assistive technologies: taped texts, telephone handset amplifiers, assistive listening devices or systems, telecommunications devices for Deaf persons, closed caption decoders, braille calculators printers or typewriters, note takers, open and closed captioning, interpreters, voice synthesizers, readers, specialized gym equipment, videotext displays, television enlargers, calculators or keyboards with large buttons, talking calculators, electronic readers, and a reaching device for library use. However, not all of these are commonly attributed. The most used technology provided by post-secondary access services are those that change the nature of reading and writing. These are technologies that read text to students, turn voice into text and notetaking tools that do a combination of both (Courtad & Bakken, 2020).

It has been estimated that approximately 10% of the entire college student population needs to use assistive technology: various software applications, tools, systems and devices, electronics and hardware that will facilitate their learning and social life on campus (Bakken et al., 2018). Malcolm and Roll (2017a) provided a listing of assistive technology related accommodations at a large American university over a five-year period (see Table 1). Although their listing is based on data from 2011 to 2015, with a few exceptions this continues to be valid today. For example, Blasey (2020) reported that in a large, four-year, public college the following assistive technology accommodations were provided: use of a computer and adaptive software for exams, recording of lectures, use of computers to take notes, notetaking software, screen reading software, assistive listening devices, and alternate format course materials (e.g., audiobooks).

Table 1. Types of assistive technology (AT) accommodations

| AT accommodation categories | Description |
|---|---|
| AT for note-taking | Smartpens that synchronize audio lecture recordings to written notes, digital recorders, software or mobile applications for note-taking |
| Audio readings | Provides audio-only format of a book or class reading, i.e., in MP3 format |
| Modified display | Changes to color, font, and masking through variety of software and applications; color overlays, open dyslexic font |
| Text and audio readings | Reading format that combines text and audio, e.g., text-to-speech |
| AT for writing | Software and mobile applications that addresses spelling, grammar, language production, mind-mapping, proof-reading |
| Text recognition | Software and hardware that provides optical character recognition to convert certain non-text file formats (e.g., PDF) into a text format |
| Alternative inputs | Hardware and software that replace the typical standard keyboard and mouse, e.g., alternate keyboards and pointing devices, voice recognition software |
| Screen reader | Software that audiblizes all computer events |
| Magnification | Software or hardware used to magnify content, e.g., screen magnification software, hand-held and mounted magnifiers |
| Ergonomic equipment | Ergonomic keyboards, pointing devices, positioning devices (wrist rests, arm supports, document holders, etc.) |
| Single-word display | Software and mobile applications that display single words during reading |
| Tactile support | Hardware and software to create tactile graphics for non-text information (images, diagrams, graphs, maps, etc.) |

*Note*. These categories of accommodation were modified from Malcolm & Roll (2017a).

Although technology has made a tremendous change in how students perform academic work, when it comes to accommodations for students with disabilities a variety of issues remain. These include possible differences in the types and frequency of accommodations received by Canadian two- and four-year college students; possible gender differences in technological versus non-technological accommodations, how technology-based accommodations are related to self-efficacy using technologies for reading and writing, and to perceived benefits of using these technologies. An important question relates to technology use by students with mental health / psychological disabilities. Ko and Petty (2020) conducted a scoping review and concluded that although there is reason to believe that students with mental health related disabilities could benefit from assistive technology, the literature is sparse and studies that do exist confound mental health related disabilities with other disabilities. Another important but under-studied topic relates to assistive technology accommodations used by students with mental health / psychological disabilities.

## 2. The Present Investigation

The goal of the present investigation was to explore four questions.

Question 1. Is there a difference in the number of different types of accommodations two- and four-year Canadian college students with disabilities receive?

Question 2. Are there differences in technology use and in the types of accommodations received by (a) males

and females, (b) two- and four-year college students with disabilities, and (c) students with mental health related disabilities?

Question 3. Which technologies for reading, writing, and organization do students with and without disabilities use, with a special emphasis on students with mental health related disabilities?

Question. 4. Compared to receiving accommodations that do not employ technology, do students who receive technology related accommodations (a) have better grades (b) report greater self-efficacy using reading and writing technologies and (c) find these to be more beneficial?

*2.1 Hypotheses*

1. Four-year college students will receive a larger number of accommodations than two-year college students.
2. Students will report receiving more non-technology (e.g., extended time for exams, note taker) than technology related (e.g., use of a computer for exams and to take notes), accommodations.
3. Students who receive technology related accommodations will be more confident in using reading and writing technologies, find these technologies more beneficial, and have higher grades.

## 3. Method

*3.1 Participants*

Participants were 118 Canadian two- and four-year college students who self-reported a disability (76 female, 35 male, 7 non-binary gender) and who indicated that they were registered for disability related services from their post-secondary institution, as well as 74 students (47 female, 26 male, 1 did not respond) who indicated no disabilities. In accordance with the recommendations of Banerjee et al. (2020) and of the Association on Higher Education and Disability (2012), we used self-reported disabilities. Participants were provided with a list of 14 disabilities / impairments and asked to indicate as many as applied to them (see Figure 1). All were participating in a larger investigation.

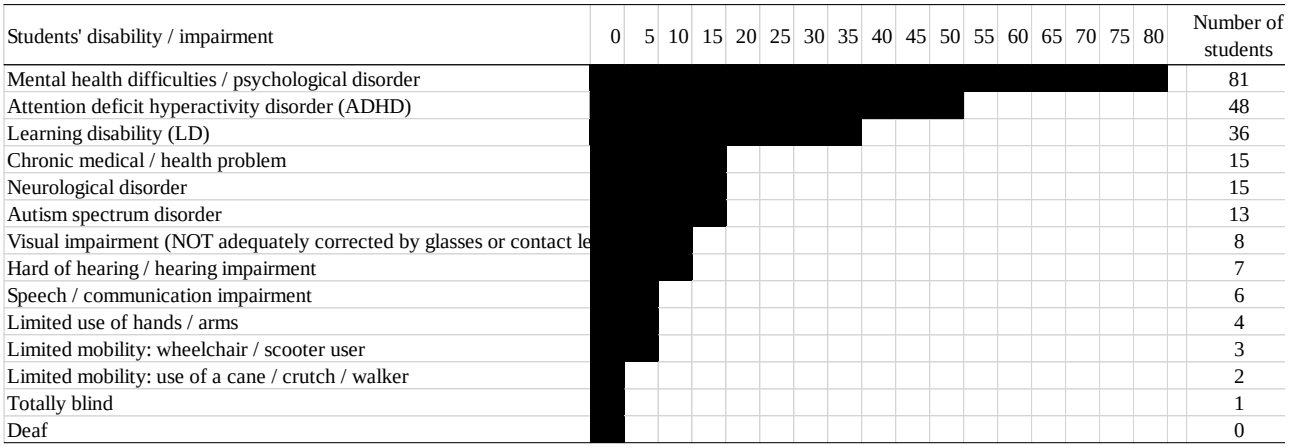


Figure 1. Disabilities / impairments of students

*Note*. 56% (66) of students had multiple disabilities (30 had two, 21 had three, and 15 had four, five, or six disabilities), while 44% (52) had one disability.

It is important to note that 56% (n=66) of students with disabilities had more than one disability (30 had two, 21 had three, and 15 had between four and six disabilities), while 44% (n=52) had one disability. The most common disabilities reported were mental health difficulties / psychological disorders, attention-deficit/hyperactivity disorder, and learning disabilities.

Among the 117 participants with disabilities who indicated type of institution, the two-year ($n$ = 89) and four-year college students with disabilities ($n$ = 28) attended 16 different post-secondary institutions. The 70 students who indicated no disability and who indicated type of institution attended 13 different colleges ($n$ = 33 two-year and $n$ = 37 four-year colleges). The majority of four-year college students were pursuing a Bachelor's degree. Two-year college students with disabilities are overrepresented in the sample because of the recruitment strategies used (i.e., oversampling in the authors' college).

Students with disabilities attending two-year institutions were, on average, 22-years-old (*range* = 17 - 48, *SD* = 5.94) and those attending four-year colleges were 26 years old (*range* = 20 - 45, SD = 5.66). The corresponding average ages for

students who indicated no disability were 20 (*range* = 18 - 28, *SD* = 2.58) and 22 (*range* = 19 - 34, *SD* = 2.76), respectively.

### *3.2 Procedure*

We administered an accessible online survey, using LimeSurvey (Version 2), that had been approved by Dawson College's Research Ethics Board. Participants were recruited in various ways, one of which was email invitations sent to Canadian postsecondary students with and without disabilities who had participated in our previous research and who had indicated that we could contact them for future studies. Announcements were also emailed to discussion lists focusing on Canadian postsecondary education and to project partners (mainly student and campus disability service provider groups). In addition, there were notices put on the web sites of groups of students with disabilities and we advertised for students with disabilities at the Canadian two-year college where the ethics certificate was issued. All students were participating in a larger investigation and were emailed a $25 Amazon gift card after completing the survey. Students were asked about their academic experiences in the fall 2019 semester (i.e., pre-Covid).

#### 3.2.1 Data Analyses

The following analyses were carried out: descriptive statistics, Chi square test on frequencies, independent samples *t*-tests, analysis of variance comparisons, (ANOVAs), effect size calculations (Cohen's *d*), and Pearson product-moment correlations.

### *3.3 Measures*

#### 3.3.1 Grades

We asked students to indicate their standardized cumulative grades (R score for Quebec two-year colleges, GPA for all other institutions).

#### 3.3.2 Accommodations

We asked students the following open-ended question, "What accommodations did you receive?" The accommodations mentioned by students were coded into nine categories (e.g., exam accommodations with technology - see Table 2) in accordance with a coding manual (Havel et al., 2020). Three trained coders had an inter-rater reliability of 93%.

Table 2. Accommodation noted by students with disabilities (including mental health) by institution type and gender

| Type of accommodation | All participants with disabilities (n=118) | Institution type | | Gender | | | Mental health related disabilities only (n=24) |
|---|---|---|---|---|---|---|---|
| | | College (n=89) | University (n-28) | Female (n=76) | Male (n=35) | Nonbinary (n=7) | |
| | % | % | % | % | % | % | % |
| Exam accommodations | | | | | | | |
| No technology (e.g. extended time on exams) | 89% | 88% | 79% | 86% | 94% | 100% | 75% |
| With technology (e.g. use of a computer to exam responses) | 25% | 38% | 29% | 29% | 20% | 57% | 13% |
| Classroom / assignment accommodations | | | | | | | |
| No technology (e.g. preferred seating) | 37% | 28% | 18% | 37% | 34% | 14% | 46% |
| With technology (e.g. permission to record lectures) | 18% | 17% | 14% | 18% | 17% | 14% | 8% |
| Accessible / digital materials (e.g. accessible format text books) | 9% | 8% | 7% | 9% | 9% | 14% | 0% |
| Academic support (e.g. tutoring services) | 6% | 2% | 11% | 7% | 6% | 0% | 0% |
| Institutional support (e.g. early semester registration) | 4% | 2% | 11% | 5% | 3% | 0% | 8% |
| Accommodations approved, but not used (e.g. Kurzweil - but didn't use | 4% | 3% | 7% | 3% | 6% | 14% | 0% |
| Other (e.g. magnifying glass) | 14% | 12% | 11% | 14% | 6% | 43% | 8% |

*Note.* This table presents the type of accommodation used by students at different types of institutions, with different genders, and by students with mental health related disabilities

#### 3.3.3 Technology Use

We asked students to indicate, using check boxes, whether they used each of six categories of technologies for reading (e.g., text-to-speech) and 10 technologies for writing (e.g., grammar checker). We also asked the students an open-ended question about what technologies they used for time management/organization/focus and how they used these (see Table 3). Using inductive and semantic coding, the responses were coded into nine categories (e.g., help with organization) in accordance with a coding manual (Jorgensen et al., 2021) created using the student responses. Two trained coders had an interrater reliability of 94%.

Table 3. Technologies used for reading, writing and time management

| Technologies used | % of all participants with disabilities n=118 | % of female participants n=76 | % of male participants n=35 | % of particpants with only mental health disabilites n=24 | % of participants with no disabiity n=74 |
|---|---|---|---|---|---|
| Technology for reading | | | | | |
| Electronic dictionary / thesaurus | 68% | 65% | 74% | 67% | 61% |
| Electronic translator | 44% | 43% | 44% | 46% | 42% |
| Text-to-speech (the technology reads your text aloud) | 37% | 41% | 29% | 25% | 17% |
| Audiobooks (a pre-recorded human voice reads your text aloud) | 32% | 32% | 34% | 21% | 15% |
| Magnification | 16% | 17% | 9% | 22% | 15% |
| Refreshable braille display | 1% | 2% | 0% | 0% | 0% |
| Technology for writing | | | | | |
| Word processor (e.g., Microsoft Word, Pages, Google Docs) | 96% | 96% | 94% | 96% | 98% |
| Spell checker | 92% | 91% | 94% | 88% | 93% |
| Grammar checker | 86% | 87% | 86% | 92% | 90% |
| Electronic dictionary / thesaurus | 80% | 77% | 80% | 79% | 81% |
| Electronic translator | 48% | 43% | 57% | 42% | 39% |
| Word prediction / word completion | 42% | 45% | 34% | 42% | 37% |
| Dictation / speech-to-text / voice recognition | 25% | 25% | 29% | 17% | 15% |
| Text-to-speech for proofreading (device reads your writing out loud to help you catch mistakes) | 21% | 23% | 20% | 13% | 10% |
| Electronic graphic organizers (e.g., mind-mapping, concept mapping) | 16% | 19% | 11% | 17% | 25% |
| Handwriting recognition | 7% | 5% | 9% | 4% | 2% |
| Technology for time management / organization and/or focus | | | | | |
| In general, do you use technology to assist with time management, organization, and/or focus? | 59% | 61% | 60% | 54% | 51% |
| Helps with organization | 29% | 28% | 31% | 25% | 24% |
| Scheduling study time | 18% | 16% | 20% | 20% | 17% |
| Helps with school work | 14% | 15% | 14% | 4% | 2% |
| Due dates / deadlines | 11% | 9% | 17% | 13% | 12% |
| Alerts / reminders / alarms | 9% | 8% | 11% | 17% | 12% |
| Help with concentration | 7% | 5% | 9% | 0% | 2% |
| Access resources provided by the instructor | 3% | 3% | 3% | 4% | 2% |
| Taking notes | 2% | 3% | 0% | 4% | 7% |

*Note*. The data of seven participants who indicated a non-binary gender are included in "all participants." Therefore, the total of females and males will be 111, 7 less than the total of 118. Technology for time management / organization and/or focus results are based on coding of text boxes. Other entries are based on check boxes.

3.3.4 College Academic Self-Efficacy

The 7-item Course Self-Efficacy Scale subscale of the College Self-Efficacy Inventory (Solberg et al., 1993) was used to evaluate confidence in students' ability to successfully perform college-related tasks/behaviors. Scores range from 1 (not at all confident) to 10 (very confident).

3.3.5 Perceived Benefit and Technology Self-Efficacy

We asked students how confident they were in their ability to use reading and writing technologies to do schoolwork, as well as about the perceived benefit of using technologies for reading (e.g., better understand), writing (better quality), and increasing work speed. We used Lime Survey (V2) pull-down menus in which all questions were scored on a 10-point Likert-scale, where 1 is strongly disagree and 10 is strongly agree. Confidence using writing technology scores were significantly related to College Academic Self-Efficacy scores for students without disabilities, $r(72) = 0.41$, $p = 0.001$. For students with disabilities, confidence using both reading and writing technology scores were significantly related to College Academic Self-Efficacy scores (reading, $r(118) = 0.31$, $p = 0.001$; writing, $r(117) = 0.27$, $p = 0.003$).

## 4. Results

### *4.1 Grades*

As for grades, the average R score for two-year college students with disabilities was 27.20 ($SD$ = 4.19) and the average GPA for four-year college students with disabilities was 3.43 ($SD$ = 0.66). Two-year college students without disabilities had an average R score of 27.64 ($SD$ = 7.48), while four-year college students had an average GPA of 3.45 ($SD$ = 0.49). The difference between the R scores of college students with and without disabilities using an independent t-test was not significant, $t(120) = 0.32$, $p = 0.749$. Similarly, there was no significant difference between the GPA of four-year college students with and without disabilities, $t(63) = 0.13$, $p = .892$. There was no significant difference between males and females with disabilities either in 2-year, $t(66)=1.12$, $p = .267$, or in four-year colleges, $t(20)=.05$, $p = .960$. Students receiving accommodations with and without technology or with digital materials had similar grades.

### *4.2 Mental Health*

Given recent concerns about accommodations – especially technology related accommodations - for students with mental

health related disabilities (see Ko & Petty, 2020), we identified 24 students who indicated that they had a mental health related disability with no comorbidities. Although we included this subgroup in the entire sample, we also report on these students separately. Virtually all of the students who only reported a mental health related disability attended a two-year college (21 of the 24 participants). The difference between the grades (R scores) of students who only had a mental health related disability and those without disabilities was not significant, $t(52) = 2.06$, $p = .08$, $d = 0.54$, but had a medium effect size. Due to the limited number of participants enrolled in 4-year colleges ($n = 2$), an analysis on grade differences could not be computed.

### *4.3 Questions 1 and 2*

*Hypothesis 1* was not confirmed. Table 2 shows that two-year and four-year college students used similar numbers of accommodations, with no significant differences between the two groups. Students at two-year and four-year colleges used a similar number of exam accommodations without technology, $X^2 (1, 116) = 1.70$, $p = 0.193$, exam accommodations with technology, $X^2 (1, 116) = 1.17$, $p = 0.280$, classroom accommodations without technology, $X^2 (1, 116) = 0.34$, $p = 0.562$, and classroom accommodations with technology, $X^2 (1, 116) = 0.01$, $p = 0.988$). Similarly, there is no significant difference between male and female students' use of exam accommodations (exam accommodations without technology, $X^2 (1, 110) = 1.78$, $p = 0.182$; with technology, $X^2 (1, 110) = 0.99$, $p = 0.310$; classroom / assignment accommodations without technology, $X^2 (1, 110) = 0.07$, $p = 0.794$; with technology, $X^2 (1, 110) = 0.03$, $p = 0.871$. Given these findings, we combined all participants for the rest of the analyses.

We also examined whether the 24 students who reported only mental health related disabilities differed from the rest of the sample in their use of accommodations. The results in Table 2 suggest that these students received significantly fewer technology-related accommodations compared to students with other disabilities, $t(116) = 2.45$, $p = 0.016$.

*Hypothesis 2* was confirmed. All students were most likely to receive exam accommodations followed by classroom/assignment accommodations (see Table 2). For both exam and classroom / assignment accommodations, students were most likely to receive non-technology related accommodations, followed by accommodations that were technology-related. A small percentage of students reported receiving accessible digital materials and academic and institutional support as accommodations. Only a few students (4%) said that they did not use accommodations that had been approved for them by accessibility services.

### *4.4 Question 3*

Table 3 indicates that students with disabilities most frequently used technology for writing, with 116 of 118 (i.e., 98%) students using at least one writing technology. Students' use of reading technology was slightly less common, with 103 of 118 (i.e., 87%) participants indicating that they used at least one reading technology. The least frequently used technology was for time management/organization/focus, with only 67 of 118 students (i.e., 57%) indicating that they used technology for this purpose. There were few differences between males and females in the use of technologies.

Table 3 also shows that the most popular technology for reading is an electronic dictionary / thesaurus, followed by a digital translator. Approximately one-third of students used text-to-speech and audiobooks. For writing, Table 3 shows that the most popular technology was a word processor, followed by spelling and grammar checkers, and the use of an electronic dictionary / thesaurus. Approximately 40% of students used word prediction. Relatively few students used speech-to-text, graphic organizers, text-to-speech for proofreading, or handwriting recognition.

It is important to note in Table 3 that students with only mental health related disabilities and those with no disabilities used reading, writing, and time management technologies with the same frequency, overall, as participants with other disabilities. However, there were some differences in the use of specific technologies, with fewer students with only mental health related disabilities or no disabilities using text-to-speech or audiobooks for reading and text-to-speech for proofreading.

### *4.5 Question 4*

*Hypothesis 3* was not confirmed. Table 4 shows that students who received either exam or classroom related accommodations with technology had a slightly, but not significantly higher, technology related self-efficacy score than students who received these accommodations without technology. A repeated measures analysis of variance (ANOVA), $F (2, 232) = 31.76$, $p < .001$, shows that students' confidence was highest in their use of writing technology.

Table 4. Accommodations with and without technology, self-efficacy and perceived benefits

| Type of accommodation | Self-efficacy (1-10) | | | | | | Perceived benefit (1-10) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Overall confidence in technology use | | Confidence in technology use for reading | | Confidence in technology use for writing | | Perceived benefit of technologies for reading | | Perceived benefit of technologies for writing | | Perceived benefit of technologies for work speed | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Exam accommodations - no technology | 7.99 | 1.74 | 7.43 | 2.35 | 8.52 | 1.62 | 6.53 | 2.46 | 8.56 | 1.90 | 7.15 | 2.06 |
| Exam accommodations - with technology | 8.08 | 1.60 | 7.57 | 2.40 | 8.60 | 1.45 | 6.90 | 2.60 | 8.50 | 2.24 | 7.28 | 2.30 |
| Classroom / assignment accommodations - no technology | 8.01 | 1.64 | 7.52 | 2.27 | 8.50 | 1.50 | 6.30 | 2.45 | 8.44 | 1.88 | 7.09 | 2.16 |
| Classroom / assignment accommodation - with technology | 8.14 | 1.83 | 7.62 | 2.60 | 8.67 | 1.46 | 6.31 | 2.81 | 8.36 | 1.62 | 6.93 | 2.17 |
| Accessible / digital materials | 8.23 | 1.81 | 7.64 | 2.91 | 8.82 | 1.47 | 7.27 | 2.66 | 8.64 | 2.07 | 7.23 | 2.68 |
| Ignoring accommodation type | 8.03 | 1.72 | 7.47 | 2.38 | 8.58 | 1.59 | 6.59 | 2.49 | 8.56 | 1.97 | 7.18 | 2.14 |

*Note.* 10-point Likert-type scaling: 1- strongly disagree, 10 = strongly agree.

Table 4 also shows that students with disabilities found technologies for writing to be more beneficial than technologies for reading or those that helped with work speed. The type of exam and classroom / assignment related accommodation (technology – no technology) was unrelated to how beneficial students found these technologies. A repeated measures ANOVA, $F$ (2, 232) = 64.04, $p < .001$, shows that students found writing technologies the most helpful.

There was no significant difference in grades (R-score: $t(67) = 0.70$, $p = 0.488$; GPA: $t(22) = 1.39$, $p = 0.891$, of students who received any kind of technological accommodation (R-score: $M = 27.61$, $SD = 4.31$, GPA: $M = 3.41$, $SD = 0.56$) and those who received only other kinds of accommodations (R-score: $M = 26.88$, $SD = 4.17$, GPA: $M = 3.44$, $SD = 0.72$).

Pearson product-moment correlations showed no significant relationship between the number of different accommodation categories used and grades (R-score: $r(68) = 0.07$, $p = 0.585$), GPA: $r(22) = 0.17$, $p = 0.431$), technology-related self-efficacy, $r(115) = 0.03$, $p = 0.775$, or perceived benefit ratings of technology for reading, $r(116) = 0.03$, $p = 0.725$) , writing, $r(115) = 0.002$, $p = 0.981$), or work speed, $r(116) = 0.01$, $p = 0.905$.

## 5. Discussion

### *5.1 Demographics*

#### 5.1.1 Students Had Multiple Impairments/Disabilities

Perhaps the most important of our findings for future research is that almost two-thirds of our participants reported multiple disabilities. Common comorbidities include: learning disability plus attention deficit hyperactivity disorder (ADHD) plus mental health related disability; ADHD plus mental health related disability; and chronic health condition plus mental health related disability. This leads us to wonder how the majority of articles on disabilities are able to provide clean, single disability categories for their samples.

In Quebec, a student typically is designated as having a single impairment, which is usually the one that will secure the most financial assistance from the government (personal communication). For example, a student with a mental health related disability and a visual impairment would be designated as a student with a visual impairment because funding is more readily available for that disability. We suggest that the practice of reporting only a single impairment, when it comes to journal articles, seriously compromises sampling integrity.

For the purposes of this study, we combined all students as we cannot report on accommodations for students with specific disabilities. If we did, had, we would have lost over half of our sample. Notwithstanding, we would like to note the very large number of students, 20%, who reported only a mental health / psychological disorder and almost 50% who reported this along with a comorbidity such as attention deficit hyperactivity disorder (ADHD) and/or a specific learning disorder. It would also be interesting to compare aspects of our results with data from students with disabilities who had not registered for disability related services.

#### 5.1.2 Gender

We should also note that six percent of students with disabilities did not identify as either male or female. While the percentage is relatively small, this suggests that surveys of students with disabilities should use inclusive gender designations. The New Digital Research Infrastructure Organization (2020) recommends that the following gender related designations be used on surveys: woman, man, nonbinary, gender fluid, trans man, trans woman, and Two-Spirit. The intersectionality of disability and gender designation, among other potential individual contexts, suggests that each person's experience can be influenced by many factors. This in turn, can affect needs, options, and choices when reporting on the experiences of students with disabilities.

We should note that there were no significant differences between the grades of students with and without disabilities, either in two, or four-year colleges. This was also true of students with mental health related disabilities.

*5.2 Types of Accommodations Received*

Consistent with Hypothesis 2, students most frequently reported receiving exam and classroom accommodations without technologies, followed by exam and classroom accommodations with technologies. Students less frequently reported receiving accessible digital materials, academic support, institutional support, and other accommodations. In addition, some students reported that they did not use all the approved accommodation.

Contrary to Hypothesis 1, the results show that the frequency of accommodation use was slightly higher among two-year college students than among four-year college students.

Similar percentages of males and females received technology related accommodations, a finding consistent with those of Malcolm & Roll (2017a), who also found that performance and satisfaction ratings for technology related services did not differ by gender. Although Abreu et al. (2017) reported that more frequent visits to the university's access center were related to higher student grades, we found no relationship between the number of different types of accommodations used and grades. However, Abreu et al. looked at number of visits while we looked at student use of different categories of accommodations.

Another issue concerns technology related accommodations for students with mental health related disabilities/impairments. Ko and Petty's (2020) scoping review about the technology needs of students with mental health disabilities suggests that this group of students, who typically report cognitive, academic and psychosocial difficulties, have only recently started to register for access services. Some of these students have little or no prior knowledge of assistive technology because they we re not provided these technologies in high school. In accordance with Ko and Petty's findings, the 24 students in our study with exclusively mental health related disabilities received somewhat fewer technology related accommodations than students with other disabilities, both when it came to exams as well as to classroom accommodations. Moreover, these students, as was the case for students without disabilities, reported using somewhat fewer different reading, writing, and time management technologies than students with other disabilities.

*5.3 Self-Efficacy and Perceived Benefit*

Hypothesis 3 was not confirmed, as students who received either exam or classroom related accommodations with technology had only slightly, but not significantly, higher technology related self-efficacy scores than students who received these without technology. Students were most confident about their use of writing technologies, which may result from familiarity with word processors such as Microsoft Word. Although the students considered most technologies to be beneficial, they found writing technologies to be most helpful. LD at School (n.d.) suggests that word processing software, such as Microsoft Word and Apple iWork – Pages can reduce the amount of time required for students to complete assignments and help with revisions and integrating feedback. Furthermore, editing software, such as Kurzweil and Read&Write, can help reduce the number of errors by improving spelling and grammar. Finally, collaboration tools, such as Google Docs and VoiceThread, can facilitate peer feedback for group projects.

*5.4 Exam Accommodations*

As others have noted, the most common accommodation did not involve technology, for extended time for exams was particularly popular (Abreu et al., 2017; Kociela, 2020; Gelbar & Madaus, 2021; Harrison et al., 2022). Students with mental health related disabilities often find extended time valuable because it can reduce the likelihood of panic attacks during an exam and because students have time to calm themselves down when needed (Bilton, 2017). Other exam accommodations that did not use technology include private rooms, access to the bathroom, permission to take small breaks, and the availability of a scribe (Havel, Wileman, & Arcuri, 2020). Technology-related exam accommodations were less common than those without technology. These consisted, primarily, of allowing students access to a computer, assistive technology such as Word-Q, and a grammar checker.

*5.5 Classroom / Assignment Accommodations*

Again, students most frequently reported receiving accommodations without technology in this category (e.g., extended time for assignments; oral presentations in front of fewer people; no deductions for errors when a computer is not accessible; no reading out loud to the class; preferred seating; and permission to arrive late for class - Havel, Wileman, & Arcuri, 2020). It is particularly important for post-secondary students with mental health-related disabilities to take preventative measures, rather than crisis-driven ones, to improve their mental health and achieve academically (Weiner, 2008). Accommodations with technology (e.g., use of a computer to take notes; permission to record lectures; use of a laptop) were also popular. These specific accommodations are similar to those noted by Paskins (2018) and by Raue and Lewis (2011).

*5.6 Other Accommodations*

Accessible / digital materials included e-text and large font documents, textbooks in accessible format, access to copies of online class documents, access to the instructor's Word or PowerPoint notes and slides, and provision of notes and slides before the class. These accommodations are also similar to those that students with disabilities in other institutions reported receiving (e.g., Abreu et al., 2017; Kociela, 2020).

As in other postsecondary institutions, students in our study mentioned the following accommodations (Havel, Wileman, & Arcuri, 2020): assistance with corrections; editing and formatting, help with studying; tutoring services; and tech support (e.g., Abreu et al., 2017). Institutional accommodations included early semester registration; psychological support; postponement of exams depending on the student's health; and opportunity to choose the student's internship first to ensure accessibility.

Of course, a few students also reported that they received accommodations that they did not use. This category included accommodations such as being provided with Kurzweil, text-to-speech, a Livescribe pen, as well as a note taker that was unnecessary (Havel, Wileman, & Arcuri, 2020). The literature indicates students frequently register with access services only to establish their accommodations, leaving many services unused (Abreu et al., 2017).

*5.7 Technologies for Reading, Writing, and Organization/Time Management/Focus*

Students most frequently reported using technologies for writing, followed by reading. Technology use for time management / organization / focus was the least common. There were few gender differences in the use of the three categories of technologies.

The most popular technology for reading was an electronic dictionary / thesaurus, followed by digital translation (Canada is a bilingual country and has immigrants from many lands). Text-to-speech and audiobooks were used by approximately one-third of students. For writing, the most popular technology was a word processor, followed by spelling and grammar checkers and an electronic dictionary / thesaurus. Word prediction was used by fewer than half of the students and relatively few used speech-to-text or graphic organizers, text-to-speech for proofreading, or handwriting recognition software. The most popular use of time management technologies was to help with organization and scheduling study time.

Students who reported only a mental health related disability, as well as those with no disabilities, were less likely to use technologies that are typically considered "assistive technologies" as opposed to general use technologies. This includes text-to-speech, audiobooks, speech-to-text and using text-to-speech for proofreading.

## 6. Limitations

We were unable to examine accommodations for students with different impairments because of the large number of students with multiple disabilities. Moreover, many of the students came from Quebec, a primarily French language province; this may have accounted for the importance of translation software. Larger research samples are needed.

## 7. Implications and Conclusions

Eligibility to receive accommodations is approached in various ways across postsecondary institutions. Although a student's experience of disability, barriers, and accommodations could be considered sufficient for establishing a need for accommodation, many institutions are still requiring documentation, including a clearly stated, updated diagnosis from a recognized professional. The participants in our study were also required to have a diagnosis but when they were asked to self-report, almost two-thirds indicated they had multiple disabilities. This differs from other studies on disabilities where researchers provide clean, single disability categories within their samples. In terms of future research, consideration should be given to the impact on findings based on self-report versus clinical diagnosis, as well as on single, versus multiple disability categories, as these distinctions may have bearings on the findings.

It is also noteworthy that data show that fewer than half of the students who self-report a disability are registered to receive accommodations (Cohen et al., 2020; Fichten et al., 2018; 2019b; McGregor et al., 2016; Newman et al., 2016; Parsons et al., 2021). Considering this statistic and factoring in our findings of self-reported multiple disabilities, it begs the question of whether the need for documentation presents a barrier to eligibility and should be reconsidered for government regulations regarding funding and for institutional guidelines to allow for greater access to accommodations for students with a history of academic challenges.

There has been some debate as to whether the use of accommodations is indicative of autonomy or dependency on the part of students with disabilities. In our study we found no relationship between the number of different types of accommodations used and students' grades. When it came to technology self-efficacy, the students in our study who received either exam or classroom related accommodations with technologies had slightly, but not significantly higher scores than students who received these without technology. It might be worthwhile to further examine the relationship

between students' use of accommodations, their academic performance and perceived technology self-efficacy. Having this data could prove helpful, as some stakeholders have erroneously judged that the efficacy of a service or the autonomy of a student are correlated with a decrease in the use of accommodations.

Non-technology related accommodations were most common, followed by technology related accommodations, in both exam and classroom related categories. However, students without disabilities in our study, who were not eligible for accommodations, used technologies at the same rate as the participants with disabilities. Perhaps this is an indication that the ubiquitous presence of technology is changing the way we think about computers and mobile devices in our classrooms and in our daily lives. If all students - those with and without disabilities - continue to have access to technology while completing academic work and writing exams, it could further remove the need for certain technology related accommodations. This holds greater impact as more students with disabilities gravitate to general use rather than assistive technologies (Fichten, Havel, Tremblay, & Arcuri, in press), which may bring us a step closer to an accessible environment for all students.

In our study, the students with only mental health related disabilities received somewhat fewer technology related accommodations than students with other disabilities, both when it came to exams as well as classroom accommodations. As the most common disability reported is mental health related difficulties, it would behoove us to take a closer at this group of students, to explore what accommodations might be more beneficial than originally considered and what role technology could play in their academic success. The fact that our sample featured a high comorbidity of mental health, ADHD and learning disabilities, further strengthens the argument that accommodations decisions, including the use of technology, needs elucidation for this population. Greater access to technology for all students might further mitigate the challenges of accessibility and inclusion at the post-secondary level.

The most common accommodation in our study, as others have also noted, was an exam accommodation that used no technology, with extended time for exams being particularly popular. Proponents of a universal design approach which, in practice, should reduce the number and types of accommodations needed, have supported the notion that if all students are given sufficient time to complete an exam, extended time is no longer required. For example, a professor may feel that extended time is already built into a scheduled three-hour exam if most students only need two hours to complete it and, therefore, 50% more time or four and a half hours total is not necessary. Is this a rationale in support of universal design or an excuse to deny an accommodation? Until we understand more through research about the impact of extended time for exams, or about how to judge the amount of time needed, extended time should remain an integral accommodation. Spenceley and Wheeler (2016) provide an interesting report on this topic.

What is perhaps most interesting in the findings is what is not considered to be assistive technology. General use technologies such as Microsoft Office and Google Docs, utilized by most students in this study, are increasingly used as adaptive aids (Chmiliar & Anton, 2018; Fichten et al., 2013; Fichten, Havel, Tremblay, & Arcuri, in press). Mobile technologies, both general use (e.g., Evernote, Quizlet) and assistive technology apps (Read&Write, VoiceOver) and devices (e.g., smartphones, tablets), were simply not mentioned as accommodations. Yet many students employ general use and mobile apps as assistive aids. In the future, providing technology related accommodations is likely to include showing students how to utilize general use software and mobile apps to do schoolwork.

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