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Teachers of Students With Learning Disabilities: Assistive Technology Knowledge, Perceptions, Interests, and Barriers

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Abstract

Assistive technology (AT) helps bridge the gap between students with learning disabilities (LD) and their peers without LD. However, this implies a need for teachers to become well-trained and proficient in the use of AT. There are established AT competencies for educators, and AT services professionals must be knowledgeable about AT to select and recommend specific technology to individual education program teams. Professionals should also be well-versed with AT to be able to train students in its use. There is a significant need for research on teachers' knowledge and perceptions of AT (i.e., interest in using it and barriers to incorporating it) as well as the best ways to provide AT training. To investigate these areas, a survey was administered to teachers of students with LD at the elementary and middle school levels. Our results indicated that completing an AT course in college along with self-reported AT proficiency in iPad reading apps were associated with higher ratings of AT knowledge. Additionally, higher AT proficiency ratings and completing AT college course work were associated with perceptions of college preparation of AT, but these factors did not predict perceptions of workplace preparation. Teachers were clearly interested in utilizing AT but felt their college did not adequately prepare them in AT, and funding issues were the most common barriers to implementing AT. Our findings suggest a need for an emphasis on AT training in college courses.

Keywords

teachers of students with learning disabilities, assistive technology knowledge, perceptions, interest, barriers

Learning disabilities (LD) comprise one of the largest disability categories under the Individuals with Disabilities Education Act (IDEA), with 38.6% (2,336,960) of all students ages 6 through 21 who are served under IDEA (6,048,882; Office of Special Education and Rehabilitative Services, 2018a). What is more, students with LD are primarily educated in the general education classroom, with 70.8% of students being served in general education for at least 80% of the school day (Office of Special Education and Rehabilitative Services, 2018b). LD manifests as "an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations" (IDEA, 2004); however, reading disabilities are the most common disorders encountered by students with LD (Handler & Fierson, 2011; Judge & Bell, 2010; Lerner & Johns, 2009). Specifically, students with LD may struggle with reading accuracy, fluency, poor spelling, and decoding (Vellutino, Fletcher, Snowling, & Scanlon, 2004). LD are a lifelong condition, and individuals with LD need to develop compensatory skills for circumventing difficulties that transcend ages and contexts (Goldberg, Higgins, Raskind, & Herman, 2003).

Assistive Technology (AT): One Piece of the Education Puzzle

The primary intent of the IDEA (2004) was to ensure that all children with disabilities have access to the general education curriculum in a regular classroom setting to the maximum extent possible. In order for some students with disabilities to participate fully in the curriculum, they need to utilize AT. According to IDEA (2004), *assistive technology* is defined 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 individuals with disabilities." In the classroom environment, AT is used for a variety of purposes such as

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communication, positioning, mobility, hearing and vision, physical education, and instruction in reading, writing, and mathematics (Biancarosa & Griffiths, 2012; Bouck, Doughty, Flanagan, Szwed, & Bassette, 2010). AT differs from instructional technology in that the latter is focused on the design and delivery of instruction and involves the use of practical techniques to enhance instruction and thus positively impact learning (Gagne, 2013); AT provides access and allows for full participation in the classroom environment. Upon reviewing data from the National Longitudinal Transition Study-2 (NTLS-2) that aimed to provide a national picture of the experiences and achievements of students who received special education in high school and transitioned to adult life, Bouck, Maeda, and Flanagan (2011) reported that students who had access to AT in school produced more positive outcomes (i.e., wages, employment, and postsecondary education).

AT provides several benefits to students with LD. For example, students can engage in independent academic activities or work collaboratively with other students instead of idly waiting for assistance (Pilgrim, Bledsoe, & Reily, 2012). The use of AT allows students with LD to learn at their own pace. This self-paced learning results in less pressure and improved communication skills, attention, and behavior (Parette & Stoner, 2008). For example, Cullen, Richards, and Frank (2008) used AT software (i.e., talking word processor software and talking word processor in conjunction with word prediction software) with students who had LD, and five of seven students showed gains in the quality and quantity of their writing. This finding is crucial for successful inclusion of AT software in the general curriculum given that students with LD often struggle with planning and organizing, editing, revising, and monitoring the writing process (Patel & Laud, 2007; Troia, 2006). Additionally, AT can help students with LD engage more readily in cooperative learning activities, as students with LD may not possess either the needed academic or collaborative skills to participate fully (Bryant & Bryant, 1998).

Bouck, Doughty, Flanagan, Szwed, and Bassette (2010) also provided evidence that the use of AT facilitates students' gaining independence as they were able to complete written assignments with minimal or no assistance. Yet another benefit of AT use is the sense of portability that it allows students to experience (Cortiella & Horowitz, 2014; Dove, 2012). Technology such as iPads and smartphones support easy mobility for these students who often move between classrooms, especially in the upper grades (Dove, 2012; Pyper, 2011).

AT and Reading

Literacy skills enable individuals to participate actively in their environments (Alberto, Fredrick, Hughes, McIntosh, & Cihak, 2007), and "technology is particularly useful in supporting participation in literacy activities in the classroom because the computer or device can provide adaptions to make students more independent in academic activities" (Stone-MacDonald, 2015, p. 4). Available AT for reading ranges from low- to high-tech and includes items such as reading guides, audiobooks (i.e., Learning Ally or Bookshare), reading pens (i.e., Pulse Smartpen by LiveScribe), optical character recognition (i.e., WINN Literacy Software Solutions or Kurzweil 3000), and speech synthesizers/screen readers (i.e., Read and Write Gold; Reading Rockets, 2019). When students use AT such as the tablet, for example, they can quickly and easily find word meanings and the background knowledge they need for reading comprehension (Biancarosa & Griffiths, 2012). Additionally, presenting children's books in digital form, along with dictionaries or other engaging activities, leads to improvements in the key components of balanced reading instruction. As the text is read orally by the narrator and accompanied by highlighted text, children become familiar with the nature of written text (Korat, 2010).

Since its release in 2010, the iPad has also shown promise for improving educational outcomes and the empirical support for its use is slowly emerging (Aronin & Floyd, 2013; Chmiliar, 2017; Hilton, 2018; Pitchford, Kamchedzera, Hubber, & Chigeda, 2018). Technology apps on these devices are another tool for supporting students with disabilities access to curriculum content. Countless apps in the iTunes store can be used to address literacy development (Stone-Macdonald, 2015). In order to ensure high-quality app selection and fidelity of instruction using iPad apps, Northrop and Killeen (2013) provide a framework for using iPad apps to build early literacy skills. Ok, Kim, Kang, and Bryant (2016) offer guidance on how to find quality apps for use with students with LD. Specifically, Ok and colleagues provide an evaluation rubric for parent, teachers, and other professionals, which consists of three sections: identifying information, evaluation, and grading. These three broad sections are broken down into specific features including app objective, examples, practice, item-error analysis, progress monitoring, motivation, navigation, visual and auditory stimuli, font, customizable settings, and content error and bias, and they provide figures for ease of implementation.

Factors Impacting AT Use

There are variances in student use of AT by disability, ethnicity, and educational settings (Quinn, Behrmann, Mastropieri, & Chung, 2009), and factors such as insufficient funding, difficulties procuring and managing equipment, time constraints, and inadequate assessment have been found to impact AT use (Ahmed, 2018; Copley & Ziviani, 2004). AT abandonment, often caused by a mismatch between AT and need, is another widespread issue (Johnston & Evans, 2005). In this section, however, we will focus on variables that impact implementation of AT by educators.

Lack of AT Exposure in University Teacher Preparation Programs

The primary obstacle in the integration and use of AT in schools at the preservice level was cited as insufficient training (Judge & Simms, 2009). In fact, Connor, Snell, Gansneder, and Dexter (2010) found that a predictor of students' use of AT in a

classroom is how competent their teacher is in using it. There is evidence of inadequate teacher training at the preservice level (Gronseth et al., 2010; Judge & Simms, 2009; Zapf, Scherer, Baxter, & Rintala, 2016). Judge and Simms (2009) studied 162 special education preparation programs and found that only about one third of undergraduate special education licensure programs required an AT course, and those programs that had an AT requirement only involved one AT course. More recently and perhaps even more troubling due to the ease of use and portability associated with newer technologies such as the iPad, representatives from higher education programs reported that slightly more than half (58%; $n = 80$ of 137) of their undergraduate programs and about half (49%; $n = 93$ of 191) of their graduate programs have access to *no* or *a limited number* of AT devices, as opposed to an *adequate* or *optimal* number of devices (Bausch & Ault, 2012). As a result of inadequate training, teachers report feeling ill prepared and intimidated in using AT with their students (Blue & Tirotta, 2011).

Teachers' Self-Efficacy With the Use of AT

Bandura (1993) defines self-efficacy as "people's beliefs about their capabilities to exercise control over their own levels of functioning and over events that affect their lives" (p. 118). Higher self-efficacy in the use of AT will render an educator more willing to integrate it into a pedagogical practice (Marino, Sameshima, & Beecher, 2009). Lei (2009) reported that although preservice teachers consider technology an indispensable part of their lives and understand its potential in helping their students learn, they still lack comfort in integrating AT into established practices. Research shows that familiarity and level of comfort in using AT developed from training opportunities can result in positive teacher attitudes and effectiveness in integrating AT into their curriculum (Davis, Barnard-Brak, & Arredondo, 2013; Van Laarhoven et al., 2008). Self-efficacy with the use of AT was also found to be higher in cases where the teacher had previously had a positive experience with the use of AT in supporting students learning (Flanagan, Bouck, & Richardson, 2013). Other researchers suggested that an integrated approach to AT training that provides repeated exposure to AT will increase teachers' familiarity, comfort, and skill in using technologies (Moore & Wilcox, 2006; Van Laarhoven et al., 2008).

Developing Effective AT Trainings

Bryant, Erin, Lock, Allan, and Resta (1998) established the groundwork for infusing a teacher preparation program in LD with AT content. Specifically, the authors enumerated critical AT competencies for preservice educators and outlined steps for designing AT curricula around those competencies. Recent empirical studies are showing positive results associated with AT trainings in teacher preparation programs (Jones, Rudinger, Williams, & Witcher, 2019; Kamei-Hannan, Howe, Herrera, & Erin, 2012; Naraian & Surabian, 2014; Poel, Wood, & Schmidt, 2013); however, there is room for exploration regarding effective training models. One possible consideration for the design of AT training is manipulation by conformity—the idea that people can be influenced to adopt certain behaviors. The results of a study by Goldstein, Cialdni, and Griskevicius (2008) demonstrate that people can be influenced by descriptive norms to conform to certain behaviors. In this study, people were convinced to reuse towels in a hotel room based on the way the information was presented to them. People were more likely to reuse towels, not because they were concerned of the effects of their behavior on the environment as they might have thought but rather since others were doing it. In another study on framing effects, Hossain and List (2012) investigated the effects of framing on productivity in a factory. In their setup, the researchers had two frames—a "Reward" frame and a "Punishment" frame. In both cases, productivity increased but more in the punishment frame than in the reward frame. Although these two studies provide interesting results, the applications of manipulating conformity for teacher training and adoption of AT are yet unknown.

What we do know more confidently is that it is important for information utilized in the design of AT trainings to embrace the ideal that technology, curriculum, and pedagogy are intertwined. The Technological Pedagogical Content Knowledge (TPACK) framework, which is built upon this integral relationship and broadly defines the types of knowledge teachers need to employ, thus has strong relevance to trainings on AT. Rather than utilizing common professional development tactics that view knowledge of technology as isolated knowledge, TPACK holds that information given in training on hardware and software should closely align with meaningful curriculum activities in the classroom. In fact, technology should be viewed as transforming the very nature of curricular content (Naraian & Surabian, 2014), and trainings specifically geared toward the integration of iPad technology should center on the premise that technology must allow the student to work at his/her instructional level (i.e., just because a student understands the technology does not mean he/she understands the content in the literacy app; Northrop & Killeen, 2013). The need to incorporate these philosophies into AT trainings is consistent with the literature demonstrating that trainings are often too generic (Biancarosa & Griffiths, 2012), neither specific to their content areas nor to a particular AT.

Statement of the Problem and Purpose of the Study

Given the prevalence of students with LD who could benefit from AT, the stipulations of the law regarding AT (IDEA, 2004) and the importance of AT in the integration of students into general education and society (Dalton & Roush, 2010; Okolo & Diedrich, 2014), there is a critical need for teachers to acquire professional knowledge of AT in order to support students with LD (Edyburn, 2013). As discussed above, teacher knowledge is directly linked to student use of AT (Judge & Simms, 2009), and the use of AT improves student learning outcomes (Hutchison, Beschorner, & Schmidt-Crawford, 2012). While Bryant et al. (1998) provided the seminal work

Table 1. Demographics of Participants.

Demographic	*n*	Percentage	*M*	*SD*
Gender				
Female	61	98		
Male	1	2		
Age			39	10.11
Ethnicity				
Caucasian	35	56.5		
African American	14	22.6		
Asian/Asian American	2	3.2		
Hispanic	7	11.3		
Native American	1	1.6		
Other	3	4.8		
Education				
Completed bachelor's degree/not enrolled in a program	5	8.1		
Currently enrolled in a master's/ specialist degree program	34	54.8		
Completed master's degrees, not enrolled in a doctorate	15	24.2		
Currently enrolled in a doctorate (PhD or EdD) program	2	3.2		
Completed doctorate degrees (PhD or EdD)	6	9.7%		
Years of experience			9.69	7.78
Certification				
General education only	14	22.6		
Special education only	6	9.7		
Both general and special education	42	67.7		
AT courses				
No AT courses as part of their college degree	51	83.1%		
AT courses as part of their college degree	11	16.9		
AT professional development (PD)				
Had participated in PD on the use of iPad apps for instruction	44	71		
Had not participated in PD	18	29		
Total	62			

establishing competences for using AT with students with LD, much of the more recent body of work is related to AT for students impacted by sensory impairments and targets itinerant teachers of the visually impaired (Kamei-Hannan et al., 2012; Zhou, Smith, Parker, & Griffin-Shirley, 2011; Zhou et al., 2012). There is a dearth of literature directly targeting classroom teacher knowledge and perceptions of AT for students with LD.

Thus, the present study contributes to the existing literature by targeting teachers of students with LD and investigating their self-reported teacher knowledge of AT. We examined whether AT knowledge varied by years of teaching experience, completion of an AT course in college, and AT professional development opportunities in the workplace. Additionally, we included participants' reported level of proficiency with preselected iPad apps as a covariate given that proficiency is likely associated with teachers' AT knowledge. Specifically, as it is difficult to measure proficiency with all forms of AT, participants reported their proficiency with 10 iPad applications to facilitate reading instruction. Furthermore, in the present study, we asked teachers to report their interests in using AT, their feelings of preparation in using it, and beliefs about barriers to using AT in the classroom. Lastly, we were interested in whether conforming to the professional community has an impact on AT use or if lack of training still stands as the main barrier. Nevertheless, our conformity manipulation was not successful; therefore, the impact of conformity on AT implementation is not highlighted in the current article.

To align with the researcher's interest in AT use by teachers of students with LD (i.e., students who are typically academic) and draw a distinction between AT and instructional technology, we defined AT to include not only devices/software/hardware (i.e., the iPad itself) but also iPad apps on those devices designed to aid in instruction. iPads were selected because of their portability (i.e., switching classrooms), their common presence in classrooms, and the perceived level of social acceptance associated with iPads. The present study addressed three primary research questions:

1. Is AT knowledge influenced by AT course completion, AT professional development opportunities, and years of teaching experience?
2. Do teachers feel prepared in using AT, and what factors predict these feelings?
3. Are teachers interested in incorporating AT in the classroom, and finally what are their perceived barriers to incorporation?

Method

Participants

Because the study focused on AT as part of reading intervention for students with LD and inquired about iPad apps relevant to early reading skills, participants were educators who had experience teaching students with LD at the elementary or middle school levels. Participants were recruited from school districts served by the Region 8 Education Service Center (ESC) in the Northeast Texas region (Region 8 serves 48 school districts), from the Council for Learning Disabilities (CLD) Facebook page, and from graduate students enrolled at one institution of higher education, specifically in graduate programs in education or related fields. All teachers employed in the ESC were recruited via an e-mail blast (containing information about the purpose of the study and a survey link), all graduate students enrolled in education-related programs were also e-mailed, and the survey link posted on the CLD Facebook page was accessible to the entire membership of the organization.

A total of 102 people began the study; 2.94% ($n = 3$) dropped out because they did not meet the qualifications. Ninety-seven percent ($n = 99$) indicated they met the qualifications, but 36.28% ($n = 37$) of those who signed the consent and started the survey did not complete it. Overall, 60.78% ($n = 62$) participants completed the study. As displayed in Table 1, most respondents were female (98%; $n = 61$), and the average age

was 39 ($SD = 10.11$). Responses to the question about ethnicity indicated 56.5% ($n = 35$) of participants were Caucasian, 22.6% ($n = 14$) were African American, 3.2% ($n = 2$) were Asian/Asian American, 11.3% ($n = 7$) were Hispanic, 1.6% ($n = 1$) were Native American, and 4.8% ($n = 3$) classified themselves as other.

The majority of our participants had education beyond a bachelor's degree, with 24.2% ($n = 15$) having completed master's degrees and 54.8% ($n = 34$) were currently enrolled in a master's/specialist degree program. The average years of teaching experience was 9.69 ($SD = 7.78$). Regarding teacher certification, 22.6% ($n = 14$) of participants were certified in general education only, 9.7% ($n = 6$) were certified in special education only, and 67.7% ($n = 42$) were certified in both general and special education.

Most participants indicated they had not had AT as part of their college degree (83.1%; $n = 51$), with only 16.9% indicating they had AT as part of their college degree ($n = 11$). However, of the 11 respondents who stated they were required to take courses related to AT, 8 stated this was one course. Thirty respondents indicated that information on AT was not a specific course but was embedded in other courses. Seventy-one percent ($n = 44$) of participants indicated they had participated in professional development workshops specific to the use of iPad apps for instructional purposes, while 29% ($n = 18$) indicated they had not.

Materials

The survey consisted of four ordered parts: the nonconformity/conformity statement, self-ratings of participant competencies in AT, self-rated proficiency with preselected iPad apps, and a demographic questionnaire. Materials for these sections are described below.

Conformity versus nonconformity framing. Two scenarios containing the definition of AT from IDEA (2004) and one example of AT, a screen reader, were included as information for participants to read about current use of AT in reading. The IDEA definition of AT was given to participants on the first question to operationally define the type of technology (i.e., to differentiate between instructional technology and AT). The information was presented as either a conformity statement: "Adoption of iPad apps has been shown to improve fluency and comprehension skills by two grade levels. Join your fellow teachers in supporting students with learning disabilities: 75% of reading intervention programs are utilizing iPad apps" or a nonconformity statement: "Adoption of iPad apps has been shown to improve fluency and comprehension skills by two grade levels. Support your students with learning disabilities by using iPad apps in reading instruction." We created three questions to determine whether the framing of the statement—conformity versus nonconformity—influence their interest in adopting AT, confidence in trying out iPad in reading instruction, and their likelihood to use iPad in reading instruction on a 1–6 Likert-type scale.

AT knowledge. For the purposes of this study, we defined AT knowledge as teachers' awareness of available AT and the procedures for including AT in a student's program. We modeled the measure from research conducted by Safhi, Zhou, Smith, and Kelley (2009) that also evaluated professional knowledge of AT competencies, as developed by Bryant et al. (1998), but targeted professional knowledge of AT devices for individuals with visual impairments. This measure contained eight competencies. The competencies were knowledge of AT devices and services, knowledge of individual education programs (IEPs) and AT, knowledge of issues; barriers and benefits of AT, knowledge of incorporating AT into the curriculum, knowledge of federal legislation and state policies regarding AT, ability to conduct functional analyses of students' needs and to select appropriate AT, ability to evaluate instructional progress and the effectiveness of AT, and knowledge of funding to support the use of AT.

Participants were asked to rate themselves according to the competency levels of *none*, *limited*, *adequate*, and *outstanding*. *None* (0) meant that the participant had no knowledge, meaning the AT was not covered in the program. *Limited* (1) meant that the participant might have heard of the AT but had insufficient knowledge of it. *Adequate* (3) meant that the participant had some knowledge of the AT and could have received some relevant training but was not proficient in its use; *outstanding* (4) meant that the participant was knowledgeable enough to where he or she could teach the course to other people. However, participants were not explicitly told what the terms meant.

Teacher proficiency with iPad apps. To determine which iPad applications would be included in the survey, the primary investigator sought to find iPad apps that addressed the five components of balanced reading instruction endorsed by the National Reading Panel (NRP). According to NRP (2000), children can benefit from explicit, systematic, and sequential instruction in the areas of (a) phonemic awareness, (b) phonics, (c) fluency, (d) vocabulary, and (e) text comprehension strategies. The list of iPad apps, representative of these five components, was generated using the Reading Rockets (www.readingrockets.org) and the International Dyslexia Association's websites (http://eida.org/). Reading Rockets is a national multimedia literacy initiative that offers information and resources on how young children learn to read, why so many struggle, and how adults can help. The International Dyslexia Association is an advocacy organization dedicated to issues surrounding dyslexia. The association serves individuals with dyslexia, their families, and professionals in the field.

Upon generation of the initial iPad apps list, we consulted with three AT experts. While one of the three experts validated the list as it was, two of them referred the primary investigator to additional websites (i.e., http://bridgingapps.org/screenbinary/?attributes=7:Reading and Phonics) for consultation. The primary investigator confirmed that the included apps were recommended on the website as well. Participants were asked to rate their familiarity with the 10 preselected iPad apps (1 = *nonuse*, 2 =*awareness*, 3 = *proficient*, 4 = *advanced*).

We refer to this measure as AT proficiency in the results section.

Demographic questionnaire. The demographics contained questions to gather general participant information such as gender, ethnicity, education, certification (i.e., general education, special education, or both), and years of teaching experience. The form captured participant's teaching situation (i.e., whether they were teaching currently or the date of their last teaching experience, the grade levels they had taught, and in which settings they had worked with students with LD).

Personal reflections on AT preparation. The demographics also asked for teacher's experience with the use of AT and the type of training that they believe they received on AT. Specifically, participants were asked to rate, on a Likert scale from 1 = *strongly disagree* to 5 = *strongly agree*, their level of agreement with three statements regarding how they felt their college and workplace prepared them to use AT. The three statements were "During my college education, I was well trained in using assistive technology," "At my workplace, I am provided with training opportunities involving the use of assistive technology," and "At my workplace, I am provided with training opportunities, involving the use of new and emerging assistive technologies, that help me stay current in the area of AT." Additionally, the form contained questions on teachers' training experiences with AT including whether they had taken a course on AT in college and, if so, how many. Respondents were then asked if they had participated in professional development trainings on AT.

Perceptions of AT. The demographic questionnaire also contained prompts targeted at teachers' perceptions. Teachers' perceptions were defined as their current views toward the use of AT. The first prompt (i.e., *Which statement most reflects you*?) asked respondents to select the option that best reflected their personal feelings and interest toward using AT from a provided list. The following options were provided: (a) not convinced AT is beneficial for instructing students with LD; (b) not interested in using AT for instruction of students with LD; (c) interested in using AT for instruction of students with LD; (d) interested in AT for instructing students with LD and likely to implement AT in the classroom; (e) interested in AT for instructing students with LD and already implementing in the classroom; and (f) interested in AT for instructing students with LD but have encountered barriers in implementation. Another prompt (i.e., *What barriers have you encountered with the implementation of AT?*) asked participants to select any barriers (instructions were to select all that applied) they had encountered related to the implementation of AT. The choices provided were (a) equipment obtainability, (b) equipment breakdown, (c) equipment portability, (d) monetary resources, (e) student characteristics—reluctance, (f) student characteristics—training, (g) teacher characteristics—reluctance, and (h) teacher characteristics—training.

Procedure

The study was conducted online using Qualtrics (Version 6) as the survey software program. Participants were provided a link to the survey. When they opened the survey link, participants read a statement that explicitly specified that eligible participants must have experience teaching students with LD at the elementary or middle school levels. Individuals were required to select one of two options: (a) they were eligible to complete the survey because of their experience teaching students with LD or (b) they lacked such experience and therefore were not eligible. By picking option (b), the individual's participation in the survey was terminated. If option (a) was selected, the participant was directed to the informed consent.

There were two consent forms available to participants—one for graduate students at a southern rural university in the United States (estimated size $\sim$ 12,000 students) and one for practicing teachers not enrolled at the institution. The reason two consent forms were used was to identify students to allow them an opportunity to earn potential extra credit if their instructors offered it as an incentive. Targeted graduate classes consisted primarily of those in the field of special education, and to our knowledge, all participating instructors offered the extra credit incentive, which likely increased participation from this subset. Practicing teachers could elect to be included in a drawing for a gift card, not to exceed US$50.00 in return for their time in participating.

Parameters were set in the survey software so that participants could only take the survey one time. Furthermore, participants were required to answer each question before proceeding to the next (i.e., Qualtrics allowed the researcher to set the program to "force" an answer before it moved the participant to the next screen). This prevented participants from accidentally skipping questions when completing the survey. However, at any time the participants could terminate the study by closing the website.

The survey either began with a statement that implied the pressure to conform with the professional community or not. Participants were asked to respond to Likert items related to this conformity or nonconformity statement. Then participants responded to items related to three additional areas: (a) AT knowledge, (b) teacher proficiency with iPad apps, and (c) a demographic questionnaire that also included teachers' perceptions of their AT training and barriers of incorporating AT.

Results

Given that the conformity manipulation did not influence teachers' interest ($M_{\text{nonconformity}} = 5.05$, $SD_{\text{nonconformity}} = 1.41$; $M_{\text{conformity}} = 5.05$, $SD_{\text{conformity}} = 0.74$), confidence ($M_{\text{nonconformity}} = 5.00$, $SD_{\text{nonconformity}} = 1.05$; $M_{\text{conformity}} = 4.43$, $SD_{\text{conformity}} = 1.12$), or likelihood of implementing AT ($M_{\text{nonconformity}} = 5.22$, $SD_{\text{nonconformity}} = 1.01$; $M_{\text{conformity}} = 4.86$, $SD_{\text{conformity}} = 0.91$), we collapsed participants across those receiving the nonconformity and conformity statements. Because most of our respondents had a certification in special

education (77%, $n = 50$), we did not include teacher certification type as an independent variable in any of the subsequent analyses. However, we should note that a preliminary analysis of teacher certification type on the dependent variables involving AT knowledge demonstrated no significant influence of certification type. We divided the results into three sections: (1) AT knowledge, (2) perceptions on AT training, and (3) and personal reflections of AT use.

In the first section, using a standard multiple regression, we analyzed the influence of three predictor variables along with a covariate on teachers' ratings of the AT knowledge. We included a similar analysis in the personal perceptions of AT training, and additionally we evaluated whether teachers' perceptions significantly differed from a neutral rating in one sample *t* tests.

The third section describes teachers' personal reflections on AT and breaks it in two subsections. In the first subsection, we report the frequency of participants' personal feelings about interest and implementation of AT in the classroom. In the second subsection, we report the distribution of teachers' responses regarding their perceptions of common barriers to AT implementation.

AT Knowledge

Teachers reported their knowledge of AT on a rating scale (1 = *none*, 2 = *limited*, 3 = *adequate*, and 4 = *outstanding*) based on eight probes. In summary, the self-reported knowledge was not more than limited. For details, see the descriptives of the eight probes in Table 2. Cronbach's α was computed to measure strength of consistency among the eight probes. We noted sufficient reliability of the 8 items ($\alpha = .89$), and in the subsequent analyses, we report the aggregate variable averaged across the eight competency ratings.

To determine whether self-reported level of teacher knowledge of established AT competencies varied as a function of teacher characteristics, we conducted a standard multiple linear regression with the AT knowledge aggregate variable as our dependent variable and years of teaching experience (Yrs Teach), completed professional development sessions related to AT (AT Prof. Dev.; 1—Yes, 2—No), and AT courses completed in school (AT Courses; 1—Yes, 2—No) as predictor variables. Teachers' self-reported proficiency with our 10 preselected iPad apps (AT proficiency) was included as a covariate. For the AT proficiency covariate, we aggregated the iPad app proficiency variable (10 items; Cronbach's $\alpha = .89$).

We entered the covariate (AT proficiency) first into the model, followed by the three predictors (Yrs Teach, AT Prof. Dev., and AT courses) and their interaction terms. We excluded interaction terms from our model due to multicollinearity. We report the results of the regression analysis in Table 3. Model 1 shows the results with the covariate alone. Model 2 includes the covariate along with the three predictors.

As displayed in Table 3, the covariate of self-reported AT proficiency significantly contributed to AT knowledge ($R^2 =$ 16.3%; see Model 1). Adding the three predictors (Years of Teaching Experience, AT professional development, and AT courses) with the covariate accounted for 24.6% of the variance, as indicated by the adjusted R^2 (see Model 2). Completing an AT course in college ($\beta = -.23$) and having AT professional development ($\beta = -.31$) predicted AT knowledge, $ps < .05$. These results suggest that having an AT course and experiencing AT professional development was associated with greater AT knowledge. As expected, higher self-rated proficiency with iPad reading apps (AT proficiency) was associated with higher ratings of AT knowledge ($\beta = .40$, $p < .01$).

Table 2. Participant Self-Rated Knowledge of Assistive Technology (AT) Competencies.

Competency	*M*	*SD*
Knowledge of AT devices and services	2.87	.64
Knowledge of individual education programs and AT	3.08	.66
Knowledge of issues, barriers, and benefits of AT	2.79	.60
Knowledge of incorporating AT into the curriculum	2.82	.67
Knowledge of federal legislation and state policies regarding AT	2.58	.76
Ability to conduct functional analyses of students needs and to select appropriate AT	2.60	.71
Ability to evaluate instructional progress and the effectiveness of AT	2.82	.76
Knowledge of funding to support the use of AT	2.10	.79

Note: Rating scale was 1 (*none*), 2 (*limited*), 3 (*adequate*), and 4 (*outstanding*).

Table 3. Regression Analysis for Predictors of Assistive Technology (AT) Knowledge.

Predictors	*B*	*SE B*	95% CI	*t*	β	*p*
1. AT proficiency	.37	.20	[1.68, 2.47]	10.63	.40	<.01
2. AT proficiency	.32	.10	[0.11, 0.53]	3.09	.35	<.01
Yrs Teach	−.01	.01	[−0.02, 0.01]	−.42	−.05	.68
AT courses	−.31	.16	[−0.62, −0.01]	−2.02	−.23	<.05
AT Prof. Dev	−.36	.13	[−0.62, −0.10]	−2.76	−.31	<.01

Note. AT proficiency refers to the aggregate measure of participants' self-reported proficiency on iPad reading apps. Yrs Teach refers to the number of years of teaching experience. AT courses (1—completed AT course in college, 2—no AT courses in college) and AT professional development (1—completed AT professional development, 2—no AT professional development) were dummy coded. "1" refers to when the covariate alone was included in the model and "2" indicates when the three predictors and the covariate were included in the model. CI = confidence interval.

Perceptions on AT Training

For personal perceptions on AT training, participants were asked to rate their level of agreement with opportunities for training in AT, ranging from 1 = *strongly disagree* to 5 = *strongly agree* with three statements: "During my college education, I was well trained in using assistive technology (college preparation; $M = 2.42$, $SD = 1.14$)," "At my workplace, I am provided with training opportunities involving the use of assistive technology (workplace preparation; $M = 3.56$, $SD =$ 1.11)," and "At my workplace, I am provided with training

Table 4. Regression Analysis for Predictors of Assistive Technology (AT) Perceptions.

Predictors	*B*	*SE B*	95% CI	*t*	β	*p*
College preparation						
1. AT proficiency	0.65	.24	[0.16, 1.13]	2.68	.33	.01
2. AT proficiency	0.58	.23	[0.11, 1.05]	2.49	.29	.02
Yrs Teach	−0.03	.02	[−0.07, 0.01]	−1.79	−.21	.08
AT courses	−1.01	.35	[−1.70, −0.31]	−2.90	−.34	.01
AT Prof. Dev	−0.13	.29	[−0.72, 0.46]	−0.45	−.05	.66
Workplace preparation						
1. AT proficiency	0.38	.25	[−0.11, 0.87]	1.54	.20	.13
2. AT proficiency	0.35	.25	[−0.14, 0.84]	1.41	.18	.16
Yrs Teach	0.02	.02	[−0.02, 0.06]	1.20	.15	.24
AT courses	0.16	.37	[−0.57, 0.89]	0.45	.06	.66
AT Prof. Dev	−0.53	.31	[−1.15, 0.09]	−1.73	−.22	.09

Note. AT proficiency refers to the aggregate measure of participants' self-reported proficiency on iPad reading apps. Yrs Teach refers to the number of years of teaching experience. AT courses (1—completed AT course in college, 2—no AT courses in college), and AT professional development (1—completed AT professional development, 2—no AT professional development) were dummy coded. "1" refers to when the covariate alone was included in the model and "2" indicates when the three predictors and the covariate were included in the model. CI = confidence interval.

opportunities, involving the use of new and emerging assistive technologies, that help me stay current in the area of AT (emerging AT in the workplace; $M = 3.24$, $SD = 1.14$). One sample *t* test was computed with a test value of 3 (neutral rating) to determine whether participants' scores were significantly different from the neutral rating. Positive values were associated with greater agreement, whereas negative values were associated with disagreeing with the statements.

Participants' college preparation and workplace preparation ratings significantly differed from the neutral rating (the comparison base value of 3) $t(61) = -4.02$ and $t(61) = 4.00$, respectively, $p < .01$. Therefore, it appeared that participants disagreed with the statement that their college prepared them for AT, but they agreed that their workplace did. However, they were neutral in regard to level of preparation by their workplace in terms of emerging AT, $t(61) = 1.67$, $p = .10$.

Similar to the regression analysis reported in the AT knowledge section, we computed a standard multiple regression with years of teaching experience, AT professional development sessions completed (AT Prof. Dev.; 1—Yes, 2—No), and AT courses completed in school (AT Courses; 1—Yes, 2—No) as predictor variables for the abovementioned statements that differed from the neutral rating. Additionally, we included AT proficiency as a covariate (see Table 4).

Including the covariate of AT proficiency in the model alone, participants' self-reported proficiency on iPad reading apps was a significant predictor of feelings of college preparation ($\beta = 33$; $R^2 = 10.7\%$). When the three predictors were added in Model 2, 19.0% of the variance was accounted for, as evidenced by the adjusted R^2. As shown in the top portion of Table 4, having an AT course was associated ratings of agreement that their college prepared them for AT ($\beta = -.34$), and higher levels of self-reported AT proficiency was also associated with higher ratings of college preparation ($\beta = .29$).

Repeating the regression analyses for workplace preparation, as displayed in the bottom portion of Table 4, neither the covariate of AT self-reported proficiency on iPad reading apps or the three predictors of years of teaching experience, having an AT college course, or having AT professional development were associated with perceptions of teachers' workplace preparing them for AT (*p*s > .05). Neither the model with the covariate alone, $F(1, 60) = 2.38$, $p = .13$, or combined with the three predictors, $F(4, 57) = 1.91$, $p = .12$, significantly predicted ratings of workplace preparation. Given participants did not perceive they received adequate training in AT use, it is reasonable that none of these variables predicted their workplace preparations.

Personal Reflections of AT Use

Participants also were asked to select the statement that best reflected their personal feelings regarding the use of and interest in incorporating AT into the classroom setting. Overall, the results indicate that 21.0% ($n = 13$) of participants were interested in AT, 33.9% ($n = 21$) participants were interested in AT and likely to implement it in the classroom, 32.3% ($n = 20$) reported that they were already implementing AT in the classroom, and 11.3% ($n = 7$) of participants indicated that they were interested in AT but had encountered barriers to implementation. Only one participant (1.6%) indicated that he or she was not convinced AT is beneficial for instructing students with LD, and no participant indicated a lack of interest in using AT in the classroom.

When asked to rate their perceptions regarding the common barriers to AT implementation, participants selected *equipment obtainability* ($n = 30$) and a lack of *monetary resources* ($n = 29$) as the most frequent barriers. *Teacher characteristics-training* ($n = 16$), *student characteristics-training* ($n = 15$), *equipment breakdown* ($n = 14$), and *teacher characteristics-reluctance* ($n = 13$) were identified by roughly a quarter of the respondents as barriers. Additionally, teachers selected equipment portability ($n = 8$) and student characteristics-reluctance ($n = 8$) as barriers to AT implementation. Participants were given an option of selecting *other* and provided a description of barriers not listed in the questionnaire. Five respondents selected *other*, with teachers indicating challenges with administration/districts preventing AT implementation, issues with finding the appropriate AT per student, and training teachers with AT beyond iPads. Finally, the option of *not applicable* was selected nine times, suggesting that these teachers did not feel that there were barriers to AT implementation.

Discussion

We identified four major findings in our study. First, completing an AT course in college, along with self-reported proficiency on iPad reading apps, appeared to predict AT knowledge. Second, completing an AT course in college was

associated with perceptions of colleges preparing teachers for AT, but it does not predict feelings of workplace preparation. Third, teachers are clearly interested in incorporating AT into the classroom. Finally, teachers cited monetary issues and acquiring equipment as the most common barriers to implementing AT. We explicate on each of these findings below.

AT Knowledge

With regards to AT knowledge, completing an AT course in college predicted teachers' knowledge of AT (such as federal legislation policies, funding sources, and incorporating AT into the curriculum). Additionally, self-reported AT proficiency ratings of 10 iPad reading apps were predictive of AT knowledge. This is consistent with the existing literature (Kalonde & Mousa, 2016) which demonstrates that "as teacher educators use and model technology to preservice teachers, the preservice teachers will in turn use what was modeled to them in instructing various subjects to the K-12 students using these and similar technologies" (p. 253). Kamei-Hannan, Howe, Herrera, and Erin (2012) found that the self-reported skills in using specific technologies increased with an AT course and "the development of technology skills is a dynamic and multifaceted process that can be facilitated by the delivery of intensive formal instruction in a university course" (p. 677).

Perceptions on AT Training

Additionally, participants provided information about their college preparation regarding AT, their opinion regarding AT use, and any barriers they felt hampered implementation of AT. Eighty-three percent of participants indicated they did not have AT as part of their college degree. As only half of the sample, approximately 54.8% of the participants, was currently enrolled in a master's/specialist degree program at the participating institution of higher education, we do not believe this finding was the product of solely one institution's preparation program. Participants who reported they encountered AT information in college reported it was not a specific course but rather embedded in other courses. The lack of teachers' feeling of preparedness by their college was evidenced by their response to the reflection question, with participants being more likely to disagree that their college had prepared them to use AT. Nevertheless, teachers agreed with the statement that their workplace offered AT professional development opportunities. These reflections point to a greater need of AT training in college courses, especially given that AT course completion was a predictor of AT knowledge. Furthermore, given having an AT course was associated with ratings of colleges preparing students for AT, this suggests that these training opportunities in college are meaningful to students as educators and therefore should be included in preservice preparatory programs. This is consistent with the existing literature on the inclusion of AT in teacher preparation programs (Jones et al., 2019; Naraian & Surabian, 2014).

Our results suggest the need for further AT professional development opportunities in the workplace, as teachers may not have been adequately trained in AT during their college education. These findings are congruent with those of Judge and Simms (2009) who found that few undergraduate special education licensure programs required an AT course. Furthermore, the authors relate teacher knowledge of AT with student use (Judge & Simms, 2009). Although the use of AT in classrooms has increased over time, researchers show that students who could benefit from the use of AT in their classrooms are still not using it (Bouck et al., 2011; Simpson, McBride, Spencer, Lodermilk, & Lynch, 2009). Because professional developments tend to prepare workers with the popular technology, the present findings support further teacher training, which logically will lead to greater student use.

Positive Teacher Perceptions of AT

Clearly more training is needed and would likely be valued by educators, as only one of our respondents indicated that he or she was not convinced of the usefulness of AT in the classroom. This overall positive perception of AT aligns with those of Flanagan, Bouck, and Richardson (2013) and Stoner, Parette, Watts, Wojcik, and Fogal (2008) who determined that teachers understood the benefits that AT affords students. This finding also supports the idea that if training on AT focuses on making it convenient and user-friendly to utilize, easy to integrate, and provides sufficient time for learning how to use it, teachers will be more likely to implement it (Biancarosa & Griffiths, 2012).

Identified Barriers to AT Implementation

Nevertheless, obtaining AT equipment and funding for AT were a common concern of teachers, as indicated by their reports of barriers to implementing AT. This finding is consistent with previously established barriers to AT use (Bausch & Ault, 2012). Notably, 16 of 62 participants (25.8%) also cited teacher training as a barrier to the use of AT in the classroom, and this finding is also congruent with literature (Gronseth et al., 2010; Judge & Simms, 2009). Teachers' reflection on inadequate training coincides with their reports of lack of college preparation. Furthermore, teachers indicated teacher reluctance, student characteristics, equipment breakdown, and administration/district issues (others) as barriers. Overall, it appeared that the majority of teachers identified barriers to AT implementation, and colleges and school districts may help to overcome these barriers by (1) providing additional training opportunities, (2) increasing teachers' self-efficacy in using AT, and (3) educating teachers and administrators on funding sources for AT and free/open apps for AT (Bryant, Bryant, & Raskind, 1998).

Limitations

There are some limitations of the present study. The first limitation was that most participants were from the same geographic region and were primarily female. This decreases the generalizability of this study. Secondly, the application of AT to teach students with LD is the primary focus of this investigation, thus decreasing generalization of findings to other types of disabilities. Nevertheless, it is reasonable to infer that the scope of the problems for other types of disabilities is similar or even more severe. Another limitation was that participants were asked to self-report their level of proficiency with a small subset of AT (i.e., 10 iPad reading apps). Furthermore, they were not asked questions that indicated how competent they were on these preselected iPad reading apps in comparison to their self-assessment of their competency. Perhaps, in the future, researchers could include qualitative survey questions that ask participants to describe how they specifically use AT and include it in the IEP. Furthermore, the type of AT being utilized by participants, who said they were already using AT in their classrooms, is unknown. Lastly, the survey completion rate was a limitation. Only 62 of the 99 who signed the consent form and started the survey completed it. Hoerger (2010) suggests that inevitably when conducting an online study some participants will immediately drop of the study. Furthermore, as the survey length increases, it is more likely the participants will drop out. Our participants reasons for failing to complete the survey are unknown; however, a shorter version of the study may have resulted in a higher completion rate.

Implications for Practice

Results indicate that teachers generally had limited knowledge in AT competencies. Further, obtainability of AT was cited as the biggest barrier to implementation of AT. Funding is required for the purchase of AT and training students and teachers in its use. School districts should research funding available through the federal and local governments and other organizations, so that teachers may be able to acquire the needed training and obtain AT for the benefit of those students who need them. Teacher preparatory classes should also be geared toward advancement of preservice teacher knowledge and skills related to AT (Parette & Stoner, 2008), as implementation of AT in the classroom will likely increase when the teacher feels comfortable and confident in its use (Connor, Snell, Gansneder, & Dexter, 2010). Furthermore, continued AT professional development is paramount given that it is associated with higher AT self-efficacy (Marino et al., 2009) and teachers in the workforce may not have had adequate AT training in college.

Future Research

Technology is constantly changing and so are the opportunities that it affords individuals with and without disabilities. Future studies should be targeted at increasing AT competencies and reducing barriers to the use of AT in instruction. Additionally, AT and apps that could benefit students with other forms of disabilities should also be investigated. It would also be helpful for researchers to inspect preservice training programs for teachers to determine the level of training available and how and where improvements can be made. Future research should also determine if the reported barriers of obtainability (lack of funding) carry over to the college level. An investigation into social and academic improvements associated with the use of AT could also emerge as a promising area for research. Finally, AT and apps that could enhance memory and retention of material could be another area for future research.

Conclusion

Researchers have shown that AT has the potential of bridging the gap between students with LD and their peers (Van Laarhoven, Munk, Chandler, Zurita, & Lynch, 2012). Legislation (IDEA, 2004) mandates the accessibility of technology to students with disabilities and requires the use of AT in educating students who have disabilities. However, successful implementation of AT requires a level of knowledge and proficiency on the part of the teacher. In fact, researchers show that the primary significant predictor of AT use in the classroom by students is the teacher's level of competence in using it (Connor et al., 2010); yet there is evidence of inadequate teacher training at the preservice level (Gronseth et al., 2010; Judge & Simms, 2009). Our results suggest that teachers felt unprepared by their college education, but AT courses are crucial given that completing an AT course predicts teachers' AT knowledge. Teachers are interested in incorporating AT and are aware of barriers to implementation. Thus, continued professional development and college course training in AT should be offered to teachers to help them feel more confident in using AT, be more likely to utilize it in the classroom, and promote more effective student learning.

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