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Speech to Text, Text to Speech:

Support for Deaf and Hard of Hearing Students

By Amanda Connelly and Jane Doyle

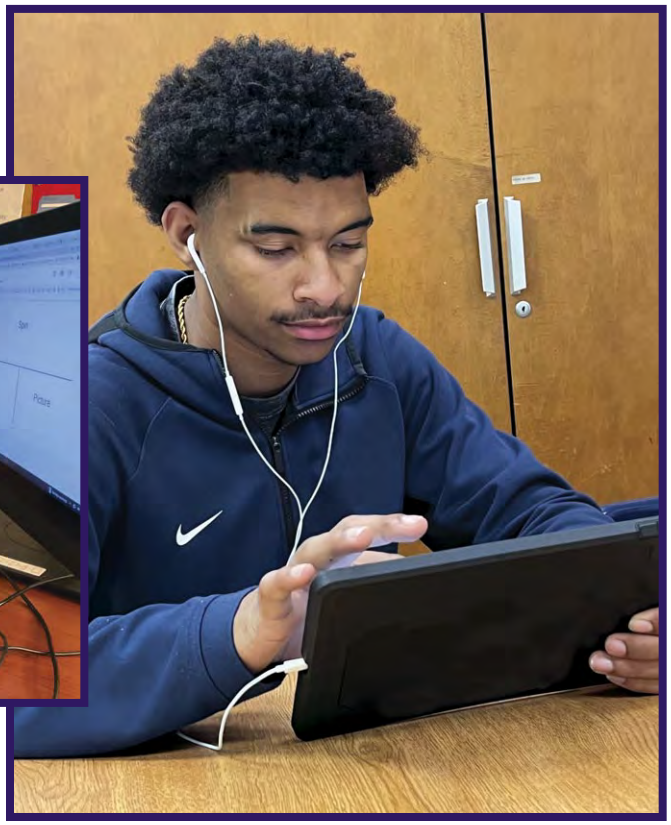
Mateo, a new transfer student, entered the Model Secondary School for the Deaf (MSSD) in 2019. Fourteen years old and in the ninth grade, Mateo's home language was Spanish, but his primary academic communication was spoken English with sign support. Mateo was reading at a pre-kindergarten level.*

Mateo was like many students, neither fluent in English nor in American Sign Language (ASL) and significantly delayed in literacy skills. At MSSD, he was provided with emerging signers services to develop his expressive and receptive ASL skills. He was also provided with speech and language services by a bilingual, Spanish-speaking speech-language pathologist. This included the use of listening devices that changed text to speech (TTS) and speech to text (STT).

TTS and STT have proven beneficial for students who are hard of hearing or who are consistent users of listening devices (Glassman, 2021; Stanberry & Raskind, n.d.). TTS and STT join a variety of other accommodations (e.g., reading aloud, scribing, pre-teaching relevant vocabulary) to support the development of students' reading and writing skills (Dawson et al., 2018).

While they may not be appropriate accommodations for all deaf students, TTS and STT may provide students who have significant auditory access with support in skills related to sounding out words, word recognition, and spelling. TTS and STT are designed to support those students whose access to spoken English is stronger than their access to printed English (The Understood Team, 2022;

Photos courtesy of Amanda Connelly and Jane Doyle



Above, left: Students have the option to turn on STT accessibility features when using Google Docs or Google Slides. **Above:** Although available as a special app or a separate device, TTS systems are also a built-in feature in modern computers, tablets, and smartphones.

National Center for Technology Learning, 2017). This includes students who:

- Read and/or write at a level that is several years behind their current grade level
- Are hard of hearing and have access to spoken language for learning
- Are strong users of hearing assistive technology (e.g., hearing aids, cochlear implants)
- Come from homes in which spoken language is the primary method of communication
- Have dyslexia or dysgraphia
- Have an identified learning disability in reading
- Have a diagnosis of attention-deficit/hyperactivity disorder

TTS and STT

During the pandemic, school buildings closed and Mateo received both instruction and speech and language services remotely. As Mateo had access to spoken English and intelligible speech, he used TTS and STT tools. These were provided first in his speech and language sessions.

TTS is an assistive technology in which the computer reads aloud text on the screen. TTS is not a recorded human voice; instead, the voice is computer generated. The commonly available TTS programs allow students to press a button on the computer screen to activate this feature. They can follow along as the text on the screen is voiced by the computer. Students activate the setting only when they choose. They can listen through built-in speakers, use headphones, or even stream the content to their personal hearing aids or cochlear implants using Bluetooth technology (The Understood Team, 2021). The volume can be adjusted to suit their preferences. Many TTS systems also highlight the paragraph or word as the system reads through the passage, making it ideal for students

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Left: Many TTS systems highlight the paragraph or word as the system reads through the passage so that students can follow along with the text. **Right:** Assistive technology—including TTS and STT—supports students' opportunities for learning and their social interactions with peers.

to follow along with the text. The delivery can be sped up or slowed down to match the listeners' preferences or processing needs. Although available as a special app or a separate device, TTS systems are also a built-in feature in modern computers, tablets, and smartphones. TTS is available for iPad and Google Chrome and commonly used nationwide.

STT is available on the electronic devices people use every day. People use STT when they ask Siri or Alexa to check the weather or play a song. Physicians use STT to compose reports, as they have for decades. Google products such as Docs and Slides and the Apple iOS operating system used for MacBook and iPad have options to turn on STT accessibility features. The device will use the built-in microphone to pick up a user's speech and transcribe it into printed words in the document or Google Slide presentation on the user's screen. STT transcribes the speaker's words verbatim; it does not adjust for incorrect grammar, vocabulary use, or missing punctuation. Individuals using STT must return to the script they produced and edit it.

In the Classroom

When in-person learning resumed, Mateo returned to MSSD where he received speech and language services, including TTS and STT, in pull-out sessions as well as integrated into his English classes. He used both TTS and STT services with audiobooks—all available to him on his school-issued iPad. He also used both technologies to help him complete assignments for other courses.

TTS and STT have strong potential for use in the classroom; both reduce the cognitive load and allow students to focus on comprehension. Sometimes teachers express concern that the use of TTS and STT in the classroom will interfere with or will replace the use of ASL, but TTS and STT simply support access to English print. These technologies do not replace ASL; they do provide those deaf and hard of hearing students who have auditory access with an additional pathway to connect with the printed component of a bilingual learning environment.

Of equal importance, TTS and STT can be used in any language, thus supporting multilingual learners. In allowing access to printed academic content, these tools can lessen anxiety related to reading and writing in a new language. Some students develop speaking and listening abilities before reading and writing skills. TTS provides these students with the opportunity to listen to and learn new words, increasing access to how words are pronounced (Carroll, 2014). At the same time, STT allows students to use their speaking abilities to produce written text with less stress (National Center for Technology Learning, n.d.). Students can use TTS and STT to develop their reading and writing abilities in their home language as well as in English.

These technologies do not replace ASL; they do provide those deaf and hard of hearing students who have auditory access with an additional pathway to connect with the printed component of a bilingual learning environment.

Accommodation and the Law

During the Fall 2022 semester, Mateo worked with a Gallaudet University graduate student speech-language intern who provided services in both English and Spanish. He demonstrated the ability to listen to and read Spanish, and he responded appropriately to comprehension questions. Mateo said he wanted to have strong language and literacy in both English and Spanish.

The Individuals with Disabilities Education Act (IDEA) requires schools to provide assistive technology—both devices and associated services—for children with disabilities. The law also requires that

training be provided to students, teachers, staff members, and parents on how to use this technology (Wright, 2023). Assistive technology supports students' opportunities for learning, their social interactions with peers, and their potential for meaningful employment and often should be incorporated into students' Individualized Education Program (IEP).

TTS and STT can be added during the annual review IEP meeting, or a periodic review meeting can be called to make changes to the IEP mid-cycle. The student's case manager, English teacher, school psychologist, audiologist, and speech-language pathologist, along with other IEP team members, should be included in the meeting. Each professional should bring relevant data to share. Parents/legal guardians at home are experts on their child, and they should also be viewed as valuable members of the IEP team.

TTS, STT, and Testing

Once Mateo succeeded in using TTS and STT in class, his speech-language pathologist, audiologist, and English teacher gathered supporting data and then recommended that he use these accommodations in testing as well. When tested using these accommodations, Mateo had increased understanding and recall. Further, the technologies allowed him to produce typed text that was more legible than his handwritten work.

TTS and STT may be especially critical tools for standardized testing. This includes state-specific English, math, and science assessments as well as the American College Testing (ACT) exam. The school testing coordinator must identify the required accommodations at the time of registration, which typically occurs months before testing takes place. It is important to identify any IEP changes required for testing accommodation needs early in the academic year.

Mateo Today

Mateo now reads at a fourth grade level and makes progress every day. Technology has allowed him to participate more fully in his classes. It has also provided us with a better way to measure his literacy skills.

For Mateo and other deaf and hard of hearing students with adequate access to spoken language, TTS and STT have proven to be valuable tools. They can help with achievement of full potential in the classroom as well as in postsecondary environments.

**Mateo is a pseudonym.*

References

Carroll, J. (2014, December 16). *Digital supports for English language learners.* Texthelp. Retrieved from *https://www.texthelp.com/resources/blog/digital-supports-for-english-language-learners/*

Dawson, K., Antonenko, P., Lane, H., & Zhu, J. (2018). Assistive technologies to support students with dyslexia. *TEACHING Exceptional Children, 51*(3), 226-239. *https://doi.org/10.1177/0040059918794027*

Glassman, S. (2021, October 16). *The best assistive technology for dyslexics.* Wired. Retrieved from *https://www.wired.com/story/the-best-assistive-technology-dyslexia/*

National Center for Technology Learning. (n.d.). *Speech recognition for learning.* Reading Rockets. Retrieved from *https://www.readingrockets.org/article/speech-recognition-learning*

Stanberry, K., & Raskind, M. H. (n.d.). *Assistive technology for kids with learning disabilities: An overview.* Reading Rockets. Retrieved from *https://www.readingrockets.org/article/assistive-technology-kids-learning-disabilities-overview*

The Understood Team. (2021, June 1). *What is text-to-speech?* Retrieved from *https://www.understood.org/en/articles/text-to-speech-technology-what-it-is-and-how-it-works*

The Understood Team. (2022, December 12). *What is text-to-speech?* Retrieved from *https://www.understood.org/en/articles/text-to-speech-technology-what-it-is-and-how-it-works*

Wright, P. (2023, July 12). *Assistive technology.* Retrieved from *https://www.wrightslaw.com/info/atech.index.htm*