Direct Instruction to Teach Students in a Comprehensive Postsecondary Transition Program how to Utilize Text-to-Speech Software Effectively

Lauren P. Bruno, Ph.D.
Washington State University

Mary Ball
University of Iowa

Erica Kaldenberg, Ph.D.
University of Iowa

Patricia Bahr, MSE
University of Iowa

Jordan Willits
University of Iowa

Abstract

This study evaluated how students enrolled in a comprehensive postsecondary transition program learned how to use text-to-speech (TTS) software to read higher-level written text. Using a pre- and posttest research design, researchers examined whether Direct Instruction effectively taught students to use a TTS program. We used third and sixth grade easyCBM (Curriculum-Based Measures) passages and corresponding reading comprehension measures to evaluate students' use of the TTS software to determine if TTS increased reading comprehension. Findings suggest that the use of Direct Instruction can facilitate the use of assistive technology and TTS readers. Implications for further research, practice, and policy are discussed.

Keywords: assistive technology, postsecondary education, intellectual disability, Direct Instruction, reading comprehension

Plain Language Summary

- Students with disabilities sometimes need support for reading skills such as comprehension and memory. One way to support students in reading is through assistive technology like text-to-speech (TTS) readers. Yet, students need to be taught how to use effectively use these tools.
- This study used Direct Instruction to teach college-aged students with intellectual and developmental disabilities how to use a TTS reader and looked to see if students could use the tool independently.
- We found that Direct Instruction can support students to use assistive technology like TTS readers.

Access to the general education curriculum and inclusion with general education or traditionally-enrolled peers is one of the most common predictors for employment and independent living outcomes for students with disabilities (Mazzotti et al., 2016; Wehman et al., 2015). Inclusion is when all students, regardless of ability level, have access to

support and services needed to participate fully and meaningfully with students in the general education setting (Kaufman et al., 2016). Policies such as the Higher Education Opportunity Act of 2008 (HEOA, 2008) sought to improve access to college campuses by creating comprehensive transition programs (CTP) that provide inclusive learning and social opportunities for college-aged students with intellectual disability (ID). CTPs also offer students with ID the academic and advising support needed to that ensure students are successful in the college setting (HEOA, 2008). Yet, students with ID continue to face barriers accessing inclusive courses on college campuses. College-aged students are entitled to receive reasonable accommodations to be successful on a college campus under the Americans with Disabilities Act (ADA, 1990) and one type of accommodation often used includes the use of assistive technology (AT). While simply providing students with AT meets the ADA requirement, it alone does not meet the specific students' needs. For instance, students need to be supported and taught how to use the AT or else it will inevitably be abandoned. When individuals with ID are taught how to use AT using Direct Instruction, the AT becomes a more meaningful tool to their success and independence.

Assistive Technology and Inclusion

AT can support students with ID to reach new levels of independence and inclusion, both academically and socially. AT is a recommended instructional tool that promotes greater opportunities towards inclusion and enables students with disabilities to gain independence and participate more fully in activities (Wehmeyer et al., 2006). However, the student must often rely on self-advocacy and self-determination to establish and maintain the support they require to be successful (Newman & Madaus, 2015), including accessing and learning how to operate AT independently and effectively in college. AT can support literacy instruction, and teachers report that AT is a useful tool to help students with disabilities, yet they use it minimally (Flanagan et al., 2013). The advantages of AT are recognizable to both instructors and students, yet the task of implementing AT can be intimidating. Challenges include needing to arrange trainings for both the teacher and student to learn how to utilize the AT effectively, and having the monetary means to acquire the tools (Lee & Vega, 2005; Ludlow, 2001). While a critical area of need, reading skills (e.g., decoding, fluency) are often a challenge for young adults with ID. The lack of these necessary skills also affects other critical reading components, including comprehension and memory, two of the most common areas assessed in reading.

Research has shown that AT can increase comprehension and literacy skills (Ahlgrim-Delzell et al., 2016; Salmerón et al., 2018; Young et al., 2019). A specific type of AT and one of the most common accommodations that support students with disabilities in inclusive settings include text-to-speech (TTS) software (Bakken et al., 2019; Wood et al., 2018). Read-aloud software and oral presentation of written words improve students' comprehension (Wood et al., 2018). For the past decade, TTS has been identified as a tool that provides students access to higher-level text, increases comprehension, and offers a concurrent visual and auditory presentation of the written text. For example, Young and colleagues (2019) identified that students with learning disabilities who use a TTS intervention scored higher in reading comprehension than when there was no TTS. Research confirms the utility of TTS in improving students' phonemic awareness and

decoding skills (Wood et al., 2018). Specifically, students see the written word, the highlight tool emphasizes the written word, and with TTS, the word is read aloud. The student may also interact with the text by using the dictionary, translation, and note-taking tools within the TTS software. The use of TTS provides greater access to a word's spelling, sound, context, and definition, and is used to support students' mental representation of the spoken word. Reading the written word and hearing the spoken word enhance the students' interconnections between the text, sound, and meaning of the word (Park et al., 2016), allowing the student to engage with text visually and auditorily, simultaneously. While researchers evaluate how TTS affects student performance in specific areas of reading, there is no indication of how students learn to use the software or continue use after the intervention (Atanga et al., 2019).

AT in Postsecondary Education

Barriers continue to exist for college-aged students to request and utilize accommodations effectively. For instance, Lindsay and colleagues (2018) identified common accommodation-related barriers for college-age students, including lack of knowledge from faculty, discrimination, stigmas, coping styles, and inadequate training on the use of assistive technology. However, Goegan et al. (2019) identified that a direct correlation exists for students who receive training and students' continued use of the technology. This suggests that if students do not receive sufficient training, they are less likely to use the accommodation (Goegan et al., 2019). The most used accommodation by college-aged students with disabilities is AT, specifically to support students in reading and writing using TTS and Voice-to-Text software (Zeng et al., 2018). The use of these specific AT tools allows students to interact with academic text in a meaningful way, enabling them to access higher-level content and further their educational experiences (Bakken et al., 2019). While students understand the benefits of utilizing AT in college, it is not enough to provide college-aged students accommodations; a critical need exists to train students to use the devices so that they may utilize AT efficiently.

Need for Training

AT devices can provide the proper accommodations, modifications, and/or augmentations to allow individuals with disabilities greater independence. More specifically, TTS can provide specific support to access written text that can lead to greater access to the curriculum. However, the research identifies that individuals with ID have inadequate access to AT, which may hinder their capacity to participate meaningfully in inclusive settings (Owuor et al., 2018). Lack of awareness of devices and options available is a barrier to the accessibility and usability of AT (Boot et al., 2017). Other barriers include the lack of training and implementation of AT from educators to support students' use of devices in class (Atanga et al., 2019; Zhou et al., 2011). While these are common themes throughout the literature, there is still a lack of research investigating the methods used to teach students with disabilities to use specific AT.

Direct Instruction to Teach the Use of Assistive Technology

Direct Instruction is an evidence-based instructional strategy to meet the needs of students with disabilities by providing explicit instruction that is also flexible. Engelmann's Theory of Direct Instruction uses continuous reinforcement of critical concepts and skills as new material is introduced at a steady predetermined pace that enables accelerated learning among students (Engelmann, 1980). The Direct Instruction teaching model is based on the following fundamental principles: (a) all students can be taught; (b) all students can improve academically; (c) all teachers can succeed if provided with adequate training and materials; (d) low performers can catch up to higher-performing peers; and (e) all details of instruction must be controlled to minimize the chance of students misinterpreting the information being taught and to maximize the reinforcing set of instructions.

Direct Instruction ensures that the learner is taught at their skill level (Engelmann, 1980). With Direct Instruction, students become accustomed to classroom routines (i.e., getting-ready steps on the sticker flipper, see Figure 1) and following scripted lesson plans that are consistent over time. When teaching reading instruction, Direct Instruction is one of the most common instructional techniques used in the K–12 setting to support skill development and has been found to result in statistically significant improvements in basic academic and functional skills. More specifically, Direct Instruction improves the reading (Head et al., 2018), writing (Datchuk et al., 2019), self-determination (Shogren et al., 2016), math (Harris et al., 2015), and other functional skills of students with disabilities, such as communication. Direct Instruction can be used to teach new content or skills that can be easily translated across settings (i.e., using Direct Instruction to teach students to use AT and incorporate it into their daily routine). When individuals with ID are explicitly taught how to use AT, they are also less likely to abandon the device/software. Effective AT implementation requires specific information, instruction, and supports that can foster greater access to the device and increase access to information (Boot et al., 2017). Therefore, while many of these studies measured the effectiveness of Direct Instruction to teach specific academic skills, no studies have investigated the ways students learn to use AT.

Purpose of the Present Study

Much of the AT research has been conducted in K–12 settings (Park et al., 2016; Schmitt et al., 2018), yet there is a continuous need to explore the use of AT in postsecondary education settings and its benefits on students who lack the reading and writing skills required to be successful. Therefore, this study expands on another study that utilized a randomized treatment and control research design to evaluate students' independent use of TTS software before and after the intervention (Bruno et al., 2020). Bruno and colleagues (2020) found that the use of Direct Instruction was useful in teaching students to use TTS software; yet, further research was needed to evaluate (a) student's perception of learning to use TTS; (b) generalization of skills, and (c) fidelity to ensure that the intervention was consistent across groups.

This study seeks to evaluate how Direct Instruction can teach students with ID to use TTS software to read higher-level written text that they may come across on a college campus. This study also includes the generalization of skills, having taught students how to use TTS on social media platforms (i.e., Facebook, Twitter, and Instagram). Data were also collected to ensure that the intervention was implemented with fidelity. The following research questions were used to guide the study and focused on using a TTS reader and reading comprehension.

1. Does Direct Instruction increase the use of TTS software for students with intellectual and developmental disabilities in a comprehensive transition program?
    a. Did students with intellectual and developmental disabilities, enrolled in a comprehensive transition program on an inclusive college campus, find it beneficial to learn to use TTS?
2. Is there a difference in the reading comprehension of students with intellectual and developmental disabilities when using a TTS compared to when it was not used?

Method

A pre- and posttest research design was used to understand better how students with ID enrolled in a comprehensive transition program (CTP) learned to use TTS software. After the intervention, student satisfaction was also evaluated to determine if they found the trainings and use of a TTS reader to be beneficial. The program partnered with the University's Center for Assistive Technology and Educational Research and received approval from the University's Institutional Review Board before beginning the study. Similar to a study conducted by Bruno et al. (2020), scripted lesson plans were used to teach the use of a TTS; reading comprehension was also measured using easyCBMs. easyCBMs are curriculum-based, standardized measures that can be used to assess students' mastery of skills or knowledge at specific grade levels and can also be used to monitor progress or as a formative assessment (Alonzo & Tindal, 2010).

Setting

This study was conducted within a CTP, focused on developing students' independence in living, learning, and working while being a part of a Big Ten college campus in the Midwest. Students experience integrated on-campus living, inclusive and program-specific academic learning opportunities, employment preparation, and training. The study took place in two sections of an in-person Computers & Technology course that is academically specialized for students enrolled in the CTP. A peer-mentor and practicum student were also involved in the class as additional supports. The course was held in a computer lab, took place over a sixteen-week semester, and focused on essential technology skills in education, the workplace, and/or home settings. Students were taught skills that helped them build a broad base of technical skills, such as installing and using common apps (e.g., E-mail, Uber, and University-specific apps), how to use a Chromebook, internet safety, scheduling, and social media.

Participants

Participants, ages 18 to 26, were first-year students in the CTP program. This study was conducted in the Fall, during their first semester in the program. Consent was obtained by a staff member not involved in the study during Fall orientation (before the start of the semester) when the students' parents were still present and could sign as well in cases where the student was not their own guardian. During this time, no one chose to opt out of the study, and students (N = 19) were enrolled in the technology course, a required course for program completion. Students were either enrolled in the Monday (n = 10) or Wednesday (n = 9) class section, based on their class schedules. At the beginning of the semester and start of class, students were reminded that they could let the instructor or their advisor know at any time that they wished to stop their participation in the study. A total of 19 students participated in this research, six female students and 13 male students. All students who participated in this study were identified as having an intellectual disability (ID), developmental disability, and/or a learning disability. According to the HEOA (2008), the requirements for a student to qualify as having ID include individuals with significant limitations in cognitive functioning and adaptive behavior (i.e., conceptual, social, and practical skills). Students' IQ scores ranged from 54 to 97, with a mean of 71. Six students were taught to use a screen reader before entering the program (31%) with four indicating they no longer use it (21%). 58% (n = 11) of students indicated that learning to use a screen reader would be helpful.

Materials

The computer lab was equipped with PC laptops running Windows 10 with typical applications installed (i.e., Microsoft packages, Internet Explorer, and Google Chrome). Before the semester began, students set up a professional Google account allowing for syncing of settings, extensions, bookmarks, and other Google applications saved to the individual's account to provide access across devices. Although computers were provided, students were required to come to class with their device (e.g., Chromebook/Macbook), a list of passwords, and headphones. If students' headphones were not compatible with the computer (i.e., wireless), a pair of headphones was provided during instruction.

Text-to-Speech Software

Snap&Read was installed and used via a Google Chrome Extension to allow students to access the software across devices (Don Johnston, Inc., 2016). Snap&Read is a widely used and available tool that can be customized to meet users' individualized needs. Before using Snap&Read, students could adjust their settings, including speed, pitch, and text font colors. Also, there were options for a picture-supported dictionary, color overlays, reading lines, removal of distractions, text leveling, and, if needed, a translation feature. Snap&Read was used to read text documents aloud, even if the document was not technically accessible. Accessible text is considered any format that a computer encodes as text (i.e., .txt, .docx, or .html); text on webpages is also considered accessible text. Inaccessible text is typically encoded as an image (i.e., .png, .jpeg); PDF documents are identified as accessible or inaccessible depending on settings.

Instructional Materials for the Intervention

Seven total lessons (see Table 1) were carefully developed to teach students to use Snap&Read independently. Each lesson focused on a specific skill needed to learn to use Snap&Read, including setup, use of the features, and generalization of the skills. Teaching these skills is based on Engelman's Theory of Direct Instruction (1980), which states that lessons are developed and follow a logical order to occur over time. During lessons, instructors observed mastery of skills and focused on the generalization of skills. The lessons elicited background knowledge, followed by a gradual release of responsibilities (i.e., I do, we do, you do). Students were then able to practice the skills for generalization. The lesson plans were scripted and used by the different instructors delivering the intervention in the Monday or Wednesday section of the class to ensure consistency.

Instrumentation

easyCBM for Reading Comprehension

This study measured students' abilities to use TTS readers after the receipt of Direct Instruction. We selected to use third and sixth grade easyCBM passages to meet students at their instructional levels. Each easyCBM passage consisted of one story, and 20 corresponding questions were used (Alonzo et al., 2006). Though the use of an easyCBM does not directly measure students' knowledge related to the use of TTS readers, it allowed the researchers to present information electronically and evaluate students' use of the TTS readers when presented with written text—researchers observed students' use of the TTS reader when presented with the accessible online text. The use of the easyCBMs was then used to answer research question 2, which sought to evaluate if the reading comprehension of students who used TTS increased.

Third and sixth grade easyCBMs were selected based on the students' achievement on the norm-referenced Woodcock-Johnson Test of Cognitive Abilities (WJ-IV; Schrank et al., 2014). The WJ-IV results were used because they were the most up-to-date information the program had on students' reading abilities. The WJ-IV evaluates students' academic achievement, oral language, and cognitive abilities (Schrank et al., 2014). On the WJ-IV broad-reading assessment (letter-word identification, reading fluency, and passage comprehension assessments), students' age-equivalent scores ranged from 7-4 to 17-10, with the average age being 10-5. Using the WJ-IV, grade equivalents were calculated and ranged from second through twelfth grade, with an average between fifth and sixth grade reading levels.

Use of the TTS Reader

Students were assessed on their use of the TTS reader and their ability to use the software independently. Data was collected using the researcher-developed Direct Instruction Programming Program Tracker (DIPPT). The DIPPT is a Google Sheet used to record a student's attendance, evaluate if the daily criterion were met (1 = yes, they did reach the criteria for the day; 0 = no, they were unable to meet the criteria for the day),

and document additional notes. Attendance was measured across the following five areas, worth two points each: (a) on time/stay until the end, (b) ability to complete all getting-ready steps, (c) I do (teacher model), (d) we do (guided practice), and (e) you do (independent practice). Additional notes were recorded based on anything that may have been notable about the students' performance and/or participation in the lesson, including their use of the TTS reader, or reasons they may not have met the day's criteria. The primary course instructor completed the DIPPT during each class. Data collection began during the pre-assessment and finished with the final post-assessment.

Sticker flipper

Sticker flippers are a self-developed tool used to assist students in self-monitoring their ability to independently complete the "getting-ready steps" before the beginning of instruction. Getting-ready steps included: (a) get your computer, (b) plug in your headphones, (c) turn your computer on, (d) log into your school account, (e) check your sound, (f) click on the Google Chrome icon, and (g) log into your Google account. Sticker flippers were modeled with the students during the first class and then implemented throughout the semester for self-monitoring. As students completed each of the "getting-ready steps," they flipped down the binder clip, which allowed the instructor to monitor student independence (see Figure 1).

Procedures

Once data collection began, students completed two easyCBM reading comprehension measures for the pre-assessment and two easyCBM reading comprehension for the post-assessments. Only one assessment was conducted per class session. Thus, during the first week, students completed the pre-assessments during class on Monday and Wednesday, and at the conclusion of instruction, students completed the post-assessments the following week on Monday and Wednesday. To evaluate the students' use of TTS, students were observed during pre-assessments and post-assessments. Attendance data and mastery data were also used to determine if students could master each step required to use Snap&Read independently. The pre- and post-assessment measures consisted of a third grade easyCBM passage and a sixth grade easyCBM passage. Each student was assigned one of two passages for each grade level (i.e., 3rd A or 3rd B, and 6th C or 6th D) and took the other grade level measure for their post-assessment. For example, if a student took third grade A and sixth grade C for their pre-assessments, they took third grade B and sixth grade D for their post-assessments. During the pre-assessments, all students took the third grade easyCBM measure first, followed by the sixth grade easyCBM measure, and for the post-assessment, students took the sixth grade easyCBM measure first, followed by the third grade easyCBM measure. Each time students took the pre- and post-assessments, they were provided verbal directions, which included the statement: "read the passage any way you would like, you may use any tools you want to." easyCBM passages and questions were provided electronically via Google Drive. A printed copy of the corresponding questions was also provided, as students were used to responding to assessments via paper/pencil; thus, students recorded answers on the paper copy. Upon completion of all pre-assessments, the Direct Instruction intervention began.

Direct Instruction Intervention

The instructors were provided instructional materials, which consisted of seven total lessons delivered over 25–40-minute periods. Each lesson had a mastery check at the end to determine if students could complete the skill learned independently. Mastery checks included a whole-class discussion or demonstration of the learned skill (observation). Students' mastery of skills were recorded on the DIPPT; if a student received a score of zero, indicating they did not master the skill, the instructor would provide specialized instruction. At least 85% of the class met mastery each time; thus, re-teaching of skills was not necessary, and instructors taught each lesson once and progressed without any adjustments made.

Social Validity

Students were given researcher-developed pre- and post-self-report surveys to measure their prior use of TTS readers and their perceptions of learning how to use a TTS reader. The measures were given to students using paper/pencil and also displayed on the projector in the front of the room. Questions were read aloud to students, and students were asked to answer each question by circling their responses. The pre-social-validity measure consisted of seven questions and evaluated students' prior use of AT, including: (a) if they were previously taught to use a TTS reader, (b) how often they use it, (c) what types of devices it is used on, (d) if they know how to use it, and (e) if they thought learning about TTS readers would helpful. The post-social-validity measure asked students (a) how they plan to use the TTS reader in the future, (b) how often they plan to use it, (c) where they will use it, and (d) what types of devices they would use it on. The final questions asked students if they thought learning to use Snap&Read was helpful. Both measures consisted of yes/no and multiple-choice questions, including selecting how often they plan to use it (e.g., every day, week, when told to use it, select all, or I do not need to use a screen reader).

Fidelity

Fidelity data were collected using direct observation of the instructor for the section to ensure that the intervention's implementation was consistent across the course sections and recorded electronically using Qualtrics, a web-based survey and data collection tool. Every session had a minimum of two observers that were trained on data collection by the researchers. Fidelity data measured the extent to which the intervention followed the Direct Instruction program developed to teach students to use specific TTS software. Since two instructors provided the intervention across two sections of the course, the collection of fidelity data helped ensure that all students were being provided the same information, and the instructors followed the scripted lesson plans.

The observers used a QR code on the front of a binder to access the AT Intervention Fidelity Data Collection tool. The binder contained printed copies of the Direct Instruction lesson plans. The observers recorded their name and role (i.e., practicum student, mentor, volunteer), date of the lesson, start time of the lesson, end time of the lesson, and the

instructor's name. The following questions were asked to evaluate the delivery of the lesson: (1) Were the materials organized and readily available; (2) Could the teacher see all the students, and could all the students see the teacher; (3) Did the teacher deliver the instruction according to the script; (4) Did the teacher provide clear signals; (5) Did the students respond to a signal in a conversational tone; (6) Did the teacher deliver the instruction at a brisk pace; and (7) Were correction procedures provided as directed in the script?

Data Analysis

Upon completing the intervention, post-assessments were given and scored using the answer keys aligned with the reading comprehension measures. Data recorded for each question was entered into an Excel spreadsheet by a second-year student in the CTP who completed his internship in the office setting. A peer-mentor checked the accuracy of data entry, and item analysis was completed. The raw scores for the two pre-assessments and two post-assessments were calculated. All quantitative data (easyCBM scores/percentiles, social validity, fidelity, DIPPT) were entered into an Excel spreadsheet and then imported into Statistics Package for the Social Sciences (SPSS) for final analysis. Due to the small sample size ($N = 19$), type II errors may have been more likely to occur (i.e., false negatives). Using the G*Power 3.1 (Faul et al., 2009), a tool for statistical analyses was used to perform a power analysis for sample size estimation using Wilcoxon signed-rank (Creswell, 2018). A moderate to large effect size of .7 was used for estimation with an alpha = .05, and power = .80. The minimum sample size needed with this effect size is approximately $N = 19$. The nonparametric analysis and inclusion of the moderate to large effect size minimize random error in this study.

Analyses included descriptive statistics (mean, standard deviation, frequency counts) and nonparametric tests (i.e., Wilcoxon signed-rank test and Mann–Whitney U Test). The nonparametric tests were selected because the data does not meet normality assumptions to run parametric analyses, and this study had a small sample size (Nahm, 2016). Therefore, due to the non-normal distribution of data, small sample size, and control for potential outliers, the Wilcoxon signed-rank test was used to compare median scores on the easyCBM for reading comprehension just mean scores (Coreder & Foreman, 2014). The Mann–Whitney U test was then used to compare the differences between two independent groups when the dependent variable (use of TTS) was evaluated (Coreder & Foreman, 2014).

Results

This study aimed to evaluate if Direct Instruction was useful in teaching students in a CTP to use TTS software and if students felt it was beneficial to learn the skill. We also sought to determine if students' reading comprehension skills increased when using a TTS. In addition, we collected fidelity data to ensure that the intervention was implemented consistently across sections. Fidelity data were collected using direct observation of the instructor to ensure that the intervention was consistent across both sections. Interrater reliability was calculated using the percentage of agreement for all of the lessons. Observers agreed 100% of the time on six out of the seven criteria (i.e., materials

organized, teachers see all students, deliver instruction according to the script, provide clear signals, conversational tones, and correction procedures on the script). There was low agreement across the lessons when evaluating the pace of delivery (13%); yet, there was no indication that students were behind or waiting. Overall, all instructors followed the scripted lesson plan provided to them, offered clear signals, and were prepared for each class session.

Research Question 1: Use of TTS Software

Frequency counts were used to determine if Direct Instruction increased students' use of TTS. On average, students met all the daily criteria for each lesson and received all attendance points. Points were deducted when students forgot headphones (n = 2) and could not complete the getting-ready steps, or when a student did not complete a pre-assessment (n = 1). If students arrived late to class, a point was deducted; yet data indicates that they still met the criterion for the day. Table 2 presents the total number of students who used Snap&Read on the pre-assessments and post-assessments, the mean reading comprehension score per class, and the totals for the entire group (N = 19).

Students' Perceptions of Learning to use TTS

While most of the students did not receive instruction using a TTS before the intervention, four indicated that they had used it before but were not using it before the intervention. After the receipt of Direct Instruction, 14 students (74%) showed an interest in using Snap&Read in the future, with three students reporting that they would use it every day, five reporting that they would use it every week, and five reporting that they would use it when told to. While one participant indicated that they would use it in the future, they also indicated that they did not need it. 95% (n = 18) of the respondents said they now know how to use a TTS reader, and 100% said learning how to use Snap&Read was helpful (N = 19).

Research Question 2: Reading Comprehension

To evaluate the differences in reading comprehension for students with IDD who chose to use a TTS reader versus those that did not, students' raw scores on the third and sixth grade easyCBM reading comprehension measures were used for analysis. A Wilcoxon signed-rank test for nonparametric data was used in place of a paired-samples t-test to determine differences in scores on the third and sixth grade easyCBM pre- and post-assessments. The use of a Wilcoxon signed-rank test reduced the effect that potential outliers in data may have on this small sample. Results indicate that there were significant changes in pre-assessment rank (3rd grade Mdn = 11; 6th grade Mdn = 9) compared to post-assessment rank (3rd grade Mdn = 13; 6th grade Mdn = 10) on the third grade easyCBM (z = -2.364, p < .05) and sixth grade easyCBM (z = -2.262, p < .05) for the entire sample. Scores ranged from 4 to 18 on the third grade pre-assessment and 3 to 14 on the sixth grade easyCBM passage. On the post-assessments, scores ranged from 5 to 18 on the third grade easyCBM, and 4 to 14 on the sixth grade easyCBM. Means and standard deviations are presented in Table 3.

Differences Between Groups

A Mann-Whitney U test was used in place of an independent samples t-test to compare the differences of groups based on the mean scores on the easyCBM reading comprehension; this allowed the researchers to control for type II error due to the small sample size and non-normal distribution. Groups were analyzed based on the use of TTS on the post-assessment. Results indicate no difference in the use of the TTS reader and students' comprehension scores on the third grade post-assessment ($U = 38$, $p = .773$). Results of the sixth grade post-assessment ($U = 28$, $p = .494$) also indicate that there were no significant differences; yet, a moderate effect was detected. While the Mann-Whitney U analysis did not show significance, there are greater differences in mean scores for the group that used TTS readers on the post-assessment compared to those who did not (see Table 4).

Generalization of TTS

After receipt of the intervention, both sections completed the post-assessments. They were then provided with one additional lesson to evaluate their ability to generalize the skill on their own devices. Anecdotal records were used to note observations of students' use of TTS, and it appeared that students were independently able to use Snap&Read on their computers with a verbal prompt. Observers were provided with the steps that students were taught to complete independently and used a checklist with a column for additional notes of how students used Snap&Read. Additional notes from the observers included students accessing higher-level texts than the text they were independently accessing at the beginning of the semester. For example, at the start of the semester, when students were prompted to find articles to read on their own, they were more likely to go to websites with more pictures and minimal text. Towards the end of the semester, students were accessing more text-heavy articles, rather than pictures. In conjunction with Snap&Read, observations were made that students used other natural computer supports to complete their reading comprehension assessments, such as using the Ctrl+F feature to find words in the passage that corresponded with the question. Students were also more engaged (e.g., answering more detailed questions, selecting the text of interest rather than ease/level of text) in reading the passages. They spent more time completing the reading and questions during the post-assessment than the pre-assessment, when students were observed scrolling quickly and going right to the questions. Students also used pencils or the paper to follow along with the TTS audio, rather than using the highlight feature. Lastly, students were able to identify the benefits of using a TTS reader and were able to generalize it across devices (i.e., TTS on cell phones).

Discussion

Direct Instruction is useful to teach the mastery of new skills to students with intellectual disability and promotes the generalization of learning across environments (McLeskey et al., 2017). Past research focused on using Direct Instruction to teach academic skills (Hollingsworth & Ybarra, 2017; Stockard et al., 2018); yet little research was focused on using Direct Instruction to teach students to use specific types of AT. AT has been identified as a support for students with disabilities who continue to face barriers to

accessing curricula; also, many students are not explicitly taught to use the device or tool (Atanga et al., 2019; Zhou et al., 2011). Therefore, this study's primary purpose was to evaluate if Direct Instruction effectively taught students in a postsecondary CTP to use Snap&Read, a TTS software that can be used to increase students' access to higher-level texts. A secondary part of this study was to evaluate if students' reading comprehension improved when using TTS.

Findings suggest that the participants in this study increased their use of Snap&Read after receiving a Direct Instruction intervention that explicitly taught how to use the software. The conclusions of this study are consistent with the previous study (Bruno et al., 2020), which identified that after the receipt of Direct Instruction, 70% of students in the treatment group were more likely to use Snap&Read when completing the easyCBM measures compared to 0% of students in the control group. The present study did not utilize a control group, and used a whole group design, findings from this study suggest that 63% of students chose to use Snap&Read on the post-assessments, and 100% of participants in this study were able to use the software independently. All students were able to complete the criterion for mastery (at the end of each lesson) and demonstrate an understanding of the TTS software use. Due to non-significant findings from the previous study (Bruno et al., 2020), we chose to further evaluate the impact of the TTS reader on reading comprehension, as it is necessary for achievement in inclusive college courses.

One of the most commonly used types of AT in a college setting includes using a TTS reader (Bakken et al., 2019; Zeng et al., 2018). AT can increase students' academic and social independence and promote inclusion. Previous literature has identified that the use of TTS readers increased student's literacy skills (Ahlgrim-Delzell et al., 2016; Izzo et al., 2009; Wood et al., 2018); yet, differences in reading comprehension were not significant in this study, based on the use of TTS readers. This may be because much of the literature on teaching reading skills has focused on using Direct Instruction to teach a specific skill or evaluate the use of TTS after reading comprehension skills were also directly taught. Because this was not the main focus of this study, the use of TTS readers to specifically support reading comprehension was not directly taught. Instead, the focus of the instruction was on the use of the TTS reader. This may suggest that further instruction is needed to teach the use of TTS related to specific skill acquisition (i.e., the use of TTS for reading comprehension). However, the supplemental anecdotal records from observations are consistent with the literature, suggesting that students were more likely to engage with the passage when using a TTS reader than reading it on their own. Behaviors were observed that suggested that students were more engaged when using a TTS reader, as measured by how those that used the highlight feature spent more time on the passage than those who did not (Park et al., 2016). Also, observation data showed students feeling more comfortable accessing and engaging with higher-level texts. This finding aligns with Schmitt et al. (2018), who stated that when students in postsecondary education settings are provided access to AT, they are more likely to have increased engagement. Future research should focus on using Direct Instruction to teach students to use different types of AT needed to support them in inclusive postsecondary courses while also measuring student achievement in traditional college courses, including the use of TTS readers. This would allow students to practice generalizing skills across environments, have the additional support provided to ensure effective use of the devices,

and enable the researchers to continue evaluating the effects of TTS (or other types of AT) in inclusive learning environments.

Limitations

The findings suggested that postsecondary students with ID can learn and generalize skills related to TTS software; some limitations should be addressed. First, a one-group pre/post-test design presents threats to internal validity. However, because reading comprehension was not the primary focus of the study and data were collected evaluating students' independent use of TTS software throughout the study, threats are minimized. Threats to validity were controlled, as the same evaluation procedure was used during the pre- and posttest to evaluate the use of TTS, and students were given different but equivalent grade-level passages for reading comprehension measures. While Bruno et al. (2020) utilized a treatment and control design, this study did not. Therefore, this study was not a true experimental study, as there was no control group for comparison. This study had a small number of student participants, which may impact the generalizability of the results of this current study. Therefore, future research should consider expanding the study to include more students across various settings. Next, several of the study measures were self-developed and based on instructors' observations, which could have a possible bias. Finally, this study focused on teaching a specific type of TTS software (Snap&Read); as technology is ever-changing and evolving, it may become outdated, yet the use of Direct Instruction to teach students to specific skills will continue.

Implications

Findings from this study can offer research, policy, and practical implications to further support the teaching and use of AT. Technology is continuously evolving, and the lack of training and support creates a greater divide between people with ID and society (Owuor et al., 2017), resulting in perceived social exclusion and feelings of isolation. This study offers insight into instructional methods, such as Direct Instruction, that are useful in teaching individuals with ID to use a TTS reader. However, research needs to continue to focus on further development and use of instructional methods and tools to support the generalization of these skills across settings for people with disabilities. As federal policies promote the use of the UDL framework and AT to increase access and opportunities for learning and inclusion in the K–12 setting, educators need to continue to be trained to use evidence-based practices to promote learning for all and teach students how to generalize the skills learned in K–12 to the postsecondary education setting.

Since the passing of the HEOA (2008), students' rates in inclusive postsecondary education settings have increased; yet access to accommodations in postsecondary education remains a challenge (Griful-Frexient et al., 2017; Lindsay et al., 2018). Therefore, higher education also needs to be strategic in the accommodations provided to college students with disabilities and consider offering more support to students entering with a disability. Instead of requiring students to self-advocate, seek out resources independently, and train themselves to use them, universities need to provide training that promotes specific accessibility tools, such as TTS readers (Goegan et al., 2019; Malcolm & Roll, 2017). By understanding the barriers students face to access

accommodations, disability service offices can find ways to make college campuses more inclusive, reduce stigma, and increase awareness of services while bolstering student success for all and increasing retention rates. Further, since training was directly correlated with use, it is evident that universities need to be mindful of how they support and train faculty, staff, and students to use the technology or accommodations provided. Therefore, based on this study's findings, one approach could be use of Direct Instruction to increase AT on college campuses to increase outcomes of students with disabilities in college.

Lastly, because students need to have the knowledge and advocacy skills to request accommodations on their own, transition teams need to consider the ways accommodations, modifications, supplements, and supports are being implemented into the student's transition plans. Some of the most significant predictors for students asking for accommodations were student self-determination, transition planning, and preparation (Newman et al., 2015). This can increase use of accommodations, yet students are also more likely to seek accommodations or supports used by the general student population (i.e., TTS on everyday technologies). Therefore, as technology becomes more prevalent, colleges and universities should consider making some of the more commonly used accommodations open to all students to reduce the stigma and make learning accessible for all, while also offering training to students and faculty on how to use the tools effectively.

Conclusion

Technology is becoming more prevalent today as an essential element of education and employment; meanwhile, social and academic expectations of people with disabilities continue to rise as well. Students with disabilities are being held to higher academic standards than ever before. Thus, there is a need for appropriate accommodations and AT to ensure that students with disabilities not only have access to curriculum but can also thrive in inclusive settings. To meet our evolving societal and educational demands, we need to continue to investigate how individuals with disabilities are provided the tools and accommodations they need to achieve and are adequately trained to use them. Overall, the use of AT can improve daily functioning and autonomy for individuals with intellectual and developmental disabilities, which promotes well-being and life satisfaction and leads to greater outcomes in postsecondary education, employment, and independent living.

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Table 1

Direct Instruction Lessons to Teach Snap&Read

Lessons	Title of Lesson	Direct Instruction Step
Lesson 1	Introduction to Alternate Reading Strategies	Elicit Background Knowledge
Lesson 2	Chrome Extensions & Google Accounts	Release of Responsibility
Lesson 3	Setting up Snap&Read	Release of Responsibility
Lesson 4	Reading Text with Snap&Read	Release of Responsibility
Lesson 5	Using OCR tool	Release of Responsibility
Lesson 6	"Putting it all Together"	Guided Practice
Lesson 7	Other Types of Text (i.e. E-mail)	Guided Practice
Post-Test	Evaluation of Student Use of Snap&Read	Mastery
Generalize	Observe Independent Use of Snap&Read	Mastery

Table 2

Number of Students who used Snap&Read on easyCBM Reading Comprehension Measures

	Pre-3 *n* (%)	Pre-6 *n* (%)	Post-3 *n* (%)	Post-6 *n* (%)
Monday (*n* = 10)	0	0	5 (50%)	6 (60%)
Wednesday (*n* = 9)	0	0	7 (77%)	6 (66%)
Total (*N* = 19)	0	0	12 (63%)	12 (63%)

Table 3

Means and Standard Deviation on easyCBM Reading Comprehension Measure by Class

	Pre-3 *M* (*SD*)	Post-3 *M* (*SD*)	Pre-6 *M* (*SD*)	Post-6 *M* (*SD*)
Monday (*n* = 10)	11.60 (4.03)	14.30 (2.26)	7.80 (2.62)	10.20 (3.15)
Wednesday (*n* = 9)	9.77 (4.35)	11.77 (3.93)	9.44 (3.00)	10.44 (2.18)
Total (*N* = 19)	11.05 (3.83)	13.11 (3.33)	8.52 (2.89)	10.31 (2.66)

Table 4

Means and Standard Deviations on easyCBM Based on Use of Text-to-Speech Readers

	Pre-3 *M* (*SD*)	Post-3 *M* (*SD*)	Pre-6 *M* (*SD*)	Post-6 *M* (*SD*)
Used TTS on Post Assessment (*n* = 12)	10.41 (4.21)	13.17 (4.13)	9.23 (2.42)	13.15 (3.93)
No TTS on Post Assessment (*n* = 7)	12.14 (3.07)	13 (1.41)	7 (3.46)	9.83 (2.48)

Figure 1

Sample Sticker Flipper and Getting Ready Steps