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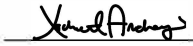
Xochitl Archey		Dec 2, 2020
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Text-To-Speech Technology for Students with Specific Learning Disabilities

by

Tali Rappaport

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Abstract

The following research project explored the relationship of text-to-speech technology (TTST) and students with specific learning disabilities (SLD) in education. Topics investigated included how TTST supports the educational goals of students with SLD, and how educational staff can support the use of TTST for SLD in instruction to promote student success. In current existing research, there have been no definitive conclusions drawn that show TTST for SLD has any concrete effects on specific skills in areas of reading, writing, and comprehension skills. Existing research does state the positive qualitative effects of using TTST for SLD, specifically regarding student focus, speed in completion of assignments and comprehension, student engagement in academics, and student attitudes surrounding schoolwork. This lack of research poses a major issue for students with SLD, leaving them to navigate a world with no supports due to the unwritten requirement of predigested information and attention educational stakeholders prefer to implement valid supports. A print (Appendix)A and digital resource (website) was created to support students, families, and educators in learning more about TTST for SLD, TTST technology and features, universal design for learning (UDL), navigating the transition into higher education, and helpful tips for implementing TTST in education for both students and teachers. As very little research on this topic exists, more research is required to better understand the effects of using TTST for SLD.

Keywords: Assistive Technology, Specific Learning Disabilities, Text-To-Speech Technology, Universal Design for Learning

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Finally, I would like to express deep gratitude for my parents, as they have always believed I was capable of greatness even when I felt defeated. They constantly remind me to brush off the dirt, appreciate all I've accomplished so far, keep opening doors, and not forget to live a little in the process.

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Chapter One

Introduction

There are many ways to eat an Oreo cookie. Some people break the halves apart, eat the filling, and then finish the two wafers. Others dunk their Oreos in milk and dig in. Is there a right way to eat an Oreo if the end result leaves the consumer satisfied and going back for more? The answer to this rhetorical question is: there is no "right" way to eat an Oreo.

In education, the permutations by which students access learning have grown immensely, in large part due to the technological advancements that are readily available. Personal, consumer devices (computers, tablets, and smartphones) are equipped with dynamic features, that allow us to have the power to individualize our relationship with the outside world at the tap of a finger. The capabilities of these devices, while additive to the ease and efficiency of everyday life, are vital for individuals with disabilities. Though individuals with disabilities may use technology in different ways to accomplish "eating the oreo," they still are able to achieve the common goal.

When we talk about technological tools that support individual educational goals, we talk about assistive technology (AT). AT is an essential tool that breaks down barriers for students in education, and it can take many forms; there are low-tech options (elevated bookstands, pencil grips, highlighters, graphic organizers, etc) all the way up to high-tech options (AAC devices, ipad apps for organization, screen readers, screen magnifiers, etc). Something as simple as a highlighter can mean the difference between meaning and frustration.

Students with Specific Learning Disabilities rely on the right combination of tools and services to support their success in education. SLD are disabilities that affect a specific process in the acquisition of learning, and/or a specific subject. Students may have difficulties in their

ability to process language (auditory/ language processing), understand mathematical sequences and numbers (dyscalculia), or read or write printed text (dyslexia/ dysgraphia) (IDEA, 2004). While these examples provide a general listing of some of the disabilities under the category of SLD, this is by no means a complete picture and only scrapes the surface of the wide variety of ways SLD can manifest. With this in mind, it becomes easier to understand the crucial role AT plays for students with SLD. There are many applications for how technology and disability are intertwined, but for the purposes of this project, I will be focusing on how Text To Speech Technology (TTST) impacts students with Specific Learning Disabilities (SLD) in an educational setting.

One such option of AT for SLD is TTST. TTST can be in the form of pre-recorded texts (aka audiobooks), or text that is read by a screen reader with synthetic voicing. TTST enables students with SLD who may have trouble processing language, struggle to read print due to dyslexia and/or dysgraphia, or who comprehend better when listening to spoken language unlock these barriers to understanding and better participate actively in their learning. Barriers broken, students with SLD using TTST may feel more in control of their learning and show more interest in their educational goals.

Purpose of Project/Statement of the Problem

Though education is a more inclusive environment for students than ever before, the educational success of students with SLD is not implied with the incorporation of AT. Students with SLD, by nature, have to learn how to adapt to be successful. Even with guidance and support from educational institutions, family, and teachers, students with SLD can still find themselves in the middle of a road with many options for TTST apps, software, platforms, and features. There is beauty in the selection that exists today with TTST, but it can also be

overwhelming for students, teachers, parents, and educational institutions to sift through to find the best fit. To add to the confusion, when students transition from high school to college there is also a transition from being covered under IDEA (2004) to qualifying for services under the Americans with Disabilities Act (ADA) (1990). Students and their families must quickly learn how to navigate this system to effectively establish themselves as students who need supportive services. The main difference between the two laws is the responsibility of the student to identify themselves to disabled services under ADA (1990) versus the responsibility of educators and providers to identify students under IDEA (2004). There is both a lack of understanding and guidance available for students with SLD to navigate this transition more seamlessly, as well as a lack of training and resources geared towards all parties (teachers, students, parents) to effectively incorporate TTST in the classroom, during instruction, and for personal and home use.

Research Questions

The following research questions guide this project:

1) How does Text To Speech Technology support students with Specific Learning Disabilities with educational goals?
    a) How can educational staff support the use of Text To Speech Technology for students with Specific Learning Disabilities in instruction and to promote student success?

Significance of Project

The significance of this project is easily reinforced by the current state of the world. In the wake of the current pandemic, COVID 19, educational institutions have transitioned to using primarily online instructional models. Providing regular instructional services, both to support

learning in general education as well as supplementary support as dictated by a student's IEP, has been challenging given the lack of face-to-face interaction and the nature of online learning. Tools such as TTST, which give students more control over their learning and teachers the ability to continue to support students from afar, are vital components in ensuring students still receive equitable learning experiences through these unprecedented times. Supplying students, families, and educators with a comprehensive digital resource to promote the acquisition, incorporation, and instructional use of TTST into academics will help account for the lack of information students and educators can usually gather from in-person meetings with disability support services, and encourage individuals to embrace self advocacy to ensure their academic success.

Definition of Terms

Assistive Technology. For the purpose of this project, Assistive Technology (AT) is any device or tool that is used to support a student's academic needs. AT can be low-tech (devices/ tools that do not require batteries and/or electricity such as pencil grips and highlighters), mid-tech/ high-tech (those that require electricity/ batteries such as a laptop, mobile tablet, and calculators). (Nepo, 2017)

Digital Capital. The acquired know how and ability to navigate technology needed for the purpose of accessibility and, specifically in this paper, academic acquisition and participation. (Seale et al., 2015)

Invisible Disabilities. Invisible disabilities refers to individuals who have physical, emotional and/or neurological conditions that are not visible simply by their appearance. These include: chronic health conditions (autoimmune disorders, gastrointestinal conditions, etc), hearing impairments and deafness, visual impairments and blindness, mental health conditions

(depression, anxiety, bipolar, etc), autism, ADHD, traumatic brain injury, specific learning disabilities (dyslexia, auditory/language processing, dyspraxia, dyscalculia, etc). For the purpose of this project, we will be focusing on invisible disabilities related to specific learning disabilities, chronic health conditions, and ADHD.

Text To Speech Technology (TTST). Technology that provides an audio reading of a given text. Audiobooks and screen readers that use synthesized voices to read text are kinds of TTST. TTST applications, software, and platforms often have additional features to improve the experience, allowing it to be customizable to fit individual needs.

Specific Learning Disabilities (SLD). A category of disability that affects the acquisition of learning due to deficits in specific processes of the brain and/or certain areas of study. SLD are diverse in nature, and manifest individuals differently. Some examples of SLD are dyslexia, language processing disability, auditory processing disability, dysgraphia and dyscalculia.

Chapter Two

Literature Review

For students with Specific Learning Disabilities (SLD), learning requires the right combination of tools to unlock the barriers in the way of access. Assistive Technology (AT), is any device or tool that is used to support a student's academic needs. AT can be low-tech (devices/ tools that do not require batteries and/or electricity such as pencil grips and highlighters), mid-tech/ high-tech (those that require electricity/ batteries such as a laptop, mobile tablet, and calculators). While there are many AT tools used to support students with SLD, for the purposes of this project, I will focus primarily on the use of text-to-speech technology (TTST) in an educational capacity. The following review of existing literature surrounding TTST will address the options, benefits, and integration of TTST in an educational environment.

Benefits of Text-To-Speech and Related Research Outcomes

The research surrounding the use and benefit of TTST to support students with SLD is controversial and lacks a clear consensus. The majority of the existing studies look specifically at a student's unassisted (without TTST) performance, which Park et al. (2017) argue, fails to evaluate the student's growth and acquired compensatory skills. Focusing on this limited measurement of success does not provide a full picture of the qualitative aspects of using TTST to support students with SLD. White and Robertson (2015) and Boone and Higgins (2007) recognize that access to curriculum necessitates student motivation, focus, speed with reading, decoding, and comprehension. Educators must consider how TTST will be used to better support target goals. I have narrowed this down to the two categories current research discusses: mastery of essential skills vs. access to content.

Foundational Skills Mastery and TTST

Discussions around TTST and its effect on student mastery of essential skills, specifically reading with fluency, reading comprehension, vocabulary, and word recognition, have caused an unclear stance on the issue in the educational community. As mentioned above, existing research is not abundant enough to generalize results that evaluate unassisted reading proficiency: a student's reading proficiency after utilizing TTST in the classroom without using TTST during evaluation (Park et. al, 2017). In an attempt to explore the effects of TTST on unassisted reading proficiency, Park et al. (2017) conducted a study in which at risk, 9th grade students used TTST as a tool to support reading proficiency. The results of the study indicated that there was a positive effect on the students' reading proficiency, specifically in the areas of vocabulary and reading comprehension, but that no definitive conclusions about the effects of TTST on unassisted reading proficiency could be drawn (Park et al, 2017). White and Robertson (2015) found that over their six-week intensive program with students ages 8-10 utilizing TTST, student reading comprehension scores improved when using TTST during testing. Like Park et al. (2017), White & Robertson (2015) caution the inference of generalized results. Forgrave (2002) emphasizes that age group and grade level are important factors to consider when determining the goal of TTST, as reading and language goals for younger students are more heavily weighted on acquisition of skills as opposed to older students, where the emphasis is heavier on academic content.

Accessing Meaning in Text Using TTST

For students with SLD, whose areas of need involve reading, decoding words, and comprehension of language, the intended goal for using TTST would be to break down these barriers and allow the student to access the content. Student access to content refers to a

student's ability to comprehend, critically analyze, and form informed opinions about content found within the curriculum. Perhaps the most significant findings reported in Park et al (2017) and White & Robertson (2015) were the compensatory skills students acquired during their use of TTST. Both studies highlighted the impact TTST had on student motivation, focus and compensatory skills with reading, making the case for TTST as an accommodation for SLD geared toward access to learning as opposed to individual skill proficiency (Park et al. 2017; White & Robertson, 2015). According to Watson et al. (2010), "many studies do not directly consider functional performance changes," which can be harder to quantitatively measure (p. 19).

The emphasis placed on functional performance, a priority that Common Core State Standards reflect in their focus on problem solving and critical thinking skills, directly supports accommodations for students whose areas of need correlate with this goal (California Department of Education, 2010). When students are required to test without their individualized, predetermined, reasonable accommodation, as written per their IEP, is it truly an equitable, accurate measure of that student's abilities? Would assessing the language abilities of a student who is hard of hearing without their hearing aids be an equitable, accurate measure of their abilities? Though the equitable access TTST affords students with SLD is hard to universalize given the complex nature of the SLD category of eligibility, the research thus far has indicated that the qualitative data has significant value when determining if TTST supports reading, comprehension, decoding, word recognition, decoding, vocabulary acquisition, and access to academic content for students with SLD (Boone & Higgins, 2007; Kattari et al., 2018; Park et al., 2017; Seale et al., 2015; Watson et al., 2010; White & Robertson, 2015).

Models of TTST

Due to the lack of research surrounding TTST in education, it is difficult to pinpoint a specific model for which TTST should be administered effectively in and out of the classroom. The educational system functions as a discrepancy-based model, which requires students to fail before they are truly supported, creating a system that focuses on student disabilities rather than their abilities (Nepo, 2017). It is a known fact that not all students learn the same way, but this goes beyond identifying visual, kinesthetic, and auditory preferences. To effectively value the diversity of all learners, whether they meet eligibility requirements for services or not, the approach to lesson planning must reflect this mindset.

Universal Design for Learning and Assistive Technology

With the advancement of accessible technology and the universal availability of these tools, the logical next step is an update of the best practices in education. One such approach, Universal Design for Learning (UDL), was born from the mindset that all students should have access to curriculum regardless of ability (Nepo, 2017). Universally designed lessons enable students to experience content through a combination of learning styles (visual, auditory, kinesthetic), provide students with options for demonstrating mastery, and account for all ability levels of learners with predetermined ways to accommodate and/or modify activities. Examples of UDL in class include choices in how students decide to demonstrate mastery (book report, powerpoint, sculpture, song, graphic organizer, etc) and differentiated ways to interact with content (written text, textbooks read using TTST, graphic organizers, large group/small group discussion, peer led activities, math manipulatives, vocabulary infused with art, videos, podcasts, etc).

UDL is a research based method of instruction with a set of guidelines, and not all UDL classrooms look identical. In the interests of finding uniformity within UDL, Cook and Rao (2018) took a closer look at the strategies employed by teachers that effectively utilize UDL to support students with SLD (Cook & Rao, 2018). One of the biggest takeaways of this study was that UDL's success lies in the fact that there will always be learner variability in the classroom, leading to the notion that curriculum, not the student, is disabled (Cook & Rao, 2018, pg. 108). Efforts to define what a generic, replicable UDL classroom looks like are unsuccessful in all studies because of the diverse nature of each classroom, even between those of the same school and district (Cook & Rao, 2018; Hitchcock & Stahl, 2003; Nepo, 2017). UDL, rather, as defined by Hitchcock and Stahl (2003), is "a way of thinking and acting" (p. 49). It starts with the belief that education should be accessible to all students in the least restrictive environment (LRE), and continues with teachers who use differentiated materials and technological tools to unlock barriers to learning for students.

AT and UDL go hand in hand. Because of the aforementioned advancements and availability of existing technology, using AT in the classroom actually makes differentiation a much more attainable goal. Many devices have customizable preferences catering to many individual needs. Specific to TTST, most applications and platforms enable the user to change the reading speed, change the contrast of text and screen, magnify text, highlight and annotate, mask other parts of the screen so as to only view a smaller chunk, and define words in their native language if they are English Language Learners. In the past, all of these features would have required a preauthorization of eligibility, as well as outside push-in or pull-out support services and devices to equitably support a student. Now, regardless of eligibility, general education teachers can utilize these customizations with the click of a button to provide a more

equitable experience for all students within the general education classroom. The ease of which we are now able to provide AT intervention and support for all students directly contributes to the growing support for UDL as best practice in education.

Issues In Existing Research

As previously noted, existing research does not paint an accurate picture of the effect TTST can have on students with SLD. While the following is not a complete explanation of why, factors that contribute to this lack of research include the lack of support and training for students and teachers, teacher buy-in in implementing TTST, and the stigma students experience surrounding TTST use.

More than Just Technology: The Importance of Training and Support

Much like handing a child a bike for the first time, providing a quick demonstration, and expecting the child to successfully perform the act of riding it, assistive technology is not simply an object used to support forward motion. To define access as "being in possession of the thing" is a disservice to students, teachers, and the stagnant research available on assistive technology use in educational settings. While access does require the physical possession of a tool, for the tool to truly be accessible, an individual must be able to demonstrate proficiency in its utilization. This is not the primary responsibility of the student; the implementation of AT in education settings is the responsibility of school staff, administration, teachers, parents, and IEP team (Boone & Higgins, 2007; Claiborne et al., 2011; Forgrave, 2002; Maxam & Henderson, 2013; Watson et al., 2010; White & Robertson, 2015). Though supportive access is stated as a mandatory service in special education eligibility determination meetings, it is hard to expect teachers to effectively fulfil this role when they themselves are not properly equipped (IDEA, 2004; Nepo, 2017). Unfortunately, there is a lack of emphasis for new and existing teachers to

learn how to use technology and AT in the classroom, leading to a lack of proficiency needed to troubleshoot devices and applications with students when issues arise. While there are resources for teachers, they are generally presented as outside professional development opportunities and additional areas of certification or expertise. It's a contradictory culture: valuing the diversity and multimodal approach through the use of technology, but not making it a key element in general education teacher training nor providing classrooms equipped with the technological capabilities to see it through. There is an obvious flaw in the system, and the first step to mending the gap between the capabilities of technology and the actual implementation of technology is to provide more required instruction for educators on how to navigate and use technology to support learning. This should already be incorporated into the higher education curriculum for upcoming teachers, as this knowledge and ability are imperative in demonstrating inclusive practices. As of now, UDL practices and assistive technology are not required in teacher preparation education, however, IDEA (2004) expects educators to be able to support students who use AT devices in the classroom (IDEA, 2004; Nepo, 2017, p. 217). It is not enough to supply teachers with lists of resources of articles on UDL practices and hope that they decide it is worth embracing wholeheartedly. Teachers should receive explicit training of experiential examples for how to manipulate existing tools to best match the needs of any given classroom population. They are just as deserving of a universally accessible approach to demystify AT and UDL as students are.

Teacher Buy-in of TTST and Peer-Reviewed Practices

Though existing studies on the use of TTST applications supporting SLD positively support student comprehension, word decoding, and focus, almost all of the concluding observations and recommendations noted the importance of teacher buy in, available AT support services, and the conscious implementation of TTST into curriculum planning and instruction. A

case study involving a high school principal's push to make his school's approach to education more equitable, depicts one account of how an unwavering belief in the value of diversity and inclusion created an environment in which all learners were recognized and accounted for (Maxam & Henderson, 2013). Though a common perception is that expertise and mastery are prerequisites to the success of AT implementation in the classroom, it is important to note that the principal, Mr. Lopez, was "never formally educated on how to deal with students with such disabilities," and the majority of his staff "never learned about such issues when they were in school" (Claiborne et al., 2011; Maxam & Henderson, 2013, p. 74). Luckily, the gap in the TTST available has been bridged, but there is still a large discrepancy pertaining to educational institutions' ability to implement and support those tools (Forgrave, 2002). Training in the area of using TTST specifically to support individual needs in an educational setting is needed, and should be an essential skill for administration, teachers, and students.

The only real barriers that exist are the perceptions that limitations are insurmountable. Educators must be resilient to keep up with the always changing dynamic of their class. They learn how to monitor student progress so that they can identify what is not working and employ a different strategy to address student needs. This constant ebb and flow, perpetuated by the static nature of most classrooms who do not use UDL and AT as common practice, could be a much more streamlined process if interventions, such as TTST, were already factored into learning activities and available to all students. Not only would this create the environment where students could individualize their learning, it would not require as much revision of lesson planning on the part of the educator. It is much easier for educators to provide multimodal options for students from the get go than it is to continually modify, revise, and gradually provide more options in line with the deficit model of eligibility.

Stigma Surrounding Students using TTST

Due to existing models of disability, specifically the deficit model of eligibility in education, students who require AT to support learning are often ostracized. Students with SLD are often viewed as students that "aren't trying hard enough" and "don't really care about their schoolwork," and by using an AT device to support their learning, they are then deemed negatively dependent. There are two issues with the above trend. First, the deficit model in education implies that students with SLD are failures because they do not perform at the level their peers do without the support from AT and other related services. Second, the view that dependency on AT devices to support learning is inherently negative reaffirms that education is only positive for students who can participate and succeed without additional support or AT. Gibson et al. (2012) writes that disability and assistive technologies should be viewed as connectivities rather than dependencies (Gibson et al., 2012). The reason AT exists is to support learning and acquisition of information. For individuals with SLD, that means having access to text via TTST to break down the barriers they face to access information. We regularly use technologies that support our interactions with the world. We use smartphones for just about everything, including wayfinding. Would it be appropriate to take away the mapping and directional functionalities on smartphones so as to make everyone learn geography by map in order to earn the right to use apps like Google Maps and Waze? Many people would be classified as "disabled." It's not realistic to view knowledge as a static entity. We, as individuals, "move in and out of assemblages" (phones, maps, people, etc), at a constant rate, none of which explicitly classify us as independent or dependent, disabled or nondisabled (Gibson et al., 2012).

Visibility also contributes to the stigma surrounding the use of TTST for SLD in education. In a room full of students, being the only student to use an AT TTST device to

interact with the curriculum creates undesired assumptions from others. One way to combat this is to adopt UDL and equip all classrooms with devices that are TTST enabled. For example, when all students have access to chromebooks with headphones, it's hard to pick out which students have been labeled as having SLD and which are receiving accommodations or extra supportive services. The use of audiobooks and Read Alouds are so commonplace that the stigma associated with TTST as an accommodation specific to SLD is starting to fade. The combination of accessibility, availability, and conventional use of TTST by all students has begun to normalize it into common practice (Gibson et al., 2012; Nepo, 2017). Ultimately, the use of TTST to support SLD shows positive qualitative tendencies in the existing research, but further research and implementation is needed (Bone & Bouck 2017; Boone & Higgins, 2007; Cook & Rao, 2018; Forgrave, 2002; Nepo, 2017; Park et al., 2017; White & Robertson, 2015).

Options of Text-To-Speech for SLD

Text-To-Speech Technology (TTST) provides a way for students with disabilities to have access to curriculum. As Bone and Bouck (2017) phrase it, "text-to-speech applications provide a synchronized visual and auditory presentation of text" (Bone & Bouck, 2017, p. 49). Unlike most audiobooks, which are primarily audio files, TTST visually displays a piece of text (a book, PDF, webpage, etc) while reading the selection aloud. Students and teachers have the opportunity to personalize this experience via the features offered within TTST applications and extensions. Common features within most apps and extensions are highlighting words and phrases as they are spoken, changing the speed and volume of which the text is spoken, and selecting a preferred voice to speak the text aloud (Bone & Bouck 2017; Park et al., 2017; Boone & Higgins, 2007).

Though students may meet the eligibility criteria for SLD, they do not all experience disability in the exact same way (Eligibility Criteria, 2014; Faucett et al., 2017). SLD is an invisible disability, meaning others cannot detect it by simply looking at an individual's physical appearance. Allowing individuals with SLD to have some control over the visibility of their disability is crucial. In other words, on the spectrum of disability visibility, students with SLD generally land closer to *invisible*, allowing them to "pass," going undetected, as someone who does not have a disability (Faucett et al., 2017; Kattari et al., 2018). Visibility is affected when assistive technologies are introduced. The use of a hearing aid to support hearing loss, wearing glasses to correct vision, and/or a student who is the only one who uses an mp3 player with headphones to read a piece of text are all concrete examples of assistive technology devices that drag the disability spectrum slider from invisible to visible. With visibility in mind, it is important to consider the assistive technology options on an individual basis, assuring that students feel comfortable in embracing the device as well as navigating the technology (Boone & Higgins, 2007; Faucett et al., 2017; Kattari et al., 2018; Seale et al., 2015; Shinohara & Wobbrock, 2016).

Student Experience using TTST for SLD

The selection of AT is a crucial component for the Individualized Education Program (IEP) team. Determining TTST would be an appropriate accommodation and/or support is only the first step. As access and inclusion become more socially accepted concepts, and technology continues to advance, more and more developers have moved in to create their own version of TTST (Bone & Bouck, 2017; Boone & Higgins, 2007). The options range from personal handheld devices with built in TTST to web extensions and apps, increasing the number of the population with access to personal "digital capital," enabling the use of TTST without the need

to request permission from educational institutions (Boone & Higgins, 2007; Seale et al., 2015). While this trend has created the opportunity for more access to TTST technologies, the assumption that developers design their software to meet the needs of individuals with disabilities in mind is false (Boone & Higgins, 2007). Boone & Higgins (2007) report that developers often design AT with specific disabilities in mind, not "what it means to offset [a] disability" (Boone & Higgins, 2007, pg. 135). Developers spend more time convincing users that "their product is effective and easy to use, rather than actually making the product effective and easy to use," and are more interested in the creation of a product rather than its intuitive usability and "user friendliness" (Boone & Higgins, 2007, p. 137).

Because there are so many TTST products and services, it can make the process of narrowing the selection to meet the needs of individual students a daunting task. With the focus of this project specific to supporting students with SLD in educational capacities, I will cater the selection to TTST that can be used in schools with the budgetary and access limitations facing educational institutions. I have limited the scope of my report to iPad/ tablet applications and Chrome web extensions, as these are the two most common platforms that educational institutions have available. Bone and Bouck (2017) provide a condensed list of text-to-speech iPad applications, including the free apps: Aloud!, Natural Reader, and Dream Reader (p51). These free apps convert PDF and Microsoft Word documents to speakable content and have the ability to highlight text as it is spoken. The free Chrome web extensions of note are: Read&Write for Google, Speak it iSpeech, and Select and Speak (Bone & Bouck, 2017, p. 51). While all of these options have a free version, a few provide the option to upgrade for more features-- Aloud!, Natural Reader, Dream Reader, Read&Write for Google-- and Read&Write for Google has educational pricing available to educational institutions. While the six options listed are free,

available for immediate use, and have customizable features that allow for more personalized experiences, they are not the only options available. There are many paid apps and Chrome web extensions available at a cost that should also be considered when existing options do not effectively support a student.

After high school, receiving support is governed by new rules. Students transition from being covered under IDEA (2004), to coverage under the Americans with Disabilities Act (ADA) (1990). The main difference in this transition is that students are now responsible for establishing their eligibility and seeking out services themselves. It is this transition that causes many students who have previously benefited from and received services in their educational experience thus far to get lost in the tide and continue their education without appropriate support. While some students may have supportive individuals to help them navigate establishing with disabled services and accommodations in higher education, many students do not know how to begin this process. Once they do get past the formalities, provide documentation, and are deemed eligible for specific accommodations, students find themselves with a listing of resources that can be overwhelming to narrow down into something tangible. There is a need to support students in navigating the transition from high school to higher education, focusing on how to acquire the accommodations and services they need to be able to succeed while also sifting through the available options for TTST to find what works best for them.

Teacher Training

Equipping students to be better navigators and advocates for themselves only goes so far. Teachers also need opportunities to learn how to better support students through AT. The companies that create TTST do not always provide training and support to educators, as they

view their transactions as business and profit. Teachers need more than just an introduction to available technologies, they need examples and hands on experiences in which the technologies are implemented in real world scenarios. It is a disservice to students, educators, and institutions not to mandate AT training and implementation instruction for new and existing teachers. There is a need for a simplified list of examples in which teachers could implement the use of TTST into existing lessons and applications for students with SLD.

Summary

The body of "assistive technology water" should be more appealing for teachers to jump into than it is presently. By practicing whole class implementation of AT supports such as TTST, education becomes more supportive of every learner in the classroom. In this more inclusive environment, asking for help becomes more normalized and students develop more independence and initiative over their educational goals and experience. The hope is that the stigma surrounding AT devices and supports becomes history, and future students using TTST to read about the adoption of AT in education will have less firsthand experience with reports of unwanted attention, exclusion, separation that once defined education. The purpose of this project is to create a digital resource (website) for students, parents, teachers, and administrators to learn more about TTST, how to implement TTST into instruction, ways in which TTST can be individualized for individual learning goals, and to support students incorporating TTST in their educational toolbox.

Chapter Three

Methodology

This project was created to bridge the existing gap of resources on the use of TTST for SLD. A deficit in awareness of how TTST is a viable tool for students with SLD led me to create a website containing this information, which exists as both a live website as well as contained in Appendix A- Text-To-Speech Technology for Specific Learning Disabilities: Website Content.

Audience and Setting

This project was designed for students with SLD who may benefit from the inclusion of TTST in academics. These students, their families, and the educators that support them needed a better hub geared toward navigating the available forms of TTST, how to navigate eligibility and services in education, and how to better implement TTST in instruction. In addition to student experiences in elementary, middle, and high school education, there was a need to provide guidance for students in the transition to college, as well as more detailed instructions for professors to incorporate TTST into curriculum and instruction at the college level. By designing a resource benefitting the key parties-- students, families, and educators-- all involved could respectively use their knowledge to create a more successful environment for implementing TTST for students with SLD.

Procedures for Developing the Project

This project came into fruition by initially examining research surrounding the use of TTST for students with SLD to support academics. Peer reviewed studies published between the years of 2000 and 2020 pertaining to TTST and SLD were collected. Many studies suggested that further research was needed to determine definitive conclusive data illustrating the effects of TTST on student success in specific academic areas, but could not find any negative effects of

students using TTST to support their academic goals in spite of the lack of substantial evidence. In addition to looking directly at studies of TTST to support SLD, specific instructional approaches which incorporated AT were examined, specifically UDL. In these studies, conclusions repetitively expressed that UDL is "a way of thinking" with guidelines rather than an explicit set of rules, which made it hard to report uniformity in practices between classrooms, schools, and districts (Hitchcock & Stahl, 2003, p. 49). This in mind, support for UDL as best practice for supporting all students was emphasized, and it became clear that there was an evident need for more concrete examples of how educators could incorporate TTST into instruction. Because the existing research touches upon students in elementary, middle, high school, and higher education, support for students transitioning into higher education was needed. The laws governing how students receive services and the services available change, and thus it was crucial to include guidance for students in navigating this change.

In deciding how to present this information, the current climate of the COVID-19 pandemic heavily favored creating a digital resource. Keeping with accessibility, I purposefully chose to design a site using Wix because of their pre-existing templates designed with accessibility regulations in mind, as well as their available resources on creating an accessible experience.

Chapter Four

Results

The project created is a website with information about TTST for SLD. The information on the website is organized by pages, which consists of 5 sections: “What is TTST?”, “TTST for SLD”, “Choosing TTST”, “Tips for Students & Teachers, and Universal Design for Learning,” and “Navigating the Transition to Higher Education”. “Tips for Students & Teachers, and Universal Design for Learning” are broken down further into individual sub pages: “Tips for Students,” “Tips for Teachers”, and “Universal Design for Learning.” Each section is designed to give a brief overview of the corresponding title, and can be viewed in Appendix A- Text-To-Speech Technology for Specific Learning Disabilities: Website Content.

The section “What is TTST?” (Appendix A- What is TTST?) gives a brief description of what TTST is, as well as a general breakdown of key features that are included in most TTST apps and programs (Appendix A- Anatomy of TTST). This subsection, “Anatomy of TTST,” defines TTST specific terms and features, which include optical character recognition (OCR), highlighted words/ sentences during reading (speech cursor), color settings/ contrast of screen, and text options & focused/ distraction free reading mode.

TTST for SLD (Appendix A-TTST for SLD) addresses the gaps in existing research on TTST for students with SLD, and touches upon the qualitative findings that support its use. It stresses the important role that educators play in the integration of TTST into curriculum (Forgrave, 2002).

Choosing TTST (Appendix A- Choosing TTST) highlights key considerations when deciding upon a specific TTST app or program for individuals with SLD. These key considerations include visibility of disability, student choice, access to technology, and a caution

to be mindful of the priorities software companies prioritize when they are advertising their product. This section also has a comparison of a select few apps and software options lending to the investigative process of finding the right TTST (Appendix A- Side-by-side Comparison of (a few) TTST). The aim with this table was to create a simplistic comparison of the features included in common TTST applications.

Tips for Students and Tips for Teachers (Appendix A- Tips for Students, Tips for Teachers) speak on a more personal level to the corresponding audiences. These tips are suggestions and encouragement, and implore both audiences to take proactive steps in furthering the equitable education experiences of students with SLD.

Universal Design for Learning (Appendix A- Universal Design for Learning) is a condensed hub of UDL and its relation to AT. There are also 4 resources listed for more in depth understanding of UDL.

There is an immense need for a better support system for students with disabilities transitioning from high school to higher education. Navigating the Transition to Higher Education (Appendix A- Navigating the Transition to Higher Education) explains why this transition can be confusing, difficult, and a bit of a change due to the laws that govern the protection of individuals with disabilities. There is a link to LD Online with further information about college, and the specifics of IDEA (2004) and ADA (1990). This page also includes suggestions of steps to take when initiation this transition, and additional recommendations of books and online resources to explore.

This website was designed with accessibility in mind and has been formatted to be easily read using TTST applications and software. It was important to uphold and echo support for TTST by making this resource as inclusive as possible.

Chapter Five

Discussion

The research process that led me to create my project was a tricky one to navigate. I initiated the search by looking into AT in education, and was able to traverse down the rabbit hole by paying closer attention to the resources used in the broader studies. After digging quite deep, and testing out keyword variations to target the SLD student experience in education and use of AT, I deduced, supporting the discussions of almost all the sources I had gathered, that there was quite a need for further exploration and future research on this issue (Bone & Bouck 2017; Boone & Higgins, 2007; Cook & Rao, 2018; Forgrave, 2002; Nepo, 2017; Park et al., 2017; White & Robertson, 2015). Being able to more clearly see that it was not just my own experiences that emphasized a need for research and accessible information pertaining to the use of AT for SLD, I hunkered down and started brainstorming topic areas to cover in a resource for students, families, and teachers. I consulted the peer reviewed studies for insight and concluding recommendations, as well as drew from my own experiences in education as a student with SLD without proper AT supports. While the print and digital resource I created (Appendix A) attempts to cover as much as possible in an effort to make up for needed research and publicly assimilated information, there are many aspects I was not able to directly address. Given the current pandemic of COVID19, the jump from the gradual integration of AT in education to an environment in which education primarily takes place in a digital world has bypassed a much needed development of procedures, guidelines, practice, and general awareness of the implications this new reality imposes on students with SLD. Unfortunately, the research before the pandemic was lacking in depth for the use of TTST to support SLD, and will fall even further behind as we try to catch up to where we are now, as opposed to where we were trying to head

prior to COVID19's abrupt interruption. For this reason, it is crucial that the institution of education uphold the ideals of IDEA (2004) and ADA (1990) to support all students, specifically those with disabilities, with appropriate strategies, supports, and accommodations. As technology advances, it is impossible to keep up with surrounding research in a timely fashion, nor should research solely dictate how students should learn best. It is in our nature to try things, specifically those we can logically provide reason to support. We would be nowhere in the process of educating students if we sat around, waiting for research to emerge to tell us how to teach a group of students, who by then have likely moved up and out of the educational system. The reality is, the use of TTST with students who have SLD does have a supportive, qualitative body of research pointing to benefits that, while not numerically valued, do positively impact students' abilities to perform better in school. We cannot measure love, happiness, or success, but we know that they are crucial to our wellness as human beings, so why must every contributing factor to a student's performance in education have a measurable number? It is this question that fuels my passion for advocacy, in which my ability to influence change transcends the limits of this project.

Limitations of Project

This project touches upon the world of assistive technology in education, but the reality is that technology is dynamic in nature, and we continue to expand its limitations. TTST is now almost always included as an embedded feature on all devices at no extra cost to the user, whereas 10 years ago it was still an additional feature or application one had to buy and install to afford the user an accessible, equitable experience. There are many more applications and services that provide TTST than I was able to cover in this paper.

As my focus was to investigate TTST specific to SLD, there are many populations of TTST users that I did not include in my research, though I read quite a bit about them. TTST is not an accommodation limited to students with SLD; students with vision impairments, ADHD, Autism Spectrum Disorder (ASD), chronic illness, other health impairments, and all other students can benefit from TTST. In a way, because we have advanced technology far enough to make it available and affordable to the general population, supporting students is less about the technology itself and more about how the institution of education views and supports students with and without disabilities. If I had endless resources, I would continue to build the case for TTST as a tool for SLD by researching and gathering more experts to attest to its existing qualitative effects, require that present and future educators receive mandatory AT training and instruction in their preparation courses and professional development, and continue to spread the ideals of UDL. No, teachers and staff do not currently receive enough training on AT tools and devices to competently navigate the use of AT student accommodations in lesson planning, classroom environment, and outside study. But it is hardly appropriate to blame each and every educator for not having the knowledge to equitably support students with these accommodations. I would use my unlimited resources to take the assumed sole responsibility of establishing, implementing, and troubleshooting AT accommodations and services off of the shoulders of special educators and assistive technology specialists by amplifying required training in AT for all educators, paraprofessionals, and administration, and push for a universe in which all educational institutions are governed by the guidelines and principles of UDL.

Next Steps

My plans for the website I created are just getting started. Yes, I have built and organized a digital resource on TTST for SLD with students, teachers, and families in mind, but I would

like to further the existing resources and expand the scope of the site. I built the site using Wix as a host, but as I have had more time to interact with the company and its features, I feel that Wix will not be the final destination of TTST for SLD. I plan to migrate the content of the site to a different platform, one that will allow me to have more control over my intellectual property while still maintaining a standard of accessibility. I am also looking into installing a widget that will allow users to use TTST to interact with the site without needing to install or use external programs.

I have had a lot of interest from individuals in the educational world requesting to view the website once it was finished. In addition, many have wanted to learn more about the use of TTST in education, specifically to support existing students who may benefit from TTST, as well as for the purpose of proving to an IEP team, other teachers, and administration that TTST is not a way for students to "cheat" and "work less" or to "just make school easier." My research of TTST for SLD, as well as my personal experience in using TTST as an accommodation in school, have given me a unique insight into the value of this piece of AT. I plan to continue to advocate for the use of TTST for SLD, backing the experiences of many students like me with existing and future research. By breaking down the assumptions people have about TTST and its use to support academics on my website, I am hoping to inspire educators to be more open to supporting students with invisible disabilities, such as SLD, Autism and ADHD, with learning environments conducive to all students.

Lessons Learned and Educational Implications

This project helped me realize that my experiences in education, specifically concerning the establishment and acquisition of appropriate accommodations and services as a disabled student, are not singular events. We are forced to either become strong advocates for ourselves,

fighting an uphill battle in which we are constantly made to question the validity of our disabling conditions, or become silent, doing the best we can with what we have, knowing that it is not equitable or accessible. While I do not speak for all students with invisible disabilities such as SLD, I am sure most of them will agree that the intent behind acquiring appropriate accommodations is never about "making it easier" or "cheating the system" or "taking up unnecessary space". It always goes back to the reasons IDEA (2004) and ADA (1990) were established: appropriate, least restrictive, equitable education for all students regardless of ability.

While ADA (1990) does protect the rights of students in higher education, too often does the responsibility to acquire and implement AT and accommodations fall upon the students themselves. This translates to more than requiring disabled students to connect with professors, reach out for support, and learn to use their preferred AT. Some students are determined to require additional documentation so as to be eligible for services, which are often costly and an out-of-pocket expense generally not covered by insurance. In addition, services that are approved by disability services do not automatically mean the university will provide an appropriate version, if at all, of the AT designated to fulfill the accommodation. For TTST, this can mean a dated version of software that the University would rather not invest further in because it "meets the criteria" as an accommodation, or that while students have been approved for the accommodation, they must now begin figuring which TTST is a good fit for their individual needs while simultaneously being expected to perform well in academics. Most disability services offices in higher education become akin to gate-keepers rather than true supportive service providers for students with disabilities.

I have also found, specifically in higher education, professors tend to be more concerned with how students complete and interact with assignments than making sure students are able to access the content of their class and instruction. The research for this project heavily spoke of the disparity of focus in education being primarily on concrete ability to perform specific academic than student access to learn how to master those specific academic tasks (Nepo, 2017; Park et al, 2017; White & Robertson, 2015). The question I continue to ask is: are we truly evaluating students on their mastery and understanding of academic content and critical thinking, or are we evaluating students on how well they are able to perform these tasks in the way that most students should be able to?

My recommendations stem from an obvious need for educators to be more mindful of the strengths and challenges of all students, regardless of documentation or established accommodations. I fully support the movement to adopt UDL as best practices in education, ensuring an equitable, accessible, appropriate education for all students.

Conclusion

I leave you with a quote from the greatest educator there ever was, Jim Henson. His legacy, which can be described as an emphasis on the pursuit of knowledge, access, diversity, inclusion, fun, and love, fully encapsulates the spirit education today is lacking. “Kids don't remember what you try to teach them. They remember what you are." - Jim Henson.

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Appendix A

Text-To-Speech Technology for Specific Learning Disabilities: Website Content

(https://talirappaport.wixsite.com/ttstforsld)

What Is Speech To Text Technology?

Text-To-Speech Technology (TTST) is a tool that uses either pre recorded human voice recordings or computer synthesized voices to read text aloud. The most common form of TTST, called "books on tape" back in the age of tape players, are audiobooks. Screen readers, which are synonymous with TTST, also provide an individual with a way to read text via read aloud from synthesized speech.

Nowadays, TTST is easy to acquire due to the advancement of technology, the availability of personal devices, and the ever-growing collection of digital texts and audiobooks. Services like Audible, Overdrive Media Console and Libby are a few examples of publicly available TTST. Companies like Apple, Microsoft, and Google have taken strides to create a more accessible experience for all users, and have included TTST services on their devices, and in their applications and operating systems.

Anatomy of TTST

TTST has come a long way since its humble beginnings of "books on tape" and "screen reader" technology. In addition to the improvements to synthesized speech, other customizable features have become commonplace across apps and platforms.

Due to the growing amount of available customizations, I thought it pertinent to break down some of these features into a "quick guide". What follows is a listing of common customizable features in TTST, with some recommendations for how they might benefit individuals using TTST.

It is important to note that customization is very much a trial and error process. There is no "correct" way to use TTST, and individuals may change settings to fit their needs from day to day.

Optical Character Recognition (OCR). Optical Character Recognition (also sometimes Optical Character Reader), or OCR, is the process by which images, photos of documents, handwritten text, and/or scans of documents are converted into machine-encoded text. In other words, this technology is able to identify and extract text from photos and scans so that a screen reader can more accurately read the text of scanned documents. This may be a built in feature in some apps, though it can also be something an individual may need to perform manually (by way of clicking a button) within an app.

Highlighted Words/ Sentences During Reading (Speech Cursor). Some TTST have the option for words or sentences to be highlighted while they are read aloud. This can be beneficial for individuals needing support to focus, a way to follow text more readily as it is being read, and/or to add another level of differentiation between the text being read and the rest of the text on the page.

Color Settings/ Contrast of Screen. There are many reasons as to why an individual might change the contrast and/or color settings on their screen. Just as we adjust the brightness settings and backgrounds on our smartphones, screen readers also have this capability. Some screen readers take this a step further, allowing a user to customize brightness, the color overlay of a text, the color of the screen cursor highlight while reading, and the text itself. This can be extremely beneficial to users who may be sensitive to light, those who need more contrast between text and screen, or even to prolong the stamina of an individual who may fatigue more quickly with the amount of bright screens they are required to stare at daily.

Text Options & Focused Reading Mode. Just like changing the font of text in a word document, some TTST applications now have the capability to change the appearance of text for an existing document. Most screen readers already incorporate OpenDyslexic font, a font designed to give dyslexic users a more accessible experience. In addition to font options, some apps allow the user to change the line and character spacing of text. There are 3 layouts of text used by screen readers:

Plain Text. All text has one font with no bold or italics. This layout is the easiest to customize, and is the most basic format of text.

Rich Text. Text in this layout can be plain, bold, or italic, and often uses the fonts of the original document. Rich Text also includes images and graphs that exist in the original document. Most eBooks support this layout.

Original Document. This layout shows the entire document in its original form. It is possible to switch between the original document and plain text, but it depends on the document. Using the Original Document layout may require performing external OCR to have a screen reader accurately recognize text from the image scanned.

Focused/ Distraction Free Reading Mode. Some screen readers also go a step further and provide a setting in which distractions can be eliminated by minimizing what is visible on the screen. Applications vary in what they call this feature, some calling it "focused reading mode," others calling it "distraction free mode". This mode also varies from app to app, but the idea is to provide a user with only the text they are reading on the screen, hiding the rest of the document and/or control buttons while in this mode. This mode can support individuals with focus, visual sensitivities, and comprehension needs.

TTST for SLD

TTST enables students with Specific Learning Disabilities (SLD) to unlock barriers to understanding language, and to better participate actively in their learning. TTST can benefit students who have trouble processing language, struggle to read print due to dyslexia and/or dysgraphia, or who comprehend better when listening to spoken language. Barriers broken, students with SLD using TTST may feel more in control of their learning and show more interest in their educational goals.

The research surrounding the use and benefit of TTST to support students with SLD is controversial and lacks a clear consensus. The majority of the existing studies look specifically at a student's unassisted (without TTST) performance, which fails to evaluate the student's growth and acquired compensatory skills (Park et al., 2017). Focusing on this limited measurement of success does not provide a full picture of the qualitative aspects of using TTST to support students with SLD. It is important to recognize that access to curriculum necessitates student motivation, focus, speed with reading, decoding, and comprehension (Boone & Higgins, 2007; White & Robertson, 2015).

Educators must consider how TTST will be used to better support target goals, along with age group and grade level (Forgrave, 2002). For students with SLD, whose areas of need involve reading, decoding words, and comprehension of language, the intended goal for using TTST would be to break down these barriers and allow the student to access the content. Student access to content refers to a student's ability to comprehend, critically analyze, and form informed opinions about content found within the curriculum. In existing studies, the compensatory skills that students acquired during their use of TTST in the classroom, specifically student motivation, focus, and compensatory skills with reading, make a case for using TTST as a viable

accommodation for students with SLD geared toward access to learning as opposed to individual skill proficiency (Park et al., 2017; White & Robertson, 2015). According to Watson et al. (2010), "many studies do not directly consider functional performance changes," which can be harder to quantitatively measure (p. 19).

There is still a need for research surrounding the use of TTST for SLD, but it is clear that the qualitative data shows that the use of TTST in academics to support students with SLD can make a big difference in accessing learning.

Choosing TTST

Allowing individuals with SLD to have some control over the visibility of their disability is crucial. In other words, on the spectrum of disability visibility, students with SLD generally land closer to invisible, allowing them to "pass," going undetected, as someone who does not have a disability (Faucett et al., 2017; Kattari et al., 2018). Visibility is affected when assistive technologies are introduced. The use of a hearing aid to support hearing loss, wearing glasses to correct vision, and/or a student who is the only one who uses an mp3 player with headphones to read a piece of text are all concrete examples of assistive technology devices that drag the disability spectrum slider from invisible to visible. With visibility in mind, it is important to consider the assistive technology options on an individual basis, assuring that students feel comfortable in embracing the device as well as navigating the technology (Boone & Higgins, 2007; Faucett et al., 2017; Kattari et al., 2018; Seale et al., 2015; Shinohara & Wobbrock, 2016).

As access and inclusion become more socially accepted concepts, and technology continues to advance, more and more developers have moved in to create their own version of TTST (Bone & Bouck, 2017; Boone & Higgins, 2007). The options range from personal handheld devices with built in TTST to web extensions and apps, increasing the number of the

population with access to personal "digital capital," enabling the use of TTST without the need to request permission from educational institutions (Boone & Higgins, 2007; Seale et al., 2015). While this trend has created the opportunity for more access to TTST technologies, the assumption that developers design their software to meet the needs of individuals with disabilities in mind is false (Boone & Higgins, 2007). Boone & Higgins (2007) report that developers often design AT with specific disabilities in mind, not "what it means to offset [a] disability" (Boone & Higgins, 2007, p. 135). Developers spend more time convincing users that "their product is effective and easy to use, rather than actually making the product effective and easy to use," and are more interested in the creation of a product rather than its intuitive usability and "user friendliness" (Boone & Higgins, 2007, p. 137).

Side-by-side Comparison of (a few) TTST

Because there are so many TTST products and services, it can make the process of narrowing the selection to meet the needs of individual students a daunting task. Some considerations to keep in mind are:

- Student preference
- Visibility
- Realistic user-friendly interface and integration of TTST into academics and other uses
- Cost of TTST and availability (most TTST nowadays have free versions and trial periods)
- Compatibility of TTST with the Device/ Platform

Features	VoiceDream	Aloud!	Capti Voice	Natural Reader	Read & Write
Platforms	iOS (iPad/iPhone) & Android	iOS 9.0 or later (iPhone/iPad)	iOS, Mac, Windows, Chromebook (Android online only) Browsers: Google Chrome, Firefox, Safari	Mac, Windows, & Chrome Extension (online application)	Google Chrome, Apple iOS (Mac, iPad), Windows PC, Internet Explorer
Cost	One time $9.99 + 1 free Premium Voice	Free & $4.99 Premium (no storage limit and no ads)	Free & Premium Plans for Personal Pro, and Education	Free & Premium (one time payment) Plans for Personal, Education, and workplace	Free & Premium Plans for Personal, Education, and workplace
Bookmarking/ Highlighting	✓		✓		✓
Focused Reading area (reduced text area)	✓		✓		✓
Customizable contrast/ color theme	✓		✓	✓	✓
Built-in Dictionary	✓	✓	✓		✓
OpenDyslexia Font	✓		✓		✓

Supports Other Languages	✓	✓	✓	✓	✓
Voice Options	• 61 free voices • 100+ Premium voices from $1.99-$4.99 (in-app purchase)	• 16 free English (1 premium)	• 100+ voices free/ premium options • Premium Voices available with subscription	• Voice options dependent upon device used (uses existing voices from accessibility settings available on device)	• Voice options dependent upon device used (uses existing voices from accessibility settings available on device)

Tips for Students

1. Know that you are important, and your needs are valid. There will be many people who do not understand just how liberating and positive TTST is for individuals with SLD, so do your best to continue to advocate for your needs and take deep breaths. You matter.
2. Ask for help. I cannot stress this enough. There are many people who can help, and then some. If you have already been through the paces with teachers, administration, IEP team, school counselors, etc, do not stop there. Disability Advocates are a great resource when you feel like you've hit a wall and are still not receiving services.
3. TTST is not "one size fits all." There are many varieties of apps, software, devices, and embedded features to choose from. It is truly about finding the right fit, kind of like finding a good pair of shoes: they all cover your feet, but they are not all comfortable, fashionable, and good for all conditions. Try not to get frustrated; you may need to trial different apps and software before you find what works for you.
4. (For students in middle school, high school, and college) It can be beneficial to schedule a meeting with your teacher outside of class to talk about your needs. If you have an IEP

or 504 Plan, this would be a good time to talk to your teacher about how they can best support you in class, and how your accommodations/ services might translate to their classroom and syllabus. If you are registered with Disability Services at your college or university, I highly recommend setting up a meeting with your professors to give them the forms Disability Services provides with your approved accommodations, as well as talk to them about your needs relative to their class and syllabus. Putting a face to the name can make all the difference for educators in assuring you are supported.

5. The transition from high school to higher education can be a bit overwhelming. You as a student will need to advocate for yourself in order to establish with the disability services office at the university/ college and to receive the support you need. Contact disability services as soon as possible to start the process of providing documentation and establishing accommodations. EVEN IF YOU DON'T THINK YOU WILL NEED TO USE YOUR ACCOMMODATIONS, it is better to have them when/if you do need them rather than having to start the process mid-semester. Check out Navigating The Transition to Higher Education for more information.
6. Ask your teacher/ professor for readings prior to needing them in class. If they allow you to access them before attending class, pre-load them into your TTST so they are ready for in class reading. It can also be helpful to skim or pre-read readings before class.
7. Ask your teacher/ professor for readings prior to needing them in class. If they allow you to access them before attending class, pre-load them into your TTST so they are ready for in class reading. It can also be helpful to skim or pre-read readings before class.

8. Being the only one wearing headphones in class can feel a little stigmatizing. This may not bother you, but if it does, acquiring some in-ear bluetooth headphones (such as Apple Airpods) can make your TTST experience a bit more discrete.

Tips for Teachers

1. While this website has been geared toward using TTST for students with SLD, the use of TTST benefits ALL STUDENTS. Please consider including TTST as a tool readily available to students in your classroom. There are many embedded TTST services and apps that are free to the public and available for use. See the TTST by Device & Platform page for more information.
2. Understand that using TTST is not a "fix all" tool for SLD. While current research cannot conclude a direct effect on specific skills mastery, it does heavily support the acquisition of language and learning and has no reported negative effects.
3. Explicitly model and teach when it is ok to use TTST in the classroom, and how to use it respectfully. This is especially important if adopting TTST in a UDL classroom for all students, with/ without IEP services & accommodations.
4. Normalize the use of headphones and devices for classroom activities when appropriate, allowing students to access headphones and devices during appropriate times.
5. Become aware of the available, public access TTST such as Google's accessibility tools embedded in Google Suite applications (google docs, google chrome web browser, google slides, etc).
6. When appropriate (middle school-college students) communicate with students about classwork and required readings beforehand. Giving students access to readings before

class to allow them more time to read/ comprehend the text, as well as to load documents into personal screen readers can make a big difference.

7. Provide enough time for all students to read through text before moving into group discussions. "Enough time" might look different from class to class and student to student, and allowing students access to readings before class may support student in-class processing time.
8. It is ok not to have all the answers, but "I'm not tech savvy" and "I don't do technology" are not acceptable reasons for not allowing students to use TTST. Ultimately, education is about the students and their needs. It is ok to ask for support from the Assistive Technology Specialist in your district, other educators both at your school and online, and your administration for professional development opportunities regarding UDL and Assistive Technology. It may take a little bit of work to understand how to use TTST and how best to implement it into curriculum and instruction, but it is worth the effort if it means the difference between student frustration and understanding.

Universal Design For Learning

With the advancement of accessible technology and the universal availability of these tools, the logical next step is an update of the best practices in education. One such approach, Universal Design for Learning (UDL), was born from the mindset that all students should have access to curriculum regardless of ability (Nepo, 2017). Universally designed lessons enable students to experience content through a combination of learning styles (visual, auditory, kinesthetic), provide students with options for demonstrating mastery, and account for all ability levels of learners with predetermined ways to accommodate and/or modify activities. Examples of UDL in class include choices in how students decide to demonstrate mastery (book report,

powerpoint, sculpture, song, graphic organizer, etc.) and differentiated ways to interact with content (written text, textbooks read using TTST, graphic organizers, large group/small group discussion, peer led activities, math manipulatives, vocabulary infused with art, videos, podcasts, etc).

UDL is a research based method of instruction with a set of guidelines, and not all UDL classrooms look identical. In the interests of finding uniformity within UDL, Cook and Rao (2018) took a closer look at the strategies employed by teachers that effectively utilize UDL to support students with SLD (Cook & Rao, 2018). One of the biggest takeaways of this study was that UDL's success lies in the fact that there will always be learner variability in the classroom, leading to the notion that curriculum, not the student, is disabled (Cook & Rao, 2018, p. 108). Efforts to define what a generic, replicable UDL classroom looks like are unsuccessful in all studies because of the diverse nature of each classroom, even between those of the same school and district (Cook & Rao, 2018; Hitchcock & Stahl, 2003; Nepo, 2017). UDL, rather, as defined by Hitchcock and Stahl (2003), is "a way of thinking and acting" (p. 49). It starts with the belief that education should be accessible to all students in the least restrictive environment (LRE), and continues with teachers who use differentiated materials and technological tools to unlock barriers to learning for students.

Assistive Technology (AT) and UDL go hand in hand. Because of the aforementioned advancements and availability of existing technology, using AT in the classroom actually makes differentiation a much more attainable goal. Many devices have customizable preferences catering to many individual needs. Specific to TTST, most applications and platforms enable the user to change the reading speed, change the contrast of text and screen, magnify text, highlight and annotate, mask other parts of the screen so as to only view a smaller chunk, and define words

in their native language if they are English Language Learners. In the past, all of these features would have required a preauthorization of eligibility, as well as outside push-in or pull-out support services and devices to equitably support a student. Now, regardless of eligibility, general education teachers can utilize these customizations with the click of a button to provide a more equitable experience for all students within the general education classroom. The ease of which we are now able to provide AT intervention and support for all students directly contributes to the growing support for UDL as best practice in education.

Resources

Center for Applied Special Technology (CAST). An organization dedicated to providing better educational experiences for students with disabilities through the use of technology. (https://www.cast.org/impact/universal-design-for-learning-udl)

The UDL Project. A collection of digital resources and guidelines relating to UDL. Lesson plans, templates, and ways to connect to other educators are also included. (https://www.theudlproject.com/)

UDL for Teachers. A series of informational videos to support teachers in their adoption of UDL principles. (http://udlforteachers.com/)

Ed Tech Update: Assistive Technology. A dynamic collection of articles relating to assistive technology and UDL. (https://www.edtechupdate.com/assistive-technology/udl/)

Navigating the Transition to Higher Education

Transitioning from high school to higher education also means a transition from receiving services under the Individuals with Disabilities Education Act (IDEA) (2004) to coverage under the Americans With Disabilities Act (ADA) (1990). The major difference is that the responsibility to establish as a student with disabilities falls heavily upon the student, not the

institution. Under IDEA (2004), it is the responsibility of teachers and school staff to evaluate and provide services to students who are eligible. Students can take on more responsibilities to advocate for themselves in elementary, middle, and high school, but it is not a prerequisite to receive eligible services and accommodations. In higher education, institutions are governed under ADA (1990), the act that protects the rights of individuals with disabilities and ensures that public spaces, employment, and education are accessible. This means that while services are available for students with disabilities, they must know where to look. LD Online, an organization dedicated to providing relevant information about learning disabilities and ADHD, has more detailed information about laws and education in their article "College Students and Disability Law".

While there is no "right" way to prepare students for this transition, starting early with self advocacy is highly recommended. Students can start to learn how to communicate more effectively with teachers and special educators about their needs as early as middle school, gradually shifting into a more active role surrounding educational goals, accommodations, and IEP team meetings. Confidence in self-advocacy is not an overnight achievement, and not all students will communicate the same way, but giving students opportunities to take ownership of their education experience is one way to foster and grow confidence.

When considering potential colleges and universities, if you know that you might require accommodations for academics, I highly recommend making an appointment with disability services whilst touring campuses to get a feel for the people behind the office. Just like touring campuses, checking out academic programs offered, and learning about student life, having a feel for what the disability services office and staff are like can be influential factors to choosing a college. Having a working relationship with the staff in the disabled services office can make a

huge difference in self-confidence, advocacy, and student success, and makes a student more likely to reach out in times of need.

Once accepted to an institution, it is important to make an appointment with disability services. All college campuses and universities are required by law to provide services to eligible students, and generally have an office on campus. Newly accepted students should email or call the disabled students office to start this process. They will likely ask for existing documentation that will support the need for accommodations, so make sure you have gathered these documents before your appointment (they may ask for them beforehand). At the appointment, the disability services counselor/ specialist will talk a bit about what they offer, review documentation and proposed accommodations, and provide you with a list of your approved accommodations to share with your professors. The process may vary slightly from institution to institution, but will be similar to the above description. Disability services also can help with setting up, using, and supporting assistive technology use, so do not hesitate to reach out for help.

Additional Resources

Recommended Books

1. Colleges That Change Lives: 40 Schools You Should Know About Even If You're Not a Straight-A Student
2. Colleges for Students with Learning Disabilities or AD/HD
3. K & W Guide to Colleges for Students with Learning Disabilities, 9th Edition (College Admissions Guides)

Recommended Online Resources

1. National Center For Learning Disabilities
2. Best Colleges: College Guide For Students With Learning Disabilities

3. US Department of Education- Transition of Students With Disabilities To Postsecondary Education: A Guide for High School Educators