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### To cite this article:

Zhang, Z. (2023). Introducing assistive technology (AT) to pre-service teachers: observations and experiences. *International Journal on Studies in Education (IJonSE)*, 5(2), 120-129. <https://doi.org/10.46328/ijonse.136>

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## Introducing Assistive Technology (AT) to Pre-Service Teachers: Observations and Experiences

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### Article Info

#### Article History

Received:

22 December 2022

Accepted:

18 March 2023

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#### Keywords

Assistive technology (AT)

Teacher education

Special education

Teacher professional

development

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### Abstract

Assistive technology (AT) can help students with special needs with their learning, and the importance of AT is on the rise with the development of new technologies and the diversification of student body. However, it is observed that pre-service teachers need to be better prepared for the use of AT in their teaching, including awareness, creative and innovative ways of problem solving, and pedagogical use of “low-tech” “mid-tech” and “high-tech” AT. Based on the observation and experience of the author in his teaching of an ICT (Information and Communication Technologies) course in a teacher education program at a middle-sized university in Ontario, Canada, this paper intends to broaden educators’ understanding of AT including hardware and software, emphasize the necessity of the introduction of AT in teacher education programs, and discuss the pedagogical uses of various types of AT tools. By sharing our observations and experiences, it is hoped that educators can be inspired to use various methods to expand the understanding of AT in pre-service teacher education and in-service teacher professional development programs.

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### Introduction

A review of literature related to assistive technology shows that the term “AT devices” is widely used, but this paper uses a broad definition of assistive technology which includes both hardware and software, so the term “AT tools” is used as a demonstration of inclusiveness. It is reported that in 2020-21, about 17.3 per cent of the total student population in Ontario, Canada relied on special education programs and services (Ontario Newsroom, 2022), which is an indication that it is highly necessary for teacher education programs in Ontario to have their teacher candidates well prepared in terms of how to help their students with special needs to succeed in their learning. The curricula of teacher education programs usually have a component of special education, but with the fast development of modern technologies, Assistive Technology (AT) plays an increasingly important role in education. Therefore, in addition to a course on special education, other courses, especially the general methods course with a focus on educational technology or Information and Communication Technologies (ICT), can also be used as opportunities to introduce various AT tools to the teacher candidates. In an ICT course he teaches, the author of this paper does a survey to find out how much pre-service teachers know about AT, and findings show that their understanding of it is mostly limited to some “high-tech” tools such as specially designed computer programs, which are generally quite costly, and they tend to believe it is hardly

possible for teachers to use AT if there is not enough funding. In order to broaden up teacher candidates' understanding of AT, a broad definition of AT is introduced in this course, and students are encouraged to explore various forms of AT, including "low-tech," "mid-tech" and "high-tech" AT tools, and help them to realize that creative and innovative ideas are also useful as some AT tools can be made with affordable and widely available materials.

## **A Definition of AT and Teachers' Use of It**

Assistive Technology Industry Association (ATiA) (n.d.) defines Assistive technology (AT) as "any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities," which can help "people who have difficulty speaking, typing, writing, remembering, pointing, seeing, hearing, learning, walking, and many other things. Different disabilities require different assistive technologies." In other words, AT is a broad term that covers not only assistive, adaptive, and rehabilitative devices for people with special needs, but also the process employed in selecting, locating, and using them.

AT tools can be equipment, software program, or product system that is designed to maintain, increase, or improve users' functional capabilities, and the use of it may enhance their learning, working, and daily living. In educational setting, commonly used AT often includes laptop computers with specialized programs, such as speech to text, text to speech, graphic organizers and word prediction software that are utilized to assist students who have difficulty speaking, typing, writing, remembering, pointing, seeing, hearing, etc. Almost two decades ago, Edyburn (2004) asserted that there was little proof that pre-service teachers received sufficient training in the use of AT to prepare them for their responsibilities to evaluate the need for, and even consider AT in Individualized Educational Program (IEP) (Ontario Ministry of Education, 2022) meetings, and the more recent report by Ahmed (2018) regarding teachers' awareness of the benefits of using AT, "89% of respondents believe teachers are not completely aware of the benefits, yet 10% believed that teachers acknowledge the importance of assistive technology" (p. 136), which indicates that more work needs to be done to help schoolteachers, both pre-service and in-service, to advance their knowledge and skills of using AT, and teacher education programs can play an important role for this advancement.

## **Special Education and the Educational Use of AT**

Special education was a topic that was started to be addressed in Ontario about four decades ago. In 1980, for the sake of inclusion, Bill 82 was passed (Ontario Ministry of Education, 2022), which mandated school boards in Ontario to provide special education services for all children with special education needs. Eighteen years later, in 1998, the passing of Regulation 181 (Ontario.ca, n.d.) required that appropriate support for the child with special education needs be provided in regular classrooms. As of 2004, it was reported that 82 percent of children with special education needs in Ontario were included in the regular classrooms (Weber & Bennet, 2004).

AT has been recognized as one such way to have children’s needs met within the regular classroom. Individuals with Disabilities Education Act (I.D.E.A., 2004) in USA defines an assistive technology device (ATD) as:

Any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability. The term does not include a medical device that is surgically implanted, or the replacement of such devices.

AT can be put into three categories, namely “low-tech” (e.g., pencil grip, slant board, high lighter), “mid-tech” (e.g., screen magnifier, voice amplification, adapted keyboard), and “high-tech” (e.g., electronic tablet, portable word processor, text-to-speech/speech-to-text program) (Autism Adventures, 2022). With the fast development of technological devices and software programs, it is necessary to keep school administrators and teachers updated of available AT, fully inform them about the technologies available to help special education students become successful in their classes (Hasselbring & Bausch, 2005/2006), meanwhile, it is equally necessary for teachers to make creative use of what is already available in daily life, especially the “low-tech” and “mid-tech” AT tools. Figure 1 shows some easily found low-tech tools.



Figure 1, Examples of Low-Tech AT Tools (Slant Board, Pencil Grip, High Lighter)

**Communication Tools**

The communication tools include oral and written expression as well as social interaction, some commonly used AT tools for this purpose are listed in Table 1.

Table 1. Examples of Communication Tools

| Oral Expression      | Written Expression |
|----------------------|--------------------|
| Message switches     | Text-to-speech     |
| Speech synthesizers  | Spell check        |
| Telephone amplifiers | Thesaurus          |
| Tape recorder        | Pencil grip        |
|                      | Speech recognition |

These AT tools can help improve oral expression capability of those who cannot express their ideas or cannot

express fluently by converting the ideas into a complete speech for listeners. For those who have difficulty in handwriting, text-to-speech and spell check are implemented to assist them to tell whether they spell the words correctly or not. Thesaurus helps when users cannot remember how to spell words, and pencil grips are designed for people who find it hard to properly grasp pencils. Speech recognition programs (e.g., Dragon Naturally Speaking, Speech Assistant, Speechlogger) are convenient enough for people to convert what they say into words directly. These programs enable students with communication problems to participate in the inclusive classroom through a simple message or pressing one or a few buttons on a certain device.

### **Positioning and Environmental Interaction Tools**

For users with physical disabilities, positioning devices such as wheelchair, alternative seating, cane, walker, and for those who require accommodation, environmental interaction tools such as adjustable desks, switches for controlling computers, a foot mouse, and remote-control devices are helpful. Some technologies, such as eye gaze tracking, are not considered ideal in the current status, but they may have interaction applications in the near future.

### **Reading and Writing Tools**

Users who have difficulty in reading comprehension and word recognition can utilize recorded materials, concept mapping software (e.g., Inspiration, Smart Ideas), graphic organizers, word recognition programs, definition software, and screen reader software (e.g., JAWS Screen Reader). Screen reader software can help vision impaired users to get information that is displayed on a computer screen. Besides special computer hardware and software, such as specially designed keyboards (see figure 2), there are also a variety of software programs that can help students with special needs, especially with learning disabilities, develop their writing skills (LDRF, n.d.).



Figure 2. Color Coded Keyboard for Visually Impaired Users, and Expanded Keyboard for Users with Physical Disabilities that Impair Gross and Fine Motor Movement

### **How Commonly Available AT can be used to Enhance Student Learning**

The use of AT depends on a variety of factors. Lindsay and Tsybina's (2011) study found that socio-cultural characteristics influence the use of communication and mobility devices. Factors such as family structure and language spoken at home influenced the likelihood of using a communication or mobility device. Parette and

Scherer (2004) argue that “disability and AT usage are integrally related and have the potential to substantively affect AT decision-making processes” (p. 222), and families from diverse cultural backgrounds may bring a range of values, priorities, and preferences to these processes. School administrators need to consider these factors to make sure students who require assistance devices have their needs met.

Focusing on modern language classrooms, Castleberry and Evers (2010) suggest that teachers should employ a universal design for learning (UDL) approach for planning instruction and technology integration for teaching. They offered 20 suggestions to provide students with varying needs with equal access to modern language classes, including using blog, wiki, Webquests, screen-reading programs, software to assist with writing assignments (e.g., word prediction programs like *WordQ* ([www.WordQ.com](http://www.WordQ.com))). Zascavage and Winterman’s (2009) study about the inclusion of students with learning disabilities who are demonstrating difficulties in reading and writing in middle school classrooms found that AT can help to build academic strength and independence for students with learning disabilities in literacy with the employment of speech recognition programs, screen reading software, organizational software, and word prediction programs that are used in conjunction with access to spelling and grammar check on a personal computer.

With the development of mobile technologies, mobile phones have become widely available, but Harris’s (2010) study conducted in UK indicates that mobile phones, which are considered essential by disabled people, were found to be largely inaccessible, meaning that “Mainstream markets still have a long way to go in making certain products fully accessible for disabled people” (p. 438). Choi and Sprigle (2011) argue that it is difficult for nondisabled designers to understand the implications, and one of the ways that this gap may be addressed during the design process is through the testing and evaluation of concepts and prototypes. According to them, a full usability test involves determining what will be measured, recruiting appropriate users, having the users perform representative tasks, and collecting data to be analyzed. Ulrich and Eppinger (2003) assert that “The test itself may involve evaluating one or multiple concepts for comparison” and as design changes become more time consuming and expensive to implement later in the process, “it is important to involve users early in the design process to help identify potential issues” (p. 37). Campigotto, McEwen and Epp (2013) suggest that there is a strong potential for successfully integrating mobile technology within special needs classrooms, although there are challenges of incorporating these technologies into curriculum in terms of practicality, teacher comfort, and the limitations of the device.

Lancioni, Singh, O’Reilly and Alberti (2019) suggest that “a variety of technology solutions is available to support different forms of communication in persons with neurodevelopmental disorders” (p. 129), and Miranda’s (2001) review of relevant literature states that for students with a wide variety of disabilities, a number of AT options are available to support their learning and communication, including “voice output communication aids (VOCAs) as well as computer hardware and software applications that provide writing and/or spelling assistance, support various aspects of learning, and/or facilitate classroom participation in general” (p. 146).

In order to make full use of AT for student learning, it is important to teach students with disabilities how to use

AT, and “continue to educate teachers and moderate their perceptions of the applications and appropriateness of AT for students with exceptionalities as well as increase their willingness to accept its use for students with learning difficulties” (Brackenreed, 2008, pp. 79-80).

Besides classroom, inclusive libraries can be of great help to patrons with disabilities, particularly those with developmental disabilities (Moisey, 2007), who may become enthusiastic library users, sending and receiving e-mail and participating in other web-based activities. By implementing an Inclusive Libraries Initiative, Moisey found that some of the users started to use the library more frequently and incorporate ICT into their day-to-day lives and suggests that “Investing in local libraries is a sound strategy for developing community capacity, increasing access for patrons with disabilities, and enhancing the inclusion of individuals with developmental disabilities in their community” (p. 66).

Simpson, McBride, Spencer, Lowdermilk and Lynch (2009) assert that AT can be applied in many situations within the school and classroom settings. Among the areas of application are existence, communication, positioning, mobility, physical education, and environmental interaction (Poel, 2007). While these areas are all part of AT, their functions and the way in which they are implemented vary considerably. The study of Chisolm, et al. (2007) indicates that “The FM system allowed participants to achieve the majority of their individualized goals” (p. 87). Simpson, et al. (2009) argue that the effective use of AT requires a team of educators who are well-versed in numerous types of technology so that they can assist in multiple areas. With the right types of AT, students can become more independent in achieving academic success at their enrolled grade level.

## **The Teacher Education Program and ICT Course**

The context of this paper is a two-year teacher education program at a middle-sized university in Ontario, Canada, and teacher candidates enrolled in the program include concurrent and consecutive students. There are three divisions, namely Primary/Junior (P/J), Junior/Intermediate (J/I) and Intermediate/Senior (I/S), and major components of the curriculum include university coursework, teaching practicum, and professional learning series with workshops given by Ministry of Education, Ontario Teachers’ Federation, and other relevant organizations. Among general methods courses, a course with a focus on ICT is offered to students in all the divisions.

For different reasons, the name of the course was changed a few times during the past decade, such as “Instructional Technology (Computer Methods),” “Learning with Technologies,” and “Digital Technologies and Social Media Applications.” In recent years, the course is offered as a full-year course that lasts from September to April, and the students meet once a week for one hour and fifty minutes each time. Within the program curriculum framework, instructors of the course are allowed to design the course the way they prefer, and the author of this paper designs the course with two main elements: 1) an introduction to influential theories related to the implementation of ICT in education and practice, and 2) hands-on learning experience through technology workshops. Besides introducing widely used hardware devices and software program packages, pre-service

teachers are also exposed to the use of different kinds of accessible ICT for teaching and learning purposes, and how these usages can help address equity, diversity, and inclusion issues in different schools.

The course is designed as a blended course (Zhang, 2014) that has both face-to-face and online components, which includes face-to-face meetings (It was fully online for two years during the Covid-19 pandemic) and learning activities in Learning Management System (LMS). The face-to-face class meetings are used for students to do presentations and technology workshops, while the LMS is used for online discussions, resource distribution, and some administrative purposes, such as sign-up for individual and group assignments. The author of this paper usually teaches 2-3 sections of the course, each section has around 30-40 students.

AT is one of the topics on special education discussed in this course, and before this topic is addressed in the course, the instructor posts a brief question in the LMS asking students' their understanding of AT, and how AT tools can be used for specific cases. They are asked to reply to the question with examples. Students' responses demonstrate that most of them have limited understanding of AT, normally some basic knowledge about high-tech AT, which indicates their view in this regard needs to be expanded. One possible cause of this phenomenon may be that at the time of this survey, AT has not yet been introduced in their special education course, and it is believed that addressing the topic in different courses can definitely enhance their learning of this topic. After the survey is closed, the instructor will compile the responses into a list, and then gives a presentation in class followed by a class discussion with the aim to help students have a broader and deeper knowledge of AT than when they started.

In addition to raising the awareness of students regarding AT and its value, they are encouraged to explore possibilities of taking advantage of widely available tools and use them as AT, helping them to understand that AT can be used at all levels to promote academic success among students with special education needs. The introduction of AT is general in this course, and teacher candidates are expected to work together with in-service teachers in their placement school in selecting appropriate type of AT for a student, by first considering potential barriers for the student and then choose AT tools that can help enhance the student's performance. It should be kept in mind that the student's needs must be identified first, and the AT second, based on the functional needs of the student. Use of an AT tool may involve training, including explaining to the student the reason the tool is needed, teaching the student vocabulary related to the tool, modeling the correct use of the tool, and monitoring to make sure the student is using it properly.

In addition to the survey and in-class presentation and discussion, teacher candidates are asked to observe what types of technology (including AT) are available and utilized in their placement schools during each of their practicum, and after the practicum, reflect on their observation and how they applied what they had learned in the university course in the course LMS space. Reflection notes from the teacher candidates show that the understanding of AT needs to be expanded to certain degrees in the schools, and the ideas they got in relation to AT in the university course helped them to not only more properly use high-tech AT, but also explore ways to make better use of low-tech and mid-tech AT tools. Some teacher candidates also indicated that their

associate/mentor teachers appreciated the knowledge and skills they shared, as well as efforts they made in this regard during their teaching practicum.

## **Concluding Remarks**

With the rapid development in digital technologies, high-tech AT is becoming increasingly available and accessible, and in some cases also more affordable. However, low-tech and mid-tech types of AT should also get enough attention, so their value can be better recognized, especially for students with physical or cognitive challenges that can be accommodated with low-tech or mid-tech AT tools. In teacher education programs, in addition to special education courses, introducing AT in ICT courses can help teacher candidates get more knowledge and skills in utilizing AT for school students with special needs. Integrating AT of low-tech, mid-tech and high-tech levels into professional development programs for in-service teachers may help teachers have a better understanding of children's needs and provide efficient assistance by the employment of AT.

Even though some educational administrators and teachers have certain knowledge about special education, their awareness of the usefulness of AT may need to be furthered, so they can take full advantage of available AT to enhance student learning. We agree with Brackenreed (2008), who argues that:

It is worth noting that AT is not aimed at fixing or remediating learning difficulties. Rather, it is used as a strategy to compensate for or accommodate areas of difficulty, generally by focusing on an individual's area of strength. Further, AT is not intended to teach or instruct (as is the case with computer-aided instruction), although it can be used to increase access to instruction. (p. 70)

The AT introduced in this ICT course is at a general level as the specifics of special education is way beyond the scope of this course. We understand that the effective use of AT requires a team of educators who are well-versed in numerous types of technology (Simpson et al., 2009), and it is hoped that what is done in this course can make some contribution to educating "well-versed" teachers. The intention of this paper is that, by sharing what is reported in literature, and experience of what is done in an ICT course in a teacher education program, readers can get some inspiration so as to raise awareness of AT of different levels among teacher educators, pre-service teachers, and in-service teachers, who will effectively and efficiently take advantage of low-tech and mid-tech AT as well as high-tech AT in their teaching practice.

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