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One Step Forward for Inclusion: Integrating Assistive Technology Across Teacher Preparation Program

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Abstract

Assistive Technology (AT) is recognized as a valuable tool for supporting their access to the curriculum. However, many educators lack experience and competence in AT implementation. This study examines the effects of a modified technology course on preservice teachers' preparedness for and perceptions of AT in inclusive classrooms. We modified *Instructional Technology Course,* which is mandatory for pre-service teachers across programs. After receiving the modified technology course, pre-service teachers show a significant improvement in their AT competence and a positive shift regarding inclusion.

Keywords

Assistive Technology, Inclusive Practices, Pre-service teachers

One Step Forward for Inclusion: Integrating Assistive Technology Across Teacher Preparation Programs

Individuals with Disabilities Education Act (IDEA) mandates the least restrictive environment (LRE) for students with disabilities, which favor educating students with disabilities in the general education classroom "to the maximum extent appropriate" alongside their peers (IDEA, 2004). According to the National Center for Education Statistics (2022), about 95% of students with disabilities received educational services in general education classrooms. The inclusion movement requires general education teachers to become responsible for providing high-quality instruction with appropriate accommodations to students with disabilities in inclusive settings (Hogan et al., 2013; Rogers & Johnson, 2018). Current research shows that modified and adapted educational services, aimed at increasing their access to general education curriculum, have contributed to the success of inclusion (Lohmann et al., 2019; Rogers & Johnson, 2018).

Assistive technology (AT), a significant source of adapted educational services, is recognized as a valuable tool in K-12 schools. Research syntheses demonstrate the positive effects of AT for students with disabilities in both curricular and non-curricular activities in inclusive settings (Bryant et al., 2010; Stauter et al., 2019). AT encompasses the use of any equipment that supports skills acquisition and development for individuals with disabilities (Tech Act, 1988). IDEA also emphasizes the consideration of AT services when preparing Individualized Education Programs (IEPs). Therefore, not only special education teachers but also general education teachers, as members of the IEP team, should have an understanding of AT services to enhance accessibility for students with disabilities in inclusive settings.

Despite the legislation and benefits of AT, many educators hesitate to implement technological aids and services for students with disabilities in their schools (Alkahtani, 2013). Research indicates that many teachers lack AT experience, have low AT competencies and limited access to AT devices, experience uncertainty about AT determination, and report unfamiliarity with AT services (Conor et al., 2010; Schaaf, 2018). Interestingly, however, despite their report on low AT competencies, educators demonstrate moderate awareness, high interest, and openness to AT services (Lamond & Cunningham, 2020). Thus, teacher preparation programs should design AT curriculum and prepare preservice teachers to be equipped with knowledge and skills to implement AT services for students with disabilities in inclusive classrooms (Crider et al., 2014; Atanga et al., 2020; Park et al., 2023)

Professional Standards Regarding AT

The Council for the Accreditation of Educator Preparation (CAEP) states that teacher candidates need to know the appropriate applications of technology for their fields of specialization (CAEP, 2019). Interstate Teacher Assessment and Support Consortium (INTASC) emphasizes that using technology is a core component of quality instruction (Council of Chief State School Officers [CCSSO], 2011). Both CAEP and INTASC standards relate more closely to the implementation of instructional technology for all students, including those with disabilities. For example, CCSSO (2011) notes that technology tools promote independent thinking and collaboration across diverse learning populations. Rather than assistive technology, these standards focus on technology applications to engage students, enhance instruction, and manage assessment data.

The Council for Exceptional Children (CEC) and CEEDAR center address technology use within instructional practices, but more specific standards in AT are also outlined. (CEC, 2015; McLeskey et al., 2017). Special educators should know how to select and use both assistive and instructional devices. Recognizing using AT as a high-leverage practice, both CEC and CEEDAR state that beginning special educators need to know how to use augmentative and alternative communication (AAC) and various assistive technologies for individuals with disabilities.

AT Instruction at Higher Education

AT instructions are commonly incorporated into pre-existing courses through online, face-to-face, or hybrid formats at the post-secondary levels. Traditional face-to-face instruction incorporates device demonstration and hands-on activities (Arslan-Ari & Baser, 2022; Kamei-Hannan et al., 2012; Poel et al., 2013). Studies that facilitated an AT Lab which included both demonstration and hands-on practice, reported that their pre-service students had high levels of satisfaction and an advanced understanding of implementing AT devices for students with disabilities (Jones et al., 2021; King & Allen, 2016; Park et al., 2022). However, post-secondary settings often struggle with experts who have the professional knowledge to demonstrate the use of AT devices (van Laarhoven et al., 2012) and face challenges because the number of instructional resources (i.e., AT devices) available for hands-on activities is often limited (Atanga et al., 2020).

van Laarhoven et al. (2012) suggest using interactive video-based tutorials introducing AT devices for pre-service teachers. After receiving video-based AT instruction, most participants reported feeling satisfied with the instructional modules and video tutorials (van Laarhoven et al., 2008). Video tutorials help pre-service teachers increase their familiarity and level of comfort with AT devices. In another study, the instructors embedded YouTube videos that demonstrated AT devices (Dreon & Dietrich, 2009). Preservice teachers watched the streaming

videos in an educational manner and had a virtual discussion. Robinson et al. (2007) also developed nine online workshops to address the integration of AT into the curriculum. Not only pre-service teachers but also university faculty, in-service teachers, family members, and school personnel could receive AT instruction through online modules. However, these video-based AT instructions limited hands-on experience with AT devices.

Wojcik et al. (2004) utilized a hybrid approach to provide AT instruction. The preservice teachers were first given video-based instruction on AT, followed by hands-on experience in an AT Lab where they had the opportunity to practice using AT devices. Jones et al. (2019) used a scavenger hunt activity in the AT Lab. With this activity, preservice teachers watched pre-determined videos, reviewed posted information regarding AT, and explored specific AT devices.

Purpose of the Study

Successful inclusion requires providing appropriate educational services to students with disabilities in the general education classroom. The use of AT increases the participation and engagement of students with disabilities in extra/curricular activities in inclusive settings. While the attitude and competencies of general education teachers toward the use of AT are fundamental factors in the successful inclusion of students with disabilities, many general education teachers are not fully informed or aware of AT. Teacher educators are able to amend this through their work with preservice teachers, but there is limited number of studies available in this matter (Park et al., 2023). Thus, in this study, we examined the effects of a modified technology course on preservice teachers' preparedness for and perspectives toward AT. The following research questions guided this study**:** (a) What are the effects of the modified technology course on pre-service teachers' perceived knowledge? (b) What are the effects of the modified technology course on pre-service teachers' perspectives toward AT?

Method

Participants and Setting

The study was conducted at a public university in the Mid-Eastern region of United States. Approximately 15,000 students were enrolled at the University. Students who enrolled in the *Emerging Instructional Technology* course during the 2022-2023 academic year were invited to participate in this study. A total of 201 students were enrolled across eight sections. Specifically, in the fall semester, 96 students were enrolled in two in-person sessions (n = 39) and two asynchronous online sessions (n = 57). In the spring semester, 101 students were enrolled in two in-person sessions (n = 44) and two asynchronous online sessions (n = 57). A majority of students were freshmen and sophomores who have declared an education major. Of 197 students, 109 students responded to the pre-survey and 92 students responded to the post-survey. The majority of participants identified as "female" (84 %), and were in general education programs (90%),

such as early childhood education, elementary education, and secondary education teaching.

Modified Technology Course

In this project, faculty across general and special education collaborated to redesign a preexisting instructional technology course that embeds hands-on instruction for both general and special education teachers. The technology course is required across all general education teacher preparation curricula (e.g., Elementary Education, Secondary Education, Early Childhood Education). The course description showed preservice teacher candidates to learn how to examine, develop, and evaluate emerging instructional technologies in educational and human services settings. The course addressed educational technology use for instruction, assessment, student engagement, communication, classroom management, and professional development. Previously, this course addressed instructional technology without an emphasis on inclusive practices. Additional content was embedded to include knowledge and skills required to effectively use technology for diverse learners, including students with disabilities.

The faculty who teach the technology course redesigned the course for several reasons. Since the COVID pandemic, K-12 schools and higher education have heavily relied on online resources where technology use has become a *must*. Though the immediate crisis of the pandemic has lessened, it has triggered a shift towards a new standard that expedites the adoption of online education (Jackowicz & Sahin, 2021). With the technology trends, the instructors noted students' requests and feedback on learning up-to-date technology and web-based resources. In addition, research report that general education teachers believed college did not adequately prepare them to utilize technology for students with disabilities (Atanga et al., 2020). Research findings also show that pre-service general education teachers have low confidence and competencies regarding the use of technology for students with disabilities (Jeffs & Banister, 2006; Park et al., 2022). Instructors acknowledged the need for incorporating instructional and assistive technology contents into the course to prepare teacher candidates as part of inclusive practices for students with disabilities.

To prepare our teacher candidates to better support diverse learners, we integrated the following concepts into the course: (a) assistive technology across areas of support and disabilities, (b) Universal Design for Learning, (c) social-emotional learning, (d) web- and app-based learning tools for diverse learners that support multi-tier systems of support, and (e) online assessment tools that incorporate data-driven instruction. Specifically, we provided demonstrations, case scenarios, and hands-on activities for assistive technology devices. For academic support, examples included demonstrations and hands-on activities for speech-to-text (e.g., Dictate), text-to-speech (e.g., Read&Write, Immersive Readers), reading pens, talking calculators, virtual manipulatives, virtual trips,

immersive learning apps, and more. The instructor also facilitated hands-on activities for communication, covering augmentative and alternative communication (e.g., voice-recording switch, Prologue2Go app, TD snap app, GoTalk Now app), vision (Braille typer and printer, SeeingAI app), hearing (lighting or vibrating alarms and apps), and accessibility features on mobile devices. Additionally, we developed an assignment focused on Universal Design for Learning. In this task, students worked in groups to explore all UDL guidelines and list technological supports aligned with each checkpoint. Students also learned about technological applications in social-emotional learning, including artificial intelligence robots and apps designed for handling emotions. Finally, we introduced several web- and app-based learning and assessment tools for diverse learners. Through this project, we expected pre-service teachers, who plan to teach students with disabilities would improve their knowledge of assistive and instructional technology in an inclusive setting.

Survey

The pre-survey contained a total of 15 questions. The first four items were demographic questions (i.e., class modality, gender, college program level, pursuing certificate). The remaining 11 questions were five-point Likert-type scale response questions assessing participants' AT competencies and perspectives regarding AT. The survey questions were adapted from previous research and modified for the population of this study (Diep & Wolbring, 2013; Parette & Scherer, 2004; Park et al., 2022; Van Larrhoven et al., 2008). The post-survey mirrored the pre-survey items but did not include demographic questions.

Of the 11 questions from pre- and post-survey, questions 1-4 were designed to assess AT competencies of preservice teachers (i.e., confidence of AT knowledge; self-evaluated preparedness for utilizing AT service for students with disabilities, incorporating AT devices into lesson plans and classroom activities, and integrating AT in terms of Universal Design for Learning). In general, higher responses on these items indicated higher self-evaluation by a participant of preparedness for providing, incorporating, and contributing AT services. Questions 5-11 were designed to explore the perspectives of preservice teachers toward AT. These items asked preservice teachers' perspectives toward AT and how they viewed teachers' responsibilities in implementing AT. Except for three reversed items (e.g., AT devices stand out and might stigmatize students by signaling disability), higher responses indicated a more positive attitude toward AT.

Data Analysis

We analyzed data using Jamovi 2.3.21, conducting a descriptive analysis, t-test, and two-way analysis of variance. To determine the effects of the modified technology course on per-service teachers' perceived knowledge, we combined the survey response of questions 1 through 4; For internal reliability, we

calculated Cronbach's alpha using Jamovi. The Cronbach alpha was 0.935, indicating a high level of internal consistency (DeVellis, 2012). Regarding pre-service teachers' perspectives toward AT, we analyzed data on individual survey items.

Results

Effects of the Modified Technology Course on AT Competencies

AT competencies were assessed by survey questions 1-4. The overall mean score of the pre-survey was 10.1 points with a 3.10 standard deviation. In the post-survey response, the mean score was 15.8 points with a 2.26 standard deviation. The mean difference between pre- and post-survey was 5.7 points, which was statistically significant ($t_{(199)} = 14.6$, $p < .001$).

We also conducted an Analysis of Variance (ANOVA) to determine the proportion of variance in the dependent variable that is attributable to the factor in question (i.e., gender, program level, pursuing a career, course modality). Overall, none of the demographic factors (i.e., gender, program level, and pursuing a career) were significant. We found somewhat interaction effects between the modified technology courses and the course modality, but it was not significant, F (1, 197) = 3.86, p = .051. However, there was a main effect of the course modality (online, in person). Participants' responses between online and in-person sessions indicated that the variance could be attributed to the course modality, F (1, 197) = 5.82, p = .017).

Effects of the Modified Technology Course on Perspectives Toward AT

Questions 5-11 were designed to explore the pre-service teachers' perspectives toward AT. These items asked how the preservice teachers perceived AT and how they viewed teachers' responsibilities in implementing AT. Pre-service teachers reported no difference between pre- and post-survey in four question items, but they showed statistically significant differences in Question 6 (*AT devices enable students to access the curriculum and enhance their learning*) and Question 9 (*AT can facilitate the inclusion of students with disabilities in general education classrooms*). In particular, in Question 6, the mean of the pre-survey was 4.16, which increased to 4.50 in the post-survey ($t_{(199)} = 3.164$, p = .002). In Question 9, the mean of the pre-survey was 4.04, which increased to 4.52 in the post-survey ($t_{(199)} = 4.472$, $p < .001$).

We also conducted an Analysis of Variance (ANOVA) to determine the proportion of variance in the dependent variable that is attributable to the factor (i.e., gender, program level, major, course modality). Across all question items, none of the factors (i.e., gender, program level, major, course modality) were significant. Mean and t-tests between pre- and post-surveys across question items are shown in Table 1.

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Discussion

The present study surveyed preservice teachers on their competencies in AT and perspectives toward AT before and after delivering a modified technology course. After receiving the modified technology course, preservice teachers showed statistically significant changes in their competencies regarding AT. Preservice teachers reported higher confidence and preparedness regarding the implementation of AT after completing a modified technology course, which result is consistent with the previous literature (Jeffs & Banister, 2006; Morrison and Jeffs, 2005; Poel et al., 2013).

However, pre-service teachers' perspectives toward AT showed little or no difference even after completing the modified technology course. Previous literature has consistently shown that AT instruction is less likely to make changes in attitude or perspectives compared to knowledge, skills, or competencies (Maushak et al., 2000; Park et al., 2022). In other words, AT instruction has greatly impacted AT competencies of preservice teachers but made less contribution to improving their attitude or perspectives. However, very few studies (Maushak et al., 2000; Park et al., 2022) examined the effects of AT instruction on attitudes or perspectives while a majority of studies examined the effects on knowledge or skills. Future studies may conduct rigorous research in this area (Part et al., 2023).

Pre-service teachers reported significantly improved scores on the questions of inclusion (*AT devices enable students to access the curriculum and enhance their learning, AT can facilitate the inclusion of students with disabilities in general education classrooms*). After receiving intensive preparation in the use of assistive technologies, preservice teachers reported more positive responses toward inclusion (Park et al., 2022). This consistent outcome provides strong support for the inclusion of a brief introduction to AT in all teacher preparation programs. Teacher preparation programs should provide AT instruction as a means to promote inclusive practices for preservice teachers (Lohmann et al., 2019; Park et al., 2023).

Limitations and Future Research Directions

In this study, pre-service teachers demonstrated significantly improved scores in the post-survey. However, it is worth noting that the results rely on participants' perceived knowledge. In other words, this study did not measure their actual knowledge (i.e., testing). All results are from self-reporting surveys, which are unclear to determine pre-service teachers' demonstrated knowledge. Future studies are recommended to include post-graduation inquiries on AT implementation in the general education setting.

Another limitation may include effects from multiple instructors who delivered the modified technology course. All course materials were co-designed and shared among three instructors, but the content regarding inclusive practices

was fairly new to faculty whose background does not include AT. This may have posed some challenges for students.

Implications for Practice

The increasing diversity in American classrooms emphasizes the importance of differentiating, accommodating, and modifying instruction to ensure the success of each learner. Assistive technology (AT) plays a crucial role in providing services to students with disabilities and addressing their individual needs when appropriate (Nepo, 2017). The key to success for both teachers and students lies in the training and knowledge of educators regarding the implementation of AT. This training should begin with teacher educators during their preservice education. It is essential for teacher education programs to take necessary measures to ensure that their graduates possess the necessary skills to deliver effective instruction for all students. Achieving this requires a solid foundation of background knowledge and training in the field of AT (Crider et al., 2014).

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Table 1
Mean and SD across Pre- and Post-Surveys

	Pre-survey (n = 109) Mean (SD)	Post-survey (n = 92) Mean (SD)	T-test
Confidence in AT knowledge	2.34 (0.830)	3.78 (0.590)	13.96**
Preparedness to utilize AT services for students with disabilities	2.59 (0.895)	4.04 (0.694)	12.71**
Preparedness to integrate AT into the lessons	2.73 (0.909)	4.08 (0.715)	11.48**
Preparedness to integrate AT in terms of UDL	2.49 (0.987)	3.92 (0.730)	11.56**
[R] Students need to learn to function without AT because the devices could negatively affect their skill development.	3.49 (1.015)	3.43 (1.303)	- 0.31
AT devices enable students to access the curriculum and enhance their learning.	4.16 (0.796)	4.50 (0.734)	3.16*
Special educators need to be familiar with assistive and instructional technologies.	3.25 (0.925)	3.49 (1.022)	1.76
General educators need to be familiar with assistive and instructional technologies.	3.44 (0.810)	3.65 (0.943)	1.71
AT can facilitate the inclusion of students with disabilities in general education classrooms.	4.04 (0.804)	4.52 (0.718)	4.47**
[R] AT devices stand out and might stigmatize students by signaling disability.	2.96 (0.838)	2.92 (1.092)	- 0.29
[R] Expensive AT devices take potential resources (e.g. money and time) away from other students.	3.48 (1.033)	3.20 (1.294)	- 1.71

Note. *$p < .01$, **$p < .001$
[R] The item was reversed questions.