Examining Factors that Support Continued Use of Assistive Technology by Postsecondary Students with Disabilities

Lauren D. Goegan, University of Alberta, Canada
Lily Le, University of Alberta, Canada
Brigitte P. Rioux, University of Alberta, Canada
Lia M. Daniels, University of Alberta, Canada

Abstract: Students with disabilities are attending postsecondary institutions in growing numbers. As such, disability service providers on campuses are providing more accommodations, including assistive technology (AT). AT can help students with a variety of learning needs; however, many students discontinue use despite the benefits that this technology can provide. To increase our understanding of discontinued use of AT, we collected both quantitative questionnaire data and open-ended written qualitative data. First, we examined three factors theorized to relate to continued use of AT and found that individual factors were more important than the environment or characteristics of the technology itself. Second, we investigated students' experiences with AT training and determined that the quality of the training experience and not simply attending training, was related to continued use of AT. Furthermore, we provide recommendations for individuals providing training to students. Collectively, the results provide the basis for suggestions concerning support and services offered to students utilizing AT.

Keywords: Assistive Technology (AT), Postsecondary Education, Higher Education, Students with Disabilities, Motivation

Introduction

As more employers view postsecondary education (PSE) as a requirement for high salary jobs (Sharpe, Johnson, Izzo, & Murray, 2005), a wider range of people are pursuing PSE with the hopes of increased probability of gainful future employment (Lang et al., 2014). One quickly expanding population at postsecondary institutions is students with learning disabilities (McCloy & DeClou, 2013; National Center for Education Statistics, 2015; Ofiesh, Rice, Long, Merchant, & Gajar, 2002; Parker & Banerjee, 2007; Sharpe et al., 2005). For example, there has been a dramatic increase in the number of students who register with disability resource centres on campuses in Canada, with increases of up to 66 percent across postsecondary institutions between 2003 and 2011 (McCloy & DeClou, 2013). Unfortunately, 11% of students with disabilities have been reported to stop attending school early because of their disability (Canadian Human Rights Commission, 2017) making it critical to ensure that students are offered appropriate supports and services. With proper supports in place, postsecondary institutions can make the necessary steps to reduce the number of students leaving school, and maximize their chances of success.

To maximize their chances of success, students with disabilities seek out and are offered accommodations when completing their PSE. There are many types of accommodations including extended time or private spaces for testing and classroom supports such as notetakers or recordings (Kim & Lee, 2016; Lindstrom, 2007). Although many forms of accommodation are important, we focus on the role of assistive technology (AT) because it has been found to be essential to student success at postsecondary (Lang et al., 2014). Despite the popularity of AT (Fichten, Asuncion, & Scapin; 2014; Parker & Banerjee, 2007) and its effectiveness (e.g., Holmes & Silvestri, 2012), many students appear to stop using AT. Thus, the purpose of this research was to increase researchers and service providers understanding of students continued or discontinued use of AT at postsecondary institutions by focusing on key individual, environment, and technology-related factors including the training students receive with their AT.

Research on Assistive Technology

AT has been described by researchers and users alike as "essential" (Lang et al., 2014, p. 73) and classified as one of five critical needs of students with disabilities at postsecondary institutions (Webb, Patterson, Syverud, & Seabrooks-Blackmore, 2008). Given this status, the use of AT has grown significantly over the last decade (Holmes & Silvestri, 2012; Parker & Banerjee, 2007). Research examining AT use by students has investigated various devices and technologies including: scanners (digital text), talking-books, tape-recorders, voice-recognition software, word prediction software, graphic organizers, and screen readers, among others (Asselin, 2014; Holmes & Silvestri, 2012; Mull & Sitlington, 2003; Sharpe et al., 2005). Research has found that students with disabilities use AT more often at the postsecondary level than in high-school (Sharpe et al., 2005). Despite increased usage and recognized need, research at postsecondary remains lacking and what does exist shows that students regularly abandon AT (Goodman, Tiene, & Luft, 2002; Holmes & Silvestri, 2012; Lang et al., 2014; Mull & Sitlington, 2003;

Roberts & Stodden, 2005). Early work in this area by Gavlin and Scherer (1996, as cited in Goodman et al., 2002) reported abandonment rates with an average of one in three students discontinuing use, with most abandonment happening in the first three months.

In exploring abandonment of AT the empirical work thus far has involved literature reviews and qualitative research methods using open-ended surveys and interviews. For example, literature reviews on AT abandonment highlight a list of typical reasons provided by students for abandonment accompanied by a descriptive account for their reasons (e.g., Day & Edwards, 1996; Alper & Raharinirina; 2006). The qualitative studies involve focus groups, interviews, or surveys and also provide a retrospective descriptive account of reasons for user abandonment (Garrison-Wade, 2012; Parker & Banerjee, 2007). This work has contributed important information around why students continue or discontinue to use their AT. Nevertheless, the discontinued use of AT by students continues at postsecondary institutions, and with increasing numbers of students with disabilities on campuses, more work in this area is needed. There is a need for quantitative research that can complement the existing research. This quantitative research can provide data that could be utilized to make predictions regarding discontinued use of AT based on the factors related to abandonment outlined in previous research.

Factors Related to AT Use

Lang and colleagues (2014) recently conducted a literature review in order to examine contemporary perspectives on students with disabilities at postsecondary institutions and the obstacles they experience when attempting to utilize AT. In their investigation, it was determined that there were three main factors related to abandonment or continued use of AT: environment, individual, and technology. The *environment* factor refers to the attitudes of instructors towards AT and the general climate of support and acceptance. *Individual* factors related to abandonment included things like the student's own motivation and self-advocacy skills. Finally, characteristics of the *technology* itself such as how much maintenance the AT requires (e.g., updates) and how easy it is to use were associated with abandonment. Identification of these factors represents an important advancement in understanding students use of AT, but they have yet to be examined in terms of predictive relationships with students' continued or discontinued use of AT. As such, our research will build on these three factors (environment, individual, and technology) outlined by Lang et al. (2014) to investigate continued and discontinued use of AT at postsecondary.

AT Training

A special component of the environment factor is AT training. Indeed, disability resource centres dedicate substantial time and resources to training. While a positive association has been noted between academic performance and AT training, the specific details of the training are often not included or are vague (e.g., Chiang & Jacobs, 2009; Roberts & Stodden, 2005). This can lead to speculation as to what elements of training were present and how each element impacts continued use of AT. Research by Abreu-Ellis and Ellis (2006) surveying disability service providers at postsecondary institutions in Ontario found that 94 percent of providers agreed that students required AT training; however, almost a third of the providers surveyed did not believe that their institution provided sufficient technology resources to meet the demands of students. This discrepancy highlights that more information on training as a specific component of the environment is needed. Bringing students' perspectives on training to bear on their continued or discontinued use of AT would represent a meaningful advancement for research and potentially for practice.

The Current Research

Even though students recognize the potential benefits of utilizing AT, they frequently abandon their AT (Holmes & Silvestri, 2012; Roberts & Stodden, 2005). Therefore, the purpose of the current study was to increase our understanding of continued and discontinued use of AT by students with disabilities at postsecondary institutions by: (1) examining environmental, individual, and technology factors related to abandonment; and (2) examining how students' experiences specifically with AT training relate to abandonment. To increase our understanding of the differences between students who continue versus discontinue use of AT we asked the following questions:
1. Do students who continued to use their AT respond to the environment, individual, and technology factors differently than those who discontinued use of AT?
2. Do environmental, individual, and technology factors predict membership into either a continued or discontinued group?

3.   How do students' descriptions of reasons for continuing or discontinuing support the quantitative results?

To increase our understanding of how AT training specifically relates to continued versus discontinued AT use we asked:

4.   Can we predict continued use of AT based on whether a student attended training and/or their experiences with training?
5.   What recommendations do students make for training that can support the development of this type of training in the future?

Overall, the results of this study can be used to explain AT abandonment as well as offer recommendations for how to reduce abandonment according to general factors and by focusing on training specifically.

Method

We employed a correlational research design that involved collection of both quantitative questionnaire data and open-ended written qualitative data. The qualitative data was analyzed to provide more information about the quantitative results (i.e., the factors that impact continued or discontinued use of AT). Students were recruited through disability resource centres at three postsecondary institutions in Western Canada. These centres each provide services to between 950 and 1450 students each year. Of the students who access services from these centres, approximately 25% access AT services. The project was approved by the Research Ethics Office at the researchers' postsecondary institution. Also, the project was approved by the Research Ethics Boards of other participating postsecondary institutions.

Participants and Procedures

During the fall semester (September to December) of 2016 three disability resource centres emailed their students who accessed AT services a link to our study. One hundred and three students clicked the Survey Monkey© link to the questionnaire. Informed consent was implied through completion of the questionnaire. Eighteen participants were excluded from the analyses because they accessed but did not complete the questionnaire. The remaining 85 participants ranged in age from 17 to 53 ($M = 27.40$ years) and predominantly identified as female (70%). The majority identified as white/Caucasian (82.5%), with others identifying as black (3.9%), Asian (3.9%), Aboriginal (1.9%), or other (7.8%). Twenty-six students were in their first year, 35 in their second, 16 in their third, 16 in their fourth, and six identified as being in their fifth year or higher (four did not respond to this question). Students were asked to identify their primary disability, with the three most common identified were learning disability (LD; 33%), attention-deficit/hyperactivity disorder (ADHD; 18.4%) and a psychiatric disorder (e.g., anxiety disorder or depression; 18.4%).

In addition to providing descriptive information, participants ($n = 85$) completed Likert-style questions about how environmental, individual, and technology factors influenced their experience with AT as well as had a chance to provide written comments explaining their choices to continue or discontinue use. Next, students indicated if they had attended AT training. Those who had attended training ($n = 62$) completed Likert-style items specific to the impact of training on their AT experience and were provided an option to provide additional comments.

Measures

Grouping variables. Participants self-classified themselves as having continued or discontinued use of AT at the time they completed the survey and self-identified if they attended AT training or not. Specifically, participants answered yes or no to the following two categorical variables: *Have you received any Assistive Technology training through [name of specific DRC]?* and *Do you still use this AT?* We treated status of AT use (continued versus discontinued use) as a categorical criterion variable. We treated the training item as a filter variable to isolate those who received training from those who did not.

Factors contributing to abandonment. In consultation with disability resource personnel we created questionnaire items to measure each of the three theorized factors associated with continued use or discontinued use of AT (Lang et al., 2014). In total, eight items asked about the *environmental factors*, nine asked about the *individual factors*, and nine were created relating to *technology factors*. For each of these items, students responded

on a scale from 1 (strongly disagree) to 6 (strongly agree) regarding how the item related to their experience with the AT they use(d) the most. Students were also asked to provide open comments on why they do/do not continue to use the AT to supplement the quantitative items.

Experience with training. In consultation with disability resource centre personnel, we created 12 questionnaire items to measure students' experiences with AT training: Seven of these items were specific to the resource centre's evaluation and the remaining five were intended for our research purposes. For each of these items, students responded on a scale from 1 (strongly disagree) to 6 (strongly agree) regarding how the item related to their experience with the AT training. We then created a summed scale, referred to as the *experiences with training* variable, wherein higher scores represented a better experience with AT training. The final items and Cronbach's alpha for internal consistency are presented in Table 1. Participants were also asked to respond to the following open-ended question: "*What recommendations would you make for future AT training offered by [name of specific DRC]?*" Students were able to include any information they felt was important for future training.

Table 1: Items for Experience with Training

Experience with Training (r = .94)
The training was effective for my learning needs.
This training helped me learn about my AT better.
The training helped me to be more independent with my studies.
The training made me more likely to use my AT in the future.
I was provided with enough training to use the AT on my own.

Results

Preliminary Analyses: Environment, Individual, and Technology Factors Scale Creation

To examine the factor structure of the researcher-created items related to environment, individual and technology, we entered all 26 items into an exploratory factor analysis (EFA) using principle component analysis with a Varimax rotation. A Varimax rotation was selected as it is the most common and recommended option (Tabachnick & Fidell, 2013). Utilizing the Kaiser criterion (Costello & Osborne, 2005), all factors with an eigenvalue greater than one were retained, producing three factors, utilizing a total of 18 of the original 26 items, that matched the constructs for which the items were created. After removing items that had low or cross loading, the final scales included four items to measure environment, eight items for individual, and six items for technology. The items, factor loading and Cronbach's alphas for the scales are presented in Table 2 and correlations between the factors are presented in Table 3.

Table 2: Items for the Environmental, Individual and Technology Factors

Environmental Factor (r = .80)
The university support services offered training for the AT.
The AT was easy for me to access.
The AT was provided to me in a reasonable amount of time.
I was provided with a number of AT options.
Individual Factor (r = .93)
The AT helped with the academic demands of my course(s).
I was personally motivated to use the AT.
I feel I have the necessary skills to use the AT.
My performance as a student was enhanced using the AT.
Using the AT improved my grades.
I had the necessary patience to learn how to use the AT.
I recognized that I had a real need for the technology.
I had realistic expectations of the technology.

Technology Factor (r = .90)

      The AT did not require a lot of maintenance (software updates, etc).

      The AT always functioned as intended.

      The AT was reliable (e.g. did not breakdown or stop working).

      When the AT did stop working, it was easy to fix the problem on my own.

      Using the AT did not require much assistance from another person.

      The AT did not require a lot of training.

Table 3: Correlations Between Measures

	1	2	3	4
1. Use of AT	-			
2. Environmental	.29**	-		
3. Individual	.58***	.64***	-	
4. Technology	.39***	.49***	.48***	-

*Note. * $p < .05$, ** $p < .01$, *** $p < .001$;
Use of AT: 2 = continued use, 1 = discontinued use

Environment, Individual, and Technology Factors and Abandonment

Research question 1. We compared students who continued to use their AT ($n = 63$) and those who discontinued use ($n = 22$) on the environment, individual and technology factors to determine if there were group differences on these factors. We utilized three independent samples *t*-tests with a Bonferroni correction to control for Type I error, $p < 0.017$. We examined the distribution of our sample and examined the Levene's test for equality of variance. The assumption of equality was met for environment but not for the individual and technology factors. Students who continued to use their AT had higher scores on the individual factor than those who discontinue use (Table 4). The mean differences between students who continued to use their AT and those who discontinued use on the environmental and technology factors were not statistically significant.

Table 4: Comparing Students who Continue and Discontinue Use of AT

Scale	*Full Sample* ($n = 85$)		*Continue Use* ($n = 63$)		*Discontinue Use* ($n = 22$)		df	t	p
	M	SD	M	SD	M	SD			
Environmental	5.09	.91	5.24	.77	4.63	1.13	81	2.31	.029
Individual	4.89	.99	5.23	.68	3.91	1.09	81	5.16	<.001*
Technology	4.61	1.06	4.84	.67	3.88	1.61	81	2.58	.018

Note. Scores are based on the average score on scale items. *$p < .017$.

Research question 2. We used a logistic regression to answer our second research question: do environmental, individual, and technology factors predict membership into either a continued or discontinued group? The model was statistically significant, $\chi^2(3) = 27.13$, $p < .001$. The model explained 44.5% (Nagelkerke R^2) of the variance in continued use of AT. Prediction success was 84.6% overall. The Wald criterion demonstrated that only the individual factor significantly predicted continued use of AT ($p = .001$); whereas, the environmental and technology factors did not. The Exp(B) value indicates that when the average response on the individual scale is increased by 1 unit, individuals are 5.91 times more likely to continue their use of AT.

Research question 3. We conducted a deductive thematic analysis (Nowell, Norris, White, & Moules, 2017) to determine the consistency of students open-ended experiences with AT with the quantitative results presented above. These experiences were used to determine if reasons for continuing or discontinuing use of AT supported the quantitative results. Based on the quantitative results that showed individual factors as important for continued use, we focused on determining if students in the continued use group would make more comments about how individual

factors supported them than those in the discontinued group. The first and second author coded the data independently beginning with the continued use group, and then compared their themes. They discussed differences in coding until they reached a consensus. We identified three themes that were the same for both students who continued to use AT and those who discontinued use: (a) personal benefits, (b) challenges, and (c) focus. Although the themes were consistent across the groups, the comments show that where students in the continued use group saw benefits of AT students in the discontinued group did not. A summary is provided in Table 4.

Table 4: Thematic Analysis with Students who Continue vs. Discontinue use of AT

Theme	Students who Continued Use	Students who Discontinued Use
Acknowledgement of personal benefit from using AT	Benefits from using the AT: • Stay on track • Helpful / Helped • Makes work easier	No Benefits from AT Use: • Not helpful • More of a hassle • Creates extra work
Challenges	Ability to overcome challenges with the use of AT: • Difficulty with reading, AT helps them overcome those challenges Challenges related to their disability able to overcome • Due to disability, AT helped them overcome challenges associated with their diagnosis	Technology its self as a challenge • Training was cumbersome, challenging to learn • The AT stopped working properly, challenge to get it working properly.
Focus	Maintain focus with AT • Focus more in class rather than focus on taking notes	AT was distracting • Encouraged me to not focus in class

The first theme that we identified from the students' responses was the acknowledgement of a *personal benefit* from using the AT. Students in the continued use group highlighted the benefit they received from the AT as a reason why they continue to use it: "Because it helps me stay on track with my textbook readings," "Because it helps me to be able to go back and re-listen to what the instructor said," and "It's helpful when I'm studying and writing my assignments. It's make [sic] the process faster, and I typically make less mistakes, as a result I'm understanding more of what I'm reading or writing." On the other hand, those who discontinued their use of AT commented that there was no benefit from the AT: "It was not helpful to me at all," "I found it more of a hassle than a benefit," and "creates extra work."

The second theme that we identified from the students' responses was related to *challenges* experienced with their AT. Students who continued to use their AT perceived that they could overcome the difficulties of their disability because of AT. For example, one student wrote that "Due to my ADHD my mind wanders and the [AT] gives me piece of mind that I never miss a thing," "Because it helps me when I write tests since I have a reading and writing disability," and "Because I still have the learning disabilities I have and I find I am much a more successful student with the [AT]." For those students who discontinue use, the AT introduced challenges in addition to their disability. For example: "The training process was cumbersome for [AT]; a lot of time is required to get it to recognize my speech, let alone jargon-heavy language," "It stopped working properly," and "being in [name of academic program], there are a lot of equations and diagrams, which it can't really handle and doesn't integrate well." Therefore, students who continued to use their AT, discussed challenges they were able to overcome with the AT, while those who discontinued use discussed challenge in terms of using the AT.

The third theme that we identified from the students' responses we named *focus*. This theme included comments where the student identified the AT as helping them focus better on their work, or, if the AT was a distraction (i.e., reduced their focus on a task). Students who continued to use their AT mentioned that the AT

helped them maintain focus: "Allows me to focus more in class rather than focus on taking notes," "Because I have dyslexia and ADHD, and I can't follow in class without it," and "During tests I use it, especially for the tacking function when going over word for word, allows me to read questions properly and not miss or add in anything." The opposite was found for students who discontinued their use of AT as they commented "I found it distracting more than anything" and "I found that it encouraged me not to focus in class, because I could just record and listen to the lecture later . . ."

Training and Abandonment

Research question 4. We were interested in predicting continued use of AT by students based on whether a student attended training and their experiences with training. Before we examined our main research question, we examined descriptive statistics and correlated the two grouping variables with the experiences with training variable. Of the 85 students who completed our questionnaire, 62 students responded that they had received training (72.9%), 20 responded they had not (23.5%), and three individuals did not respond to the question. Additionally, of the 62 who said they had received training, 77.4% indicated they continued to use the AT. However, simply receiving training was not significantly correlated to continued use of AT (Spearman correlation $r = .20$, $p > 0.05$). In contrast, students' experience with training was positively associated with continued use of AT (Pearson $r = .35$, $p = .004$). Therefore, based on our initial correlational analysis, receiving training was not significantly related to continued use of AT, but rather experiences associated with that training was positively related to continued use of AT.

Next, we performed a logistic regression in which accessing training and experiences with training were included as two predictors of continued/discontinued use of AT. Overall the regression was statistically significant $\chi^2(2) = 26.56$, $p < .001$, and the model explained 18.7% (Nagelkerke R^2) of the variance in continued use of AT. Furthermore, the Wald criterion demonstrated that only a positive experience with training significantly predicted continued use of AT ($p = .008$), while simply accessing training did not ($p > .05$). Overall our logistic regression accounted for a fifth of the variance in the continued use.

Research question 5. Given that experiences with training were related to continued use of AT, we sought to capitalize on students' recommendations for training through a qualitative inductive analysis (Thomas, 2006). Thus to answer our final research question, we examined students responses to find themes in their recommendations. The first and second author coded the data independently and then compared. The codes were grouped into themes by the first and second author collaboratively. We identified the four overarching themes: (1) booking appointments, (2) format of training, (3) individuals providing training, and (4) resources after training (see Figure 1). These recommendations highlight important considerations if services providers and looking for ways to create a more positive training experience that can be predictive of continued AT use.

The first recommendation was related to booking appointments. This included being able to schedule appointments online, having more options for appointments (e.g., group sessions, drop-in) and more training times available. These opinions can be seen in the following comments: ". . . group sessions, drop-in. I like this idea of knowing when it is so I can come by, not have to make an appointment," "online-booking of appointment," and "more appointment options, I found it hard to get in for one on one appointments."

The second type of recommendations was related to the format of training. Students had a number of suggestions for how future training should be structured. This included the frequency and structure of training sessions for example: "regular on-going training sessions as needed as technology advances." Another student said

> Do a set of 2 appointments with the software, in the first one show the basics then the student goes and practices. In the second they come back, review and show what they know, then go over the more complicated bits of the software.

Students also mentioned a number of teaching approaches that could be adapted for future training and the format utilized. For example, students mentioned: "all the teaching was strictly oral," "printed notes or easy to access tutorials, for important things," and "I would suggest allowing the student to play with the AT instead of the trainer just showing the student everything."
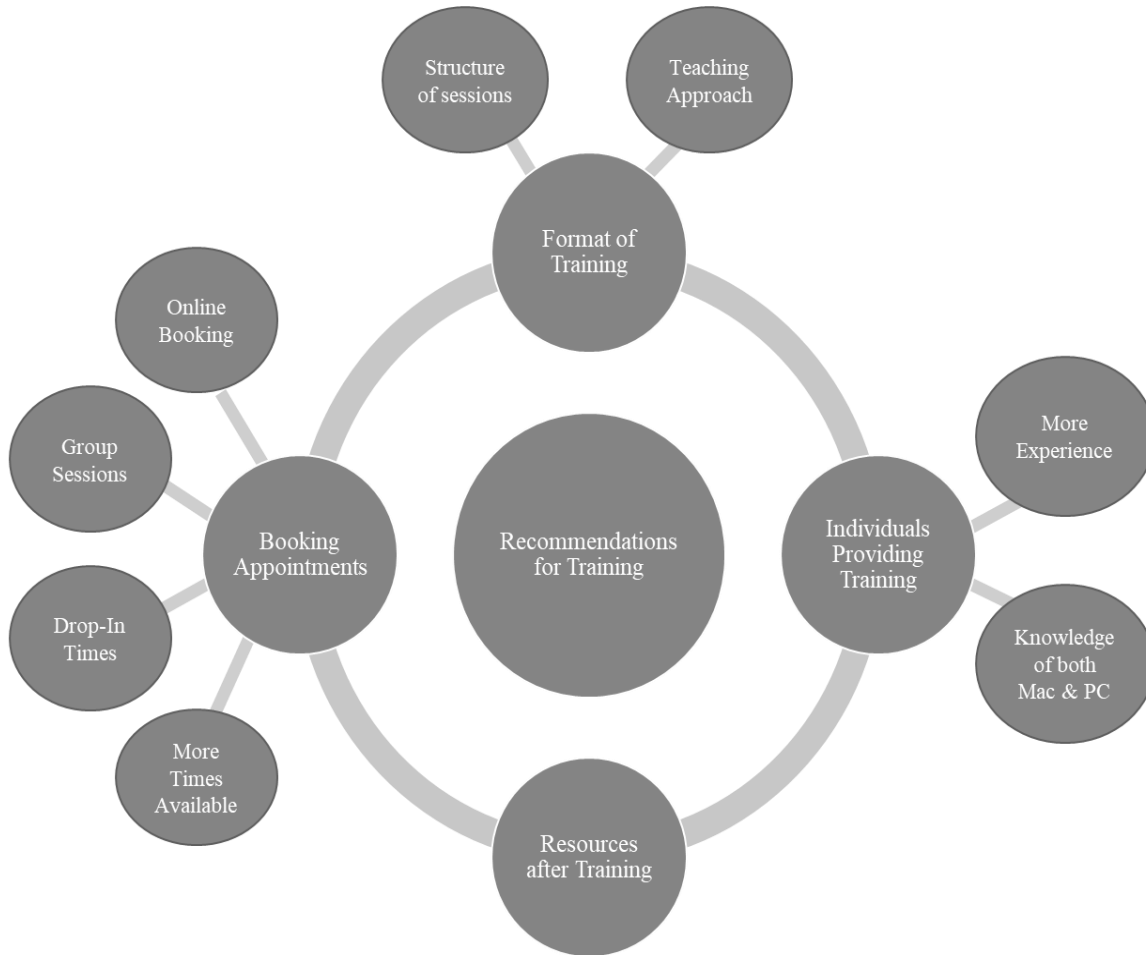
Figure 1: Training Recommendations

The third type of recommendation was related to the individuals providing the training. In particular, students felt that these individuals needed to have more experience with the ATs they provided training for, by example: "more experienced staff, it seemed like they were learning the AT too, rather than able to teach it." Students also commented on the difficulties when it came to differences on Mac and PC version of the software and the instructors' knowledge of one over another, for example, "make sure instructors know/have access to all key commands for Mac and PC."

Lastly, students recommended that additional resources be available once training concluded. This could include resources with simple explanations and instructions for students who have difficulty remembering how to utilize their AT once they have finished training. For example, one student said: "A brief, simple printed resource with explanations and instructions afterwards would be helpful for [the AT], especially as a refresher without needing to book another full training session." These suggestions offer services providers valuable information for providing training to future students.

Discussion

Our research examined why some students with disabilities discontinued their use of AT while other students continued their use of AT. We examine these two groups in relation to three common factors involved in AT use generally and AT training specifically. In this discussion, we focus on how the findings can expand our current understanding of students' use of AT. Specifically, we discuss: (a) the environmental, individual, and technology factors in relation to continued or discontinued use of AT; (b) the importance of the individual factor; (c) the importance of training for students with disabilities when it comes to their use of AT; and (d) the insights gained

from examining students' open-ended responses. Following this, we offer suggestions as to what our results mean for supports and services offered at the postsecondary level. In closing, we will also discuss the limitations of our research and recommendations for future research.

Environment, Individual and Technology Factors in Relation to Continued Use of AT

Based on the results, we were able to identify a connection between the environmental, individual and technology factors, and students continued or discontinued use of AT. Indeed, students who identified higher scores on these factors were also more likely to continue to use their AT in the future. This is consistent with previous research that examined influences on students continued use of AT (Alper & Raharinirina, 2006; Garrison-Wade, 2012; Goodman, et al., 2002; Parker & Banerjee, 2007). Furthermore, we utilized the three factors related to continued use of AT outlined in the literature review by Lang and colleagues (2014), and were able to provide some quantitative evidence as to the influence of these factors on continued or discontinued use of AT, thereby building on the work of previous research.

Individuals involved with support services who are providing assistive technology to students should be aware of environmental factors, which can include: offering training to students, making AT easily accessible to students, ensuring that AT is provided in a reasonable amount of time and providing a number of AT options. Additionally, the type of AT that is recommended needs to be given a number of considerations. For example, does it require a lot of maintenance (e.g., software updates)? Is it reliable, are problems that arise easy to fix, and how much training does the AT require? These questions are important to address when it comes to selecting appropriate AT for students. Service providers could produce a checklist of criteria to consider when providing students with AT to aid them in this process. This checklist could include the factors and items from our research here

The Importance of The Individual Factor

The factor that had the highest association with continued use of AT was the individual factor; moreover, this factor was the only one that was able to predict membership into the continued or discontinued use groups in our first logistic regression. Therefore, while all of these factors are important for students to continue to use their AT, emphasis should be placed on ensuring these individual factors are supported when providing students with AT, where possible. For example, the individual factor included the items such as: I feel I have the necessary skills to use the AT, I recognize that I had a real need for the technology, and I had realistic expectations for the technology.

While they are considered individual factors, they can be influenced by disability service providers on campuses. For example, students recognizing their need for technology can be done in consultation with disability resource centre personnel when describing the AT options available to the student. There are many different technologies students can access, and ensuring the right fit to support them is critical. This is also related to having realistic expectations for how the technology will support students. Therefore, disability service providers need to be mindful of how they are presenting the technology to students. For example, what the technology can reasonably assist students with, and its potential limitations, so that students can accurately assess their need for the technology, and have realistic expectations for when they use it.

Disability support services can also play a pivotal role in ensuring that students are provided with the skills to utilize the technology effectively through training, providing students with specific technology that meets their learning needs, and communicating the functionality and use of the AT to ensure that students have realistic expectations for use. This highlights the importance of positive training experiences identified in the second logistic regression. If these elements are in place, our research suggests that students would be more likely to continue to use their AT in the future. Therefore, service providers should consider the factors utilized in our research when developing AT training.

The Importance of Training for Students with Disabilities

Our findings highlight the importance of the quality of training that is provided to students with disabilities who are learning how to use various ATs. Our results suggest that simply attending training is not sufficient for students to continue to use their AT. Therefore, service providers that are providing students with training for their AT need to consider how the training is delivered, by whom, and what resources are available to students. Indeed, it was

positive experiences with training that were significantly correlated with continued use of AT, and significantly predicted continued use. Therefore, training needs to be designed in a way that is congruent with students learning needs, ensuring that they are properly supported in their initial experiences with AT which can increase the likelihood of future use. Nevertheless, our logistic regression was only able to account for a fifth of the variance in the continued use, and further investigation is needed to examine additional components involved that could impact students use of AT.

Insights Gained from Examining Students' Responses

Thematic analyses further highlighted the importance of personal appraisals in connection with continued or discontinued use of AT, providing additional information that is in line with our quantitative results. Indeed, those who continued to use their AT noted a number of personal benefits that they obtained from using the technology, such as assistance with textbook readings, the ability to listen to lectures more than once, and benefits for writing assignments. In contrast, those who discontinued use of AT commented on receiving no benefit, with one student suggesting "it was not helpful to me at all." Considering that individuals in both groups utilized similar ATs, the differences in their perceptions of the personal benefits from the AT are important to note. The idea of benefit can also be seen in some of the specific items included in the individual factor, for example, my performance as a student was enhanced using the AT.

To assist students in continuing to use their AT, service providers should place some focus on ensuring students see the benefit from utilizing AT, and how the AT can support students. It would be beneficial for service providers to follow up with students after they have been using their AT for a week or two. This follow up will allow them to support students who might still be struggling to use the AT, or are having challenges integrating the AT into their studies. Following up with students after a week or two, or providing regular follow up opportunities, gives services providers a chance to offer additional information, resources or training before the AT is abandoned. Furthermore, future research should examine other individual differences such as the student's disability and type of AT to further understand how to support students with their AT.

The thematic analysis also highlighted the importance of self-perception, particularly in the theme related to challenge. For example, those in the continued group commented on challenges they experienced because of their disability, and how the AT helped them to overcome those challenges; while those who discontinued use simply highlighted challenges with the use of AT (as noted above). Students who continued to use their AT may have higher levels of self-awareness, in that they were able to identify the areas where they experienced difficulties, and found appropriate assistance through the use of AT. This self-awareness might also be related to their self-efficacy (Zimmerman, 2002), in that those who continue to use the AT also felt they had the necessary skills to use the AT. These combined personal appraisals and self-perceptions impact the potential for one to continue or discontinue use of AT.

Supports and Services at Postsecondary Institutions

Our results provide important information for postsecondary institutions about services and supports available to students. While the three institutions that were surveyed offered a number of training options when it came to the use of AT, we offer some recommendations. Indeed, the suggestions of multiple formats for training and availability of resources highlight the importance of accessibility of training for students with diverse learning needs. If service providers have an intake meeting with students before accessing training, it could be advantageous to ask questions about how the student learns best. Based on the student's answers, one form of training might be recommended over another. Offering different formats for training ensures that each student can be supported in their learning.

Additionally, considering who is providing training is important for ensuring proper training. Holmes and Silvestri (2012) identified the background expertise of personnel providing training in AT was a challenge faced by postsecondary institutions and the comments by our participants also acknowledge this challenge. Furthermore, providing additional options around booking appointments and additional resources speaks to the importance of providing not only training but ongoing support for students learning how to utilize AT (Ofiesh et al., 2002). This could be accomplished through drop-in hours, refresher workshops offered during the semester, or having videos or handouts available online for students to access. Follow up communication, as mentioned above, could also assist with supporting students after training.

Based on the items from the individual factor, training needs to ensure that students take away the necessary skills to use the AT, as those who endorsed this item to a greater extent were more likely to continue to use their AT. This is consistent with the thematic analysis we conducted which identified that students who discontinued use of their AT noted a number of challenges they experienced while using it. This could be taken to suggest perhaps their personal appraisal that they did not have the necessary skills or knowledge to adequately use the technology provided. Moreover, training should ensure that all skills necessary to properly utilize the AT are addressed. One avenue through which this can be accomplished is through the use of videos and other take-away materials for students noted above.

Ensuring that students are provided with appropriate AT for their learning needs is an important role of disability resource offices. Additionally, these offices secure funding for eligible students though the Federal/Provincial Grant for Postsecondary Students with Permanent Disabilities (Alberta Student Aid, 2017). Additional information around funding for AT can be found on for each province online (e.g., https://studentaidbc.ca and https://studentaid.alberta.ca) Administrators at these offices need to ensure that students themselves identify the benefits of using the technology, instead of being provided with technology based on a one-size-fits-all mentality. One potential way this can be accomplished is through intake interviews with students to investigate which AT options students perceive as best for their learning needs and the type of courses they are required to complete at postsecondary.

A second possibility is to provide trial technology for students. Indeed, with research reporting discontinued use of AT at rates of one in three individuals, with most occurring within the first three months (Gavlin & Scherer, 1996 as cited in Goodman et al., 2002), providing AT on a trial basis could mitigate these abandonment rates and allow students to try a number of AT options to determine which meets their needs best. Furthermore, when students return the technology after the trial period, they can meet with someone at the disability resource office to talk about their experience with the AT. This provides an opportunity to give the student additional information or resources as needed. Doing so could ensure that when the time comes to apply for AT funding, the student has identified which technology works best for them and would have established realistic expectations as to how it worked, resulting in the increased likelihood of their continued use.

Limitations and Future Directions

While our findings provide important insights regarding the continued or discontinued use of AT by students, there are three important limitations that should be mentioned. First, the sample consisted of students with a variety of disabilities who utilized different AT options. While most were diagnosed with a LD, ADHD, or a mental health disorder (70%), these students might have very different reasons for utilizing various AT options available to them. As such, future research should further investigate to determine if differences can be found across disability categories. This would provide additional information as to how to better assist students with their AT so they are less likely to abandon it in the future. Because this approach would reduce the possible sample size, it may be particularly supported by qualitative designs. Future research should also examine each of the AT options separately to determine if the factors vary between the AT options. Furthermore, our sample was limited to three postsecondary institutions within one Canadian province. Future research should expand the sample to other provinces and countries to determine the nature of AT use across Canadian postsecondary institutions, or even extend to other countries.

Second, nearly 20% of participants accessed the survey link but did not complete the questionnaire and therefore were unable to be included in the analyses. This missing data may have affected our results and we encourage researchers to find ways to collect research that is accessible to all students to potentially reduce the amount of students who did not complete the survey. Although we had designed the survey to meet the accessibility needs of students with disabilities (e.g., online, option to use AT during completion, etc.), it may not have been sufficient to support students in completing the full questionnaire. Generally, online surveys offer a number of advantages over paper-and-pencil delivery for students with disabilities (Roberts & Allen, 2015; Van Selm & Jankowski, 2006); however, we were unable to clarify questions or ensure that students were provided with the necessary accommodations they required to complete the survey.

Third, while the creation of the environmental, individual, and technology factors were based on findings from previous research and in consultations with disability resource centre personnel, the final items included in the

factors were based on an EFA which selected the best items to be included in each factor. While we acknowledge that a factor analysis supported the placement of our items within each of the categories, we did not undertake a formal validation study and, therefore, more robust analyses are needed on these scales. Our research provides initial information as to the importance of these factors on students' use and discontinued use of AT, and it is our recommendation that future research is needed to conduct a more formal scale development and validation of the quantitative items and factors.

Conclusion

Our research provides preliminary information on the continued or discontinued use of AT by students with disabilities. While this research provides valuable information about the importance of training and also the individual, and how one's motivations, beliefs, and perspectives significantly impact one's use or abandonment of AT, further research is needed to expand on our initial results. Further, understanding these factors and the impact they have on AT use or its abandonment is timely and critical as the number of students with disabilities entering postsecondary education continues to increase (Ofiesh et al., 2002; Parker & Banerjee, 2007; Sharpe, et al., 2005). Therefore, building more understanding as to the factors that separate those who continue and discontinue to use their AT is imperative, and future research is needed to explore and expand on these components to further provide a greater, more in-depth understanding of this complex research area.

REFERENCES

Abreu-Ellis, C., & Ellis, J. B. (2006). The challenge of accommodation in higher education: A survey of adaptive technology use in Ontario universities. *Journal of Teaching and Learning*, *4*(1), 31- 41. Retrieved from http://windsor.scholarsportal.info/ojs/leddy/index.php/JTL/article/view/84/118

Alberta Student Aid. (2017). *Students with Permanent Disabilities.* Retrieved from http://studentaid.alberta.ca/applying-for-funding/students-with-permanent-disabilities.aspx

Alper, S., & Raharinirina, S. (2006). Assistive technology for individuals with disabilities: A review and synthesis of the literature. *Journal of Special Education Technology*, *21*(2), 47-81. Retrieved from http://jset.unlv.edu

Asselin, S. B. (2014). Learning and assistive technologies for college transition. *Journal of Vocational Rehabilitation*, *40*(3), 223-230. doi:10.3233/JVR-140687

Canadian Human Rights Commission. (2017). *For persons with disabilities in Canada, education is not always an open door*: CHRC report. Retrieved from https://www.chrc-ccdp.gc.ca/eng/content/persons-disabilities-canada-education-not-always-open-door-chrc-report

Chiang, H. Y., & Jacobs, K. (2010). Perceptions of a computer-based instruction system in special education: High school teachers and students' views. *Work*, *37*(4), 349-359. doi:10.3233/WOR-2010-1089

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1-9. Retrieved from https://pareonline.net/getvn.asp?v=10%26n=7

Day, S. L., & Edwards, B. J. (1996). Assistive technology for postsecondary students with learning disabilities. *Journal of Learning Disabilities*, *29*(5), 486-492. doi:10.1177/002221949602900503

Fichten, C. S., Asuncion, J., & Scapin, R. (2014). Digital technology, learning, and postsecondary students with disabilities: Where we've been and where we're going. *Journal of Postsecondary Education and Disability*, *27*(4), 369-379. Retrieved from https://files.eric.ed.gov/fulltext/EJ1059994.pdf

Garrison-Wade, D. F. (2012). Listening to their voices: Factors that inhibit or enhance postsecondary outcomes for students' with disabilities. *International Journal of Special Education*, *27*(2), 113-125. Retrieved from: http://files.eric.ed.gov/fulltext/EJ982866.pdf

Goodman, G., Tiene, D., & Luft, P. (2002). Adoption of assistive technology for computer access among college students with disabilities. *Disability and Rehabilitation*, *24*(1-3), 80-92. doi:0.1080/09638280110066307

Holmes, A., & Silvestri, R. (2012). Assistive technology use by students with LD in postsecondary education: A case of application before investigation? *Canadian Journal of School Psychology*, *27*(1), 81-97. doi:10.1177/0829573512437018

Kim, W. H., & Lee, J. (2016). The effect of accommodation on academic performance of college students with disabilities. *Rehabilitation Counseling Bulletin*, *60*(1), 40-50. doi:10.1177/0034355215605259

Lang, R., Ramdoss, S., Sigafoos, J., Green, V. A., van der Meer, L., Tostanoski, A., . . . & O'Reilly, M. F. (2014). Assistive technology for postsecondary students with disabilities. In G. E. Lancioni & N. N. Singh (Eds.), *Assistive technologies for people with diverse abilities* (pp. 53-76). New York, NY: Springer.

Lindstrom, J. H. (2007) Determining appropriate accommodations for postsecondary students with reading and written expression disorders. *Learning Disabilities Research & Practice*, *22*(4), 229-236. doi:10.1111/j.1540-5826.2007.00251.x

McCloy, U. & DeClou, L. (2013). *Disability in Ontario: Postsecondary education participation rates, student experience and labour market outcomes* (Paper No. 14). Retrieved from Higher Education Quality Council of Ontario: http://www.heqco.ca/SiteCollectionDocuments/At%20Issue%20-%20Disability%20in%20ON_ENG.pdf

Mull, C. A., & Sitlington, P. L. (2003). The role of technology in the transition to postsecondary education of students with learning disabilities: A review of the literature. *The Journal of Special Education*, *37*(1), 26-32. doi:10.1177/00224669030370010301

National Center for Education Statistics (2015). *Digest of Educational Statistics: Table 311.10. Number and percentage distribution of students enrolled in postsecondary institutions, by level, disability status, and selected student characteristics: 2007-08 and 2011-12*. Retrieved from: https://nces.ed.gov/programs/digest/d15/tables/dt15_311.10.asp

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, 16(1), 1013. doi:10.1177/1609406917733847

Ofiesh, N. S., Rice, C. J., Long, E. M., Merchant, D. C., & Gajar, A. H. (2002). Service delivery for postsecondary students with disabilities: A survey of assistive technology use across disabilities. *College Student Journal*, *36*(1), 94-108.

Parker, D. R., & Banerjee, M. (2007). Leveling the digital playing field: Assessing the learning technology needs of college-bound students With LD and/or ADHD. *Assessment for Effective Intervention*, *33*(1), 5-14. doi:10.1177/15345084070330010201

Roberts, K. D., & Stodden, R. A. (2005). The use of voice recognition software as a compensatory strategy for postsecondary education students receiving services under the category of learning disabled. *Journal of Vocational Rehabilitation*, *22*(1), 49-64.

Roberts, L. D., & Allen, P. J. (2015). Exploring ethical issues associated with using online surveys in educational research. *Educational Research and Evaluation*, *21*(2), 95-108. doi:10.1080/13803611.2015.1024421

Sharpe, M. N., Johnson, D. R., Izzo, M., & Murray, A. (2005). An analysis of instructional accommodations and assistive technologies used by postsecondary graduates with disabilities. *Journal of Vocational Rehabilitation*, *22*(1), 3-11.

Tabachnick, B. G. and Fidell, L. S. (2013). *Using Multivariate Statistics*. Pearson: Boston.

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, *27*, 236-246. doi:10.1177/1098214005283748.

Van Selm, M., & Jankowski, N. W. (2006). Conducting online surveys. *Quality & Quantity*, *40*(3), 435-456. doi:10.1007/s11135-005-8081-8

Webb, K. W., Patterson, K. B., Syverud, S. M., & Seabrooks-Blackmore, J. J. (2008). Evidenced based practices that promote transition to postsecondary education: Listening to a decade of expert voices. *Exceptionality*, *16*(4), 192-206. doi:10.1080/09362830802412182

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into practice*, *41*(2), 64-70. doi:10.1207/s15430421tip4102_2.

ABOUT THE AUTHORS

Lauren D. Goegan is a Ph.D. student at the University of Alberta in the Department of Educational Psychology. Her research examines the academic success of students transitioning from high school to postsecondary with emphasis on those with learning disabilities.

Lily Le is a PhD student at the University of Alberta in the Department of Educational Psychology. Her research examines emerging adults' motivations for using communication technologies in romantic relationships.

Brigitte P. Rioux is a Communications Coordinator with the Office of the Dean of Students at the University of Alberta.

Lia M. Daniels is an Associate Professor at the University of Alberta in the Department of Educational Psychology. Her research examines student and teacher motivation and emotions with the hope of creating supportive learning environments.