Using Kurzweil 3000 as a Reading Intervention for High School Struggling Readers:
Results of a Research Study

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Abstract

Despite increased use of assistive technology by struggling readers, scientific research on the effect of using assistive technology is limited. An experimental study was conducted to examine the effects of using text-to-speech software (i.e., Kurzweil 3000) upon the reading performance of ninth grade struggling readers when not using the software (i.e., unaided). After using the software for one semester, the intervention group students had significantly greater increases in vocabulary and comprehension when compared to the control group students. These findings contribute to increasing the scientific evidence-based research on the use of text-to-speech software as a reading intervention for secondary struggling readers.

Keywords

Assistive technology for reading, text-to-speech software, high school struggling readers

Introduction

The US No Child Left Behind Act (NCLB) of 2001 (P.L. 107-110) Title I, Part B, promotes *Reading First* and *Early Reading First* initiatives to ensure all students, including students with disabilities and at risk, read by the end of the third grade. In addition, the Assistive Technology Act of 2004 (PL 108-364) and the New Freedom Initiative of 2001 mandate the use of assistive technology (AT) as mainstream culture to support students with disabilities, and at risk, and address their learning needs (White House). Text-to-speech (TTS) software is one example of AT that has become more widely used by struggling readers in high schools (Engstrom; Silver-Pacuilla and Fleischman). However, scientific research on the effect of such TTS software use on high school students' reading is very limited (Deshler).

Kurzweil 3000 version 12 (2010) is one of the TTS software programs used frequently in schools. This TTS software utilizes optical character recognition (OCR) to convert print materials into electronic format. The software presents a steady pace of auditory and visual input of text and includes embedded reading supports. It supports reading by (1) highlighting segments of text to focus readers' attention on chunks of words; (2) increasing font size or decreasing the number of words on the screen to improve focus and accuracy; (3) gradually increasing reading speed to train the eyes to move more quickly across the page; (4) allowing students to listen to a passage multiple times to reinforce the flow and cadence of the words; and (5) allowing readers to instantaneously look up words and have the word meaning read back to them from the built in dictionary.

The purpose of this study was to determine the effectiveness of TTS software (i.e., Kurzweil 3000 version 12) as a reading intervention for 9th grade struggling readers. For the purpose of this study, a struggling reader was defined as a student in Grade 9 who read at or

between a 1.0 and 6.9 grade level equivalency (GLE) on the Gates-MacGinitie Reading Test (GMRT; MacGinitie, MacGinitie, Maria, and Dreyer) at baseline.

The following research questions were investigated:

1. To what extent does the use of TTS software affect reading vocabulary outcome of 9th grade struggling readers?

2. To what extent does the use of TTS software affect reading comprehension outcome of 9th grade struggling readers?

3. To what extent does the use of TTS software affect reading rate outcome of 9th grade struggling readers?

Methods

To investigate the research questions, an experimental design was used. The duration of the intervention was one semester (approximately 10 weeks). Data were collected from Spring 2011 to Spring 2012. For analysis, the combined data set was used.

Teachers were recruited and randomly assigned into the intervention group or control group. Then, students were recruited and assigned based on their teachers' group assignment. To maximize the number of students who benefit from the intervention, more teachers were assigned to the intervention group than to the control group.

After group assignment, project staff provided one hour of training on the use of the software to the intervention group teachers and students using a researcher-developed TTS

guide. The proficiency of teachers and students in using the software was assessed both immediately and two weeks after the training, using a fidelity checklist.

After the training and fidelity check, students in the intervention group were encouraged by the teacher to use the TTS software to read scanned grade level reading materials during participating teachers' content area classes for at least 400 minutes during the semester. The use of the software by the intervention group was tracked with an automated TTS software log. The control group received neither training in nor access to the TTS software; these students received typical instruction in content area classes.

Students' reading vocabulary and comprehension were measured using the Gates MacGinitie Reading Tests (GMRT) (MacGinitie, MacGinitie, Maria, and Dreyer). The GMRT 7/9 was administered to all participants, in both the control and intervention groups, once at the beginning of their participation semester and once at the end. At each testing occasion, a different parallel form of the GMRT was administered to reduce the effects of the test-retest bias. In addition, to measure reading rate, students were instructed to read the first passage in the GMRT for 30 seconds and mark the last three words that they read. The number of words read per minute was then calculated by multiplying the number of words read in 30 seconds times two.

The data on a total of 164 students were used for the analysis. Of the 164 participating students, 32 students participated in the control condition, and 132 students participated in the intervention condition.

Results

On average, students in the intervention group used the TTS software for 582 minutes during one semester. To examine the effects of the TTS reading intervention upon the unaided reading outcomes (i.e., reading vocabulary, reading comprehension, and reading rate) of struggling readers in Grade 9 (i.e., tested without the TTS software) the data were analyzed using Analysis of Covariance (ANCOVA).

Table 1 Results of Analysis of Covariance for reading vocabulary, comprehension, and rate.

Source	df	Type III SS	MS	F	Partial η^2
Reading Vocabulary					
Pre-score	1	212.772	212.772	113.282**	.434
Group	1	9.052	9.052	4.819*	.032
Error	148	277.982	1.878		
Reading Comprehension					
Pre-score	1	68.121	68.121	64.675**	.303
Group	1	5.055	5.055	4.799*	.031
Error	149	156.938	1.053		
Reading Rate					
Pre-score	1	53868.228	53868.228	14.186	.107
Group	1	5488.575	5488.575	1.445	.012
Error	119	451860.762	3797.149		

*p < 0.05, **p < 0.001

Effect of TTS Software Use on Vocabulary

There was a significant positive effect of the TTS intervention upon reading vocabulary, after statistically controlling for students' baseline performance on the vocabulary measure, F (1, 148) = 4.819, $p < .05$, partial $\eta^2 = .032$. The mean, of the intervention group, when adjusted for initial differences (M = 4.964 GLE), was significantly higher than the adjusted mean of the control group (M = 4.322 GLE).

Effect of TTS Software Use on Reading Comprehension

After statistically controlling for pre-reading comprehension GLE scores, a significant effect of the TTS intervention upon reading comprehension was found, F (1,149) = 4.799, $p < .05$, partial $\eta^2 = .031$. The mean of the intervention group when adjusted for initial differences (M=4.981 GLE) was significantly higher than the adjusted mean of the control group (M=4.493 GLE).

Effect of TTS Software Use on Reading Rate

After controlling for students' baseline performance on the measure of reading rate, a statistically significant difference in post-reading rate was not found, F (1,119) = 1.445, $p > .05$. The mean of the control group adjusted for initial differences (M = 198.92) was higher than the adjusted mean of the intervention group (M = 181.41), but this difference was not statistically significant.

Discussion

The research addressed the effects of using TTS software on the reading performance of 9th grade struggling readers (measured while not using the software). The positive findings included significant improvements in vocabulary and comprehension, but not in reading rate.

Specifically, the vocabulary gains of students in the intervention group exceeded the vocabulary gains of the control group by a GLE of six months. The reading comprehension gains of students in the intervention group surpassed the reading comprehension gains of the control group by a GLE of five months. This finding implies a correlation between reading comprehension and knowledge of word meanings (Stahl and Nagy). In fact, Cromley and Azevedo found, through a path analysis conducted with data on struggling readers, that vocabulary makes the largest contribution to reading comprehension.

In addition, previous studies investigated the effects of TTS use by measuring students' reading comprehension while using the TTS software. Thus, this study makes a unique contribution to the reading intervention literature. It also supports McKenna and Walpole's hypothesis that struggling readers' unaided levels of reading competency will gradually improve as a result of the use of AT.

This study did not find a significant effect of TTS software use upon student reading rate. For this study, reading rate was defined as a running record of the number of words read silently per minute. Students' word reading accuracy was not examined. A future study is necessary to investigate the TTS effect on unaided reading accuracy.

Conclusion

While students' access to AT for reading is increasing, scientific research on the effects of AT on reading performance is limited. This experimental study investigated the effects of TTS software use on reading vocabulary, reading comprehension, and reading rate of high school struggling readers. The results indicate the significant effect of TTS software use for increasing vocabulary and reading comprehension of high school struggling readers, but not for increasing

reading rate. This study contributes to increasing the scientific evidence-based research on the use of a computer-based AT for improving the unaided reading of high school struggling readers.

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