Using Text-to-Speech Software to Improve Reading Outcomes Among Secondary Struggling Readers

Many secondary students will grapple with complicated course texts and new terminology. Yet for struggling readers, the challenge of reading to learn is especially arduous. With adoption of the Common Core State Standards (CCSS) of 2012, attention is shifting to the critical need to facilitate struggling readers' immediate access to their course texts while supporting literacy development in the content areas. Text-to-speech (TTS) software is an educational technology that teachers can leverage to help meet this pressing need.

WHAT IS TEXT-TO-SPEECH SOFTWARE AND HOW CAN IT HELP?

TTS software is widely used to help struggling readers gain access to print. Using speech synthesis technology, TTS software transforms electronic text into sounds that resemble naturally-voiced human speech (Taylor, 2009). When using TTS software for reading, a student listens to a passage voiced aloud and reads along, following the text on the computer's screen. Several TTS software packages (e.g., Kurweil 3000, WYNN reader) also include integrated study features designed to promote active reading. For example, the software can automatically highlight individual words and sentences as the speech synthesizer voices the text aloud. Other features allow students to highlight text, create sticky and audio notes, look up words with hyperlinked reference tools and even extract selected text to a new TTS readable document.

Recently, we investigated whether TTS software use can improve reading outcomes among 9th graders who were reading at least two grades below their current grade level (1.0 to 6.9 grade level equivalent (GLE)). Over a 10-week period, 134 students and 21 teachers used the TTS software to read and learn from textbooks, articles, novels and Web pages in their content area classrooms. Before and after the intervention, we measured students' reading proficiency without the use of the software (unaided). Results were dramatic. Analyses revealed that after 10 weeks of TTS software use, the unaided reading comprehension and vocabulary gains of the intervention group surpassed the gains of the control group, by the GLE of five months and six months, respectively (Park, Roberts, Takahashi, & Stodden, 2013). This finding is exciting and significant as previous studies of TTS software have utilized single group designs without a control group (e.g., Roberts, Takahashi, Park & Stodden, 2013; Stodden, Roberts, Takahashi, Park & Stodden, 2012) or measured students' reading skills and comprehension while using the TTS software (e.g., Dimmitt, Hodapp, Judas, Munn, & Rachow, 2006; Disseldorp & Chambers, 2002; Lange, McPhillips, Mulhern, & Wylie, 2006).

READING TO LEARN IN A TTS ENABLED CLASSROOM

Below, we offer a glimpse into a TTS-enabled classroom transcribed from a video observation of Ms. Lu's (pseudonym) classroom.

Visitors to Ms. Lu's secondary classroom will notice the rhythmic sound of fingers tapping computer keyboards, clicking mouses and the quiet hum of students' thinking. Students wearing headsets listen attentively to a marine biology text voiced aloud while their eyes follow the passage displayed on

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their computer screens. Students move their cursor to circle words, highlight sentences and attach virtual sticky notes to the text. Ms. Lu is a secondary teacher using TTS software to improve her students' reading comprehension and content area learning.

At the front of Ms. Lu's classroom, a display maps out how students can use the different TTS study tools while reading to learn. Ms. Lu's TTS-enabled computer is connected to a projector and screen so that her computer's display is visible to students. When modeling how to use TTS software study tools, Ms. Lu voices aloud her thinking about their use and provides time for students to practice using the study features on their own.

For this science lesson, students use TTS software to read through an assigned passage without interruption. Next, students read the passage again while leveraging TTS software features to monitor and repair their comprehension. First, students circle unfamiliar words they wish to define, then place the cursor before each word to access a hyperlinked dictionary. Students then copy and paste the word definitions into bubble notes they attached to the text. Next, students use the highlighter to capture key information and add virtual sticky notes containing their questions or comments about the text. Finally, students add a footnote, within which they type a summary of the section they just read.

While Ms. Lu uses TTS to support students' reading comprehension and vocabulary development, she captures opportunities to model the kinds of thinking that advance learning within the science discipline. For example, when modeling how to record questions onto virtual sticky notes, Ms. Lu audibly voiced questions about marine life, which emerged while reading the text. About a marine mollusk, Ms. Lu asked: "I wonder what is inside the chamber. Is there any gas or any life inside?" and "I wonder what happens to old chambers?" Through authentic questioning, Ms. Lu made her thinking visible (Ritchhart, Church, & Morrison, 2011) and modeled sustained intellectual curiosity – a thinking disposition characteristic of scientific inquiry, meaningful engagement with text and knowledge production within a discipline (Tishman, Jay, & Perkins, 1993).

Several students in Ms. Lu's classroom are struggling readers. Most do not have computers in their homes and rarely engage in reading outside of school. Yet, twice a week, students use TTS software in her classroom. Since incorporating the TTS software into her classroom practice, Ms. Lu has noticed an increase in students' reading engagement. "When they use the software, they are really focused on their reading material. Their eyes are moving – they are reading, not just daydreaming." She also highlighted that students' use of the software's annotation tools support their engagement with text. "It's quiet, but I can tell there is a lot of thinking going on … they are asking questions while reading and making comments, too ... I think they are thinking more critically … beyond the text."

INCORPORATING TTS IN YOUR CLASSROOM PRACTICE

Reading in the content areas provides students with authentic opportunities to apply reading strategies. In the discussion below, we share our ideas on how teachers can harness TTS software features to support struggling readers' reading skill and literacy development in the content area classroom.

FACILITATE DECODING

The ability to decode multisyllabic words is critical for secondary student success in content area classes (Carnine & Carnine, 2004). Yet, adolescents with reading difficulties may lack effective strategies to decode the multisyllabic words that comprise their content area texts (Archer, Gleason, & Vachon, 2003). Students with decoding difficulties can benefit from using TTS software that automatically highlights words and sentences as the speech synthesizer voices the text aloud. This feature helps students focus their attention on individual words and sentences. Students with decoding difficulties can also benefit from TTS software with an integrated word syllable reference tool. While using the software, students can click on a challenging word and listen to each syllable of the word voiced aloud. To further reinforce the correspondence between graphemes and speech sounds, students can quietly subvocalize the word's syllables while softly tapping out the number of syllables (Carreker, 2011). As students become more fluent readers, cognitive effort that was once consumed by decoding can be freely applied towards monitoring understanding (Rose & Dalton, 2002).

COMPREHENSION MONITORING

Students who closely attend to text and strive for meaning are monitoring their understanding (Mckeown, Beck, & Blake, 2009). Formulating questions and constructing summaries while reading are practices that support meaning making (Gajria & Salvia, 1992; Klinger, Vaughn, & Boardman, 2007). Using TTS software, students can read along as they listen to the passage, then pause the speech synthesizer to monitor their understanding. Students can conveniently type their questions or key points onto virtual sticky notes they attach to the passage. Students can also record verbal questions, comments and summaries as audio-notes they can embed within the passage. Just as writing and talking about text support learning and comprehension (Duke, Pearson, Strachan, and Billman, 2011), the audio-notes feature can be especially helpful for students who form mental representations through talking about text. At the end of each passage, students can also add a footnote, within which they type summaries of the scientific processes or author perspectives they encounter through the text.

COMPREHENSION REPAIR

Good readers also revise summaries of what they have read (Duke et al., 2011). Students who reread, restate, identify unknown words and request help are employing fix-up strategies that repair breaks in comprehension (Shanahan & Shanahan, 2008). Using TTS software, students can listen to a complex passage multiple times, highlight main points and circle unfamiliar words. Then, using TTS reference tools, students can click on an unknown word to listen to the word's definition, synonyms or syllables voiced aloud. Students can record their comprehension questions in virtual sticky notes or in audio-notes and then share these questions with their teacher and peers.

SUPPORT VOCABULARY DEVELOPMENT

Underdeveloped reading vocabulary limits a reader's ability to infer word meanings from context (Stahl & Nagy, 2006). For students who have good mastery of oral language, listening to the text while reading can help

overcome the challenges of comprehending text and facilitate exposure to new vocabulary (Dalton & Grisham, 2011). Whether TTS software is used for repeated reading or to support students to read widely, several features of the software can be combined with word-learning instruction. Many TTS software programs provide convenient access to a hyperlinked dictionary and thesaurus. While using TTS software for reading, students may simply "click" on a word to see and hear word definitions and synonyms read aloud. Teachers can encourage students to utilize the embedded reference and study tools. Using annotation tools, students can easily circle challenging or unfamiliar words. Later, they can use the extract function to make lists of these words and add the definitions to make personalized glossaries. While some students can study these words independently, the word lists and glossaries can also be shared with students' special education or ELL instructors.

PROMOTE CONTENT AREA LITERACY

One way teachers can promote disciplinary literacy is by enculturating the kinds of thinking that advance knowledge development within the content domain (Moje, 2008). For example, teachers can challenge students to reason from evidence and evaluate truth claims, two thinking dispositions that advance understanding within social science and science disciplines.

To enculturate these thinking dispositions in a social studies or science classroom, teachers can use the Red Light, Yellow Light routine (Project Zero, n.d.; Ritchhart et al., 2011) with an interesting text. This thinking routine employs probing questions to elicit students' evaluation of truth claims presented in primary documents, such as historical papers and journal articles. Developed by David Perkins, the questioning routine prompts students to evaluate truth claims as very doubtful (What are the red lights?), possibly inaccurate (What are the yellow lights?) and convincing (What are the green lights?) (Ritchhart et al., 2011). Use of this thinking routine motivates students to dig deeper into the text, look for sweeping generalizations and draw on textual evidence when critiquing an author's recommendations (Ritchhart et al., 2011) - thinking dispositions highly valued within the social science and science domains.

Use of TTS software features can help students remember when and how to apply Perkin's Red Light, Yellow Light routine while reading. Using TTS software to read a primary document, students can read while listening to the passage voiced aloud and highlight doubtful claims in red, possibly inaccurate claims in yellow and convincing claims in green. Students can then use TTS software to circle the author's evidence in support of his/her truth claims. Meanwhile, students can record their skeptical thinking about the truth claims in audio or sticky notes they attach to the text. Students can use the extract function to export the author's truth claims (red, yellow, and green highlights) and the author's supporting evidence (circled text) into a new TTS accessible document. By adjusting the extraction settings, students can create an outline of truth claims and supporting evidence that nests circled text beneath the highlighted text.

During small group or whole class discussions, students can refer to these outlines when identifying evidence for truth claims and refer to their audio and sticky notes when offering reasons why they are skeptical of the author's claims. As a follow-up assignment, students can print their outlines and choose a truth claim to critique in a take-home writing assignment.

LOOKING FORWARD

TTS software with integrated features can be a valuable instructional technology for reading, which can open a door leading to improved motivation and cognitive engagement. TTS software use expands students' access to interesting reading materials and can support students' vocabulary development and passage comprehension. Through the use of TTS software, students are consequently better prepared to participate in small group and whole class discussions of text. We hope teachers will further explore the benefits of this technology for struggling readers. As youth are preparing to exit high school, it is important that we provide them with every opportunity likely to improve their chances for success.

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