THE IMPACT OF SELF-QUESTIONING STRATEGY USE ON THE TEXT-READER ASSISTED COMPREHENSION OF STUDENTS WITH READING DISABILITIES

Genevieve Manset-Williamson
Michael Dunn
Indiana University
Rebecca Hinshaw
Indiana State University
Jason M. Nelson
University of Montana

This study involved an examination of the impact of a self-questioning strategy on the text-reader assisted comprehension skills of six students in grades five through eight with reading disabilities (RD). The purpose of this study was to determine the degree older children with RD comprehend text-reader assisted text that is at or above their actual grade level and whether comprehension of text-reader assisted text be could be enhanced if students with RD were taught and prompted to used self-questioning strategies. Students were asked to listen to and visually track sixth to seventh grade level text that was read to them using the Kurzweil 3000 text-reader software. They were then asked to answer seven multiple-choice inferential questions and to summarize the passage in a retell. Data were analyzed using a multiple-baseline, single subject design and a repeated-measures ANOVA. Results suggest that students with RD can have comprehension difficulties that are not resolved by text-reader software, and that self-questioning strategies significantly improve their ability to comprehend text supported by text-reader software. Results, however, varied between students. Implications for the use of text-reader software and comprehension instruction are discussed.

The trend in accommodation provision since the seventies has been to provide older children and adolescents with reading disabilities (RD) access to text by reading it to them. Until recently this was accomplished by using either an instructional staff person or a tape recorder. Now with increasing frequency, and the advent of more sophisticated text-reader software, any text can be read to a student by a computer (Hasselbring & Bausch, 2005/2006). This is a breakthrough that more than anything else could alter the educational experiences and success of students with RD. The research on the use of text-reader software with students with RD is still evolving, however, and at a slower pace than the development of the technology. With the growing availability of text-reader software to schools, it is conceivable that teachers will be tempted to simply scan course text or exams into a computer and leave students alone to access the information. Reading comprehension, however, is a more complex skill than simply identifying words. For some students, poor comprehension is a direct result of struggles with word identification and reading fluency. For others, however, deficits in comprehension are also a result of an inefficient application of comprehension strategies, a deficient lexicon and limited world knowledge. For these latter students, text-

reader software may address the problem of word identification and fluency, but will not necessarily guarantee that students will comprehend the text read to them.

Teaching comprehension strategies and related skills to students with reading skill deficits at the word level without reading assistance is difficult, however, because the level of the text that they can access is often not complex or sophisticated enough to use as a base for teaching the reading skills related to comprehension. Text-reader software provides an opportunity to address important reading skills related to comprehension that can't be addressed when students with RD read text on their own. In this pilot study, the authors examined whether students could comprehend text at or above their actual grade level when they used text-reader software, and whether the addition of a self-questioning comprehension strategy during the text-reader software reading enhanced the comprehension of upper elementary and middle school students with RD.

Text-Reader Software

Text-reader software combines optical character recognition technology with speech recognition in a system that allows the computer to read aloud scanned in or online text. Often the text is highlighted as it is read, and options such as a dictionary, highlighting pen or the ability to add voice or written notes as text are included. In general, the use of text-reader software makes sense for older children who still struggle with the decoding of words and fluency. Because the diagnosis of reading disability, particularly dyslexia, implies that students' word identification skills and fluency trail their ability to comprehend, an accommodation that renders text accessible is an appropriate means of compensating for the disability. Text-reader software also provides the advantages of bimodal presentation of text (Higgins & Raskin, 2005; Montali & Lewandowski, 1996) and more control by the reader. Student tracking of words and phrases can be assisted by the highlighting of words and text, which can be sped up or slowed down depending on student preference and intent. Beyond providing access to text, text-reader software may help in focusing attention for longer periods of time and in assisting students in reading faster, which contributes both to the ability to comprehend and to complete assignments (Hecker, Burns, Elkind, Elkind, & Katz, 2002). The computerized format also provides a degree of independence that is not found when accommodations are in the form of staff readers; an important feature both for the students' developing sense of agency and for under-resourced special education programs. Related interventions, mostly with a different population of students, have been found to be effective. Talking, interactive books, for instance, were found to significantly impact underlying processing and decoding skills of five and six year old students with phonological processing deficits (Littleton, Wood, & Chera, 2006). In a study with fifth and sixth grade students, Reinking et. al., (1985) compared the effects of student-read (*off-line*) text, student-read text presented on the computer, and computer manipulated text with a variety of enhancement options, including the ability to manipulate text to get definitions or simpler text structure. Another group had the enhancement option and a prompt to review the passage before answering questions. Unexpectedly, these researchers found that the off-line readers had equal or higher comprehension scores than those using text-reader software alone, and that only the group with text enhancement options and a prompt to review the passage scored significantly higher than the off-line group. (Reinking & Schreiner, 1985). In contrast there is evidence that simply reading aloud text contributes to students' improved scores on standardized tests of comprehension; specifically students who have deficits in decoding (Crawford & Tindal, 2004; Elbaum, Arguelles, Campbell, & Saleh, 2004; Fletcher et al., 1998).

The research on text-reader software with elementary and middle school students with RD, while promising, is presently limited and inconclusive. Related technology like hand held text-readers, for instance, were found to significantly increase the comprehension of text of upper elementary and secondary students with RD, but not to a level of competency (Higgins & Raskin, 2005). In this study, students using the *Quicktionary Reading Pen II* demonstrated a significant greater gain in their ability to comprehend text. Even with this accommodation however, the average post-test standard scores were still in the mid-80s, suggesting that students would still struggle to comprehend text using this compensatory devise. In another study, computer-assisted reading that included the option to click on a word a student does not know was found to significantly affect word reading, but not necessarily general reading comprehension ability (Wise, Ring, & Olson, 1999). Text-reader software was found to be effective in increasing comprehension for college students with learning disabilities and Attention-Deficit/Hyperactivity Disorder (ADHD) as well, but it is not clear if this would translate to younger students who may or may not be college bound (Elkind,

1998; Hecker et al., 2002). Results for those studies that did use text-reader software with upper elementary students have been mixed; showing promise for some students while showing no benefits for others (Leong, 1995; Swanson & Trahan, 1992; Underwood, 2000). Leong (1995) contrasted text-reader software alone with that which included explanations for difficult words, prior question and answering reading awareness exercises, and a combination of text-reader software, explanations, and reading awareness exercises. Even with supports and accounting for underlying processing differences, chronological age controls significantly outperformed poor readers on comprehension items that included inferential questions. Underwood et. al., (2000) investigated what children learned when they used a computer-based interactive talking book. They found that reading ability was the only predictor of comprehension outcomes, suggesting that the text-reader software did not necessarily mediate problems students had with reading.

It is not clear why text-reader software is not effective for more students with RD. Perhaps it is because students' underlying deficits in language processing both contributes to the decoding ability and to their comprehending text as it is read to them (Swanson & Trahan, 1992). Or perhaps, once words are read to them, other factors contributing to comprehension problems in their more fluent peers with learning disabilities- limited lexicon, text structure knowledge or cognitive strategies for instance- may be revealed. An additional factor may be the monotone nature of the reading. As opposed to books-on-tape or human readers, whose variable (and often lively) intonations can add interest and aid comprehension of a text, the text-reader software is not capable of subtle inflections, pauses, and emphasis. In our summer clinic for students with RD, we found that when we first introduced text-reader software many students tended to drift off and not pay attention to the computer. Others appeared not to be able to understand what was being read to them even if they were paying attention. The source of their difficulties with comprehension went beyond the ability to read the words. It became clear that the task would have to be altered to maximize student comprehension. We decided to introduce comprehension strategies.

Comprehension Strategy Instruction

There is theoretical and empirical evidence to support the addition of strategy instruction when students with RD are using text-reading software. Students with RD are often delayed or limited in their development of reading comprehension related metacognition and cognitive strategies (Dickson, Collins, Simmons, & Kameenui, 1998a; Gersten, Fuchs, Williams, & Baker, 2001; Wong, Harris, Graham, & Butler, 2003). Deficits in metacognition and reading strategies contribute to their inability to comprehend text, even when they can read the words. Metacognition during reading includes readers' awareness and self-regulation of their cognitive processes, as well as their motivational beliefs about their reading (Dickson et al., 1998). A reader with well-developed metacognition will monitor their reading processes and evaluate whether the reading strategies applied are effective given the task at hand. Metacognition also involves anticipation or prediction of what will occur in the text given students' background knowledge on the topic and text structure. In addition, metacognition includes deliberately focusing attention on essential elements of text and minimizing attention on extraneous details. When there is an awareness that meaning is breaking down, good readers self-regulate reading related cognitive processes and strategies. Reading strategies may include changing the pace of reading given the task, rereading, skimming, and use the broader context to aid in definitions and interpretation. Many students with RD also appear to have limits in the underlying executive processes tied to metacognition, such as working memory and attention (Swanson & Saez, 2003). These limitations in metacognitive and cognitive strategies are exacerbated for some students by a limited background knowledge of content, text structure, and vocabulary (Williams, 2003). When limits in metacognitive skills are combined with difficulty in decoding and fluency, it is no wonder that reading is such a difficult task for these students. In short, students with RD are most in need of sophisticated reading related metacognition and strategies and yet are typically the least likely to apply them.

Self-Questioning Strategy Instruction.

Researchers have demonstrated that comprehension strategy instruction can be effective for students with RD, particularly on immediate measures of reading comprehension (Dickson et. al., 1998; Gersten et al., 2001; Wong, 1996; Wong, Harris, Graham, & Butler, 2003). Comprehension strategy instruction designed for students with RD typically includes pre-reading, during reading, and post reading activities designed to mimic the metacognitive and cognitive strategies used by good readers. Depending on the strategic

approach, students are generally asked to use their prior knowledge of the topic and clues in the text (i.e. pictures, headers) to predict what may happen in the upcoming narrative and to summarize structural features (i.e. main characters, the problem, how the problem is resolved). With expository text, students commonly asked to summarize the main idea, and generate questions related to the important ideas (Manset-Williamson & Nelson, 2005). Interventions focusing on expository text may also include instruction in identifying and addressing different text structures (Bakken, Mastropieri, & Scruggs, 1997; Williams, 2003). Some models are student mediated, where teacher direct instruction in the strategy itself is faded (Englert & Mariage, 1991; Fuchs D., Fuchs. L., Mathes, & Simmons, 1997; Klingner, Vaughn, & Schumm, 1997). The early work of Palinscar and Brown (1984) with *reciprocal teaching* provided a model for the directly teaching the internalization of strategies associated with an engaged and active reader. In reciprocal teaching, teachers instruct small groups of students in four strategies (asking questions, summarizing, clarifying, and prediction). Teachers fade out their directions and the students take turns as group leaders. This peer-mediated and reflective practice is designed to assist students in the transfer of self-regulating reading behaviors.

Self-questioning during reading can be particularly effective for students with RD (Scruggs & Mastropieri, 1998). The advantage of self-questioning is that it embodies other comprehension strategies mentioned earlier. In order to create appropriates questions, for instance, students are required to use clues from the first (often the topic sentence) of the paragraph and their prior knowledge of the topic in order to predict what may be said in the paragraph. They will then have to be actively engaged in meaning making in order to determine whether the question was answered or not, and will have to practice paraphrasing in order to summarize the paragraph.

The barriers researchers and teachers face when teaching comprehension strategies to students who have significant delays with both word identification and comprehension is that students cannot access the text in order to apply comprehension strategies. For the students in this study, for example, their instructional level of reading was on average at a second grade level. Any text presented to these older students at a second grade level was not complex enough to challenge their comprehension. Text that matched their actual grade level was not accessible at all to them. Text-reader software appeared to be a possible solution to this dilemma.

In this study, an adaptation of the FIST self-questioning strategy (Clark et. al, 1984) was used (see figure 1). Students were prompted to read the first sentence of a paragraph, create a question from the sentence that might be answered by the paragraph, and then after reading the paragraph, determine whether the author answered the question or not. Asking questions at the beginning of paragraphs and then either answering those questions embodies a number of reading strategy approaches.

Purpose of Study

Many older children with RD have significant delays in word identification, fluency and comprehension. While text-reader software has the potential to make text accessible to students with RD, the years of delay in developing basic reading skills has locked students out of developing comprehension strategies needed to gain meaning from complex text. In order to speak to these problems, we addressed two questions in this study: a) to what degree do older children with RD comprehend computer read text that is at or above their actual grade level? ; and b) will the comprehension of computer read text be enhanced if students with RD are taught and prompted to use self-questioning strategies?

Method

Participants and Setting

Originally, 8 students participated in this study. Because two of the students had mastery scores (6 or 7 out of a possible 7) on their baseline probes, they did not continue with the strategy instruction. The six students included in the study and the two discontinued were entering grades 5-8; demonstrated at least a 50% discrepancy between expected grade level and measures of reading fluency and comprehension, with no students with Broad Reading scores over above the 3.5 grade level (Reading Fluency and Passage Comprehension subtests from the Woodcock-Johnson Tests of Achievement, 3rd Edition [WJ-3]; Woodcock, McGrew, & Mather, 2001); at least one standard deviation (SD=10) below the mean on measures of phonological processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) and; a Reynolds

Intellectual Assessment Scale (Reynolds Intellectual Screening Test [RIST]; Kamphaus & Reynolds, 2002) index score of 75 or above. They were recruited from both private and public schools through principals and teachers for a summer reading clinic, where they received tutoring in basic reading skills, as well as comprehension instruction using the text-reader software. All instruction took place at a private school for students with reading disabilities. All the students were white males and came from a range of low-income to middle class households. Students scores on the intellectual screening measure RIST were in the average range (M=96.17, SD= 4.7) and reading ability was significantly deficient, with standard scores on Broad Reading averaging 73.17 (SD=9.6) and a Grade Equivalent of 2.68 (See table 1 next page).

Table 1
Participant Characteristics

Student Number	Age (in months)	RIST[b]	Phonological Awareness[c]	Phonological Memory[c]	Rapid Naming[c]	Broad Reading[c]	Broad Reading GE[e]	Basic Reading Skills[d]	Basic Reading Skills GE	Passage Comprehension	Passage Comprehension GE
1	11-6	105	88	112	94	85	3.5	86	3.1	92	4
2	14-2	96	76	70	91	58	2.2	65	2.2	55	1.9
3	12-3	91	88	88	67	76	3	88	3.8	80	2.9
4	10-10	95	76	115	88	66	2.4	75	2.5	65	2
5	10-3	94	91	82	82	76	2.4	84	2.5	76	1.9
6	10-7	96	88	76	76	78	2.6	87	2.9	80	2.1
M	11-7	96.17	84.5	90.50	83.00	73.17	2.68	80.83	2.83	74.67	2.47
SD	1-5	4.7	6.68	18.82	10.16	9.60	.483	9.06	.57	12.95	.84

Note. All test scores are standard scores unless otherwise noted.

[a] All scores in parentheses represent standard deviation. [b] Reynolds Intellectual Screening Test Composite Score. [c] Comprehensive Test of Phonological Processing Composite Score. [d] Woodcock Johnson Tests of Achievement, 3rd Edition Composite Score. [e] GE = Grade Equivalent.

Procedures

Students attended the reading clinic four days a week for six weeks in the summer. Each day after one-one tutoring that focused on phonemic awareness, decoding, and comprehension instruction (see Manset-Williamson & Nelson, 2005), students would read expository passages on the computer. Passages were chosen from workbooks designed to provide practice in reading comprehension for middle schools students, and average readability on a Dale-Chall Readability Index of 7.28 (*SD* = .81). Passages were chosen at this level as to be too difficult for students to complete without support, but not untypical of what they would experience in their social studies or science text. The *Kurzweil3000* software was used to read the scanned in passages. The *Kurzweil3000* was set so that it highlighted words as they were read at 150 words per minute, but students were taught how to reset the speed to their preference. Students maintained control in that the computer stopped reading at the end of each sentence, and were required to click on the mouse in order to proceed to the next sentence. Students were instructed to independence in the use of the software before the study began. Each student wore headphones with a microphone and passages were assigned in a random order to students. In the baseline phase, students were asked to use the text-reader software to read the passages and complete the multiple-choice and summary. During the FIST training phase, prompts were embedded in the text to remind students to create a predictive question for each paragraph and then summarize the response (see figure 1). Students created both a question and a response via voice note they embedded in the text. During this phase, tutors provided scaffolded instruction to

students, supporting their efforts to create questions that would likely be answered by the text and to paraphrase the answer to their question. If their question was not answered by the paragraph, students were told to say in the voice note: *the question was not answered in the paragraph. One question that was answered was….* Students remained in this phase for either two to three sessions until it was determined by an independent observer and the tutor that the student could independently apply the FIST strategy. In the final phase, students worked independently with FIST prompt embedded in text that was read to them by the computer.

Use the FIST strategy as you read. When you reach the FI, make a question with the first sentence. When you see ST, survey the paragraph for answers and tie the answers into the question in one sentence. If the paragraph doesn't answer the question, say a question the paragraph does answer.

FI. The S.S. *Edmund Fitzgerald was* a freighter that hauled iron and talconite ore from the western end of the Great Lakes to the steel factories in Detroit, Michigan. The freighter had left the port in Superior, Wisconsin, slightly ahead of the *Arthur M. Anderson.* When an early November storm produced high waves and gale-force winds, the two ships maintained close contact. ST.

Figure 1.
Sample Paragraph with directions and embedded FIST Strategy

Sample Student Question (FI)	Sample Student Summary Sentence (ST)
"What did the freighter do?"	"It left the port and there was a big storm."
Why did he call him?	"Because he needed backup."
"Did they find it?"	"They lost contact with the ship."
"Why are they down there?"	"They didn't answer my question but they told us what they did underground."
"What did they do after they barked?"	"It didn't answer my question but it talked about how they dig their holes."

Figure 2.
Sample FIST paragraph questions and summary sentences.

"It's about ships that lost contact in a storm."
"It was about prairie dogs."
"I don't remember."

Figure 3.
Sample Retell responses.

Dependent Measure

Multiple Choice Questions. Immediately following the text-reader software reading of the passage, participants completed computer read multiple-choice test consisting of seven inferential items per passage. Tests scores ranged from 0-7. Inferential questions were created by the authors, and represented main ideas

in each paragraph. The following question types were included for each passage: Summary (*Which sentence best summarizes the entire passage*?), True or False questions (*Which of these sentences is true according to the passage*?), and content specific question (*Some village people's houses are built on stilts because…*). Passages were randomly assigned to students in order to address passage effects. Students responded to the multiple choice by marking their responses on a worksheet.

Retell. After reading the passage, students were prompted by the computer during baseline and FIST to use their Voice Note command (a command that allowed their taped message to be embedded into the passage as they spoke into headset microphones), and to tell us all the important ideas you can remember about what you just read. They were asked again, Is there anything else you remember about the passage? Add those ideas here with a Voice note command…. These retells were coded for the number of unique Passage Related Ideas. Passage Related Ideas were defined as an utterance that consists of a group of words consisting of a subject and a predicate, where either the subject or the verb could be implied. The first author and a second researcher coded the passages for the number of Passage Related Ideas. The inter-rater reliability for the coding of the retell was .86. Reliability was established by dividing the raters' agreements by the total number of scores. If the raters disagreed upon the scoring of a particular response, they discussed the scoring and reached consensus on each disagreement.

Unfortunately, we found when transcribing the voice notes that sound quality was often corrupted by students pressing on the microphones with their hands or not clearly responding into the microphones. Because of this, for the retell analysis, only complete responses were included. In this case, there were 25 complete responses (out of 48 possible), with one student whose responses could not be transcribed at all. Even so, the retell data was included because it provides additional information about students' comprehension. Still, because they do not represent all possible responses, they should be interpreted with caution.

Data Source and Analysis.
Both a group repeated-measure and a multiple-baseline design was used to measure the impact of the strategy instruction on students' comprehension. For the group design, mean scores were calculated for all six students in the baseline phase, the FIST training phase, and the independent FIST phase. Statistical significance in means were calculated using a repeated-measures ANOVA and Sheffe posthoc comparison tests were performed to confirm differences between individual phases (Tabachnick & Fidell, 1989). Effect size was calculated by subtracting the baseline mean from the Training and FIST phase means and dividing by the average, or pooled, standard deviation (Cohen, 1988; Hunter, Schmidt, & Jackson, 1982).

In the single-subject, multiple-baseline analysis, four of the students were in the baseline phase for four sessions, received FIST training for two sessions, and applied the FIST independently, with only computer prompts, for three sessions. In order to control for practice effects, the remaining two students remained in the baseline phase for seven sessions, received FIST training for three sessions, and applied the FIST independently, with only computer prompts for two sessions.

Results
Group Repeated-Measures Analysis.
Mean scores for by phase and individual students can be found in Table 2 below. Baseline scores indicate that even with the text-reader software , students were only able to answer on average less than 50% of the questions correctly, and that for students overall this improved across phases. Students on average scored significantly higher than baseline in the FIST Training and FIST phase, F (2, 44) = 11.179, p < .001 (See table 2). Posthoc analysis confirmed significant differences and large effects between FIST training (M=4.07, SD = 1.85) and baseline (M=2.37, SD=1.6, p<.01, d =1.7) and between FIST (M=4.69, SD=1.7) and baseline (M=2.37, SD=1.6, p<.001, d =1.4). This analysis suggests that strategy training had a significant and large effect on students' ability to answer multiple choice inference questions.

Table 2
Mean Score by Phase and Student

	Phase		
Student Number	Baseline	FIST Training	FIST
1	3.75	6.00	5.33
2	2.00	2.50	4.33
3	3.75	7.00	6.33
4	2.75	4.00	4.66
5	1.00	3.00	3.50
6	2.14	3.00	3.00
Total	2.37	4.07	4.69

Multiple-baseline Single-Subject Analysis
Single-subject analysis allows for an examination of the individual differences in effects of the FIST strategy. Students were divided into two cohorts roughly by age in order to more easily display the data, with one student with an extended baseline in each of the cohorts. Figures 4 and 5 illustrate the levels and trends for the scores on the multiple-choice test and number of Passage Related Ideas on the retell for individual students.

Multiple-Choice Questions. For all students, most baseline scores for multiple choice were quite low. With the exception of one perfect baseline score for Student 3 , the baseline scores were less than or equal to 0% correct. In addition, between student baseline levels differed greatly, ranging from an average of 1 to 3.75 correct answers. This indicates that while all students struggled to correctly answer the multiple-choice questions, they had different comprehension skill levels upon entry into the program. These differences in comprehension ability were not indicated by the standardized assessments except, perhaps, in for the case of Student 1, who had relatively higher reading scores on his WJ-3 assessment (see Table 1).

For Cohort 1 (see Figure 4), trend and level changes indicate some effect of FIST treatment, but it is not conclusive. For this cohort, a positive trend in the baseline for all three of the students suggests other factors, perhaps practice effects, contributed to the change. For Students 1 and 3, there was an immediate level change between baseline and treatment phases; a change maintained by most students during the independent FIST phase. However, despite the mean level change, the majority of data points overlapped between Baseline and FIST phases, weakening the evidence of FIST effects for these two students. Student 6 did not demonstrate a change in score and appeared to reach a plateau at a score of three.

Cohort 2 provides better evidence for the impact of FIST strategy instruction (see Figure 5). Baseline scores for this cohort are relatively stable, with a range from zero to four. This stability continues on with the extended baseline for Student 6. There is also a significant level change once students enter FIST training, and is generally maintained during the independent use of the FIST strategy. The percentage of non-overlapping data between the FIST and baseline phases for Students 2, 4, and 5 were 30%, 66%, and 66% respectively.

Retell Analysis. Retell probes provided little evidence for the impact of FIST strategy on students' ability to summarize passages (see Figures 4 and 5). Overall, there was no significant difference between baseline (M = 1.09, SD = 1.22) and FIST (M=1.91, SD= 1.64) in the data. The number of ideas ranged from 0 to 3 in the baseline and 0 to 6 in the FIST strategy, with the majority of the time students providing 2 or less retell ideas for each opportunity. There was no systematic trend to suggest an effect of FIST; although some differences were seen for Students 2 and 5. Again, because of the lost data due to technical difficulties, the retell information should be interpreted with caution.

Discussion

In this pilot study, six students with RD used text-reader software, and then a combination of the text-

reader software and self-questioning strategies, while reading expository passages. Here we found that the text-reader software alone provided some, although limited, benefit to students. Each of these students,

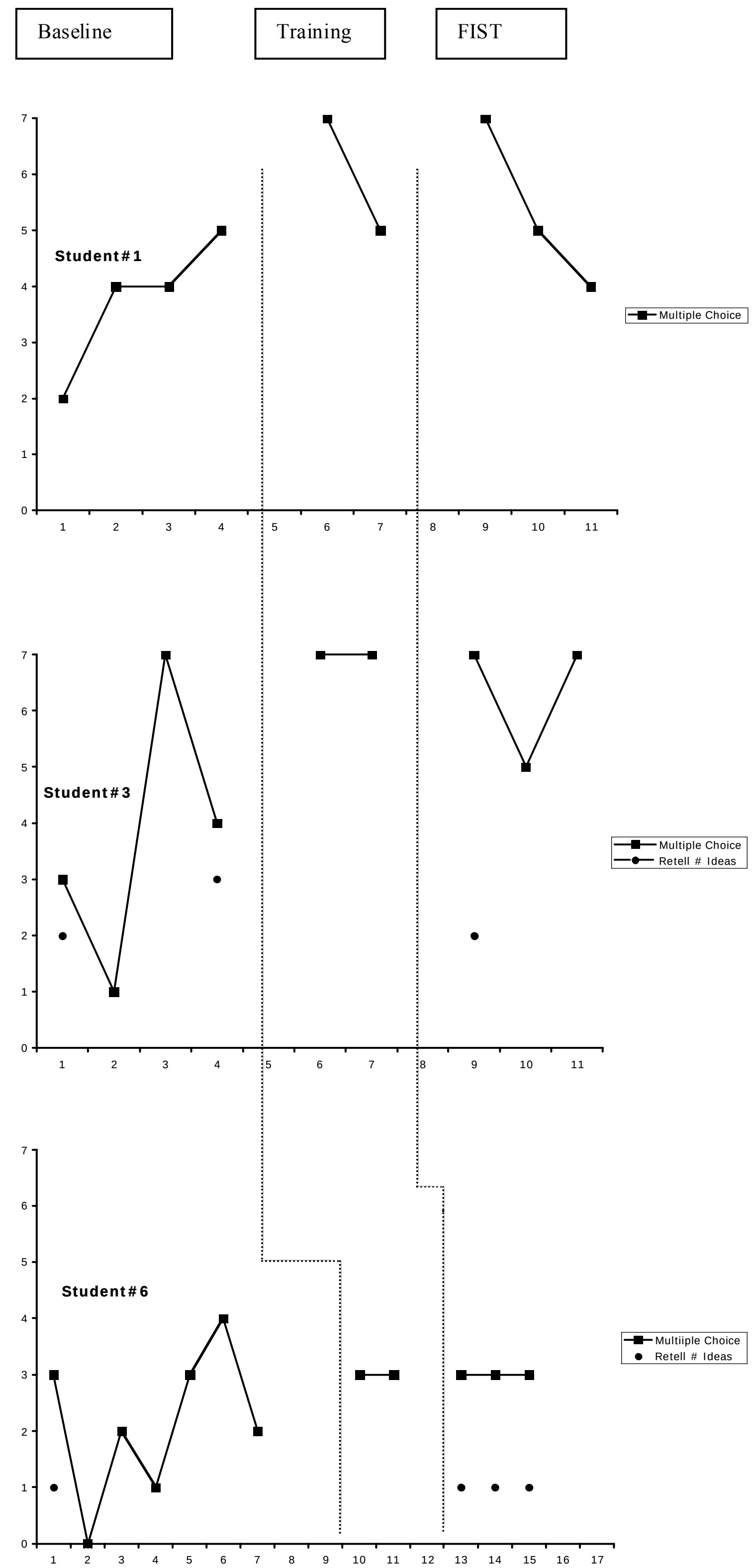

Figure 4.
Cohort 1: Number of correctly answered multiple-choice inference questions and number of ideas expressed during retell for baseline, FIST training, and FIST.

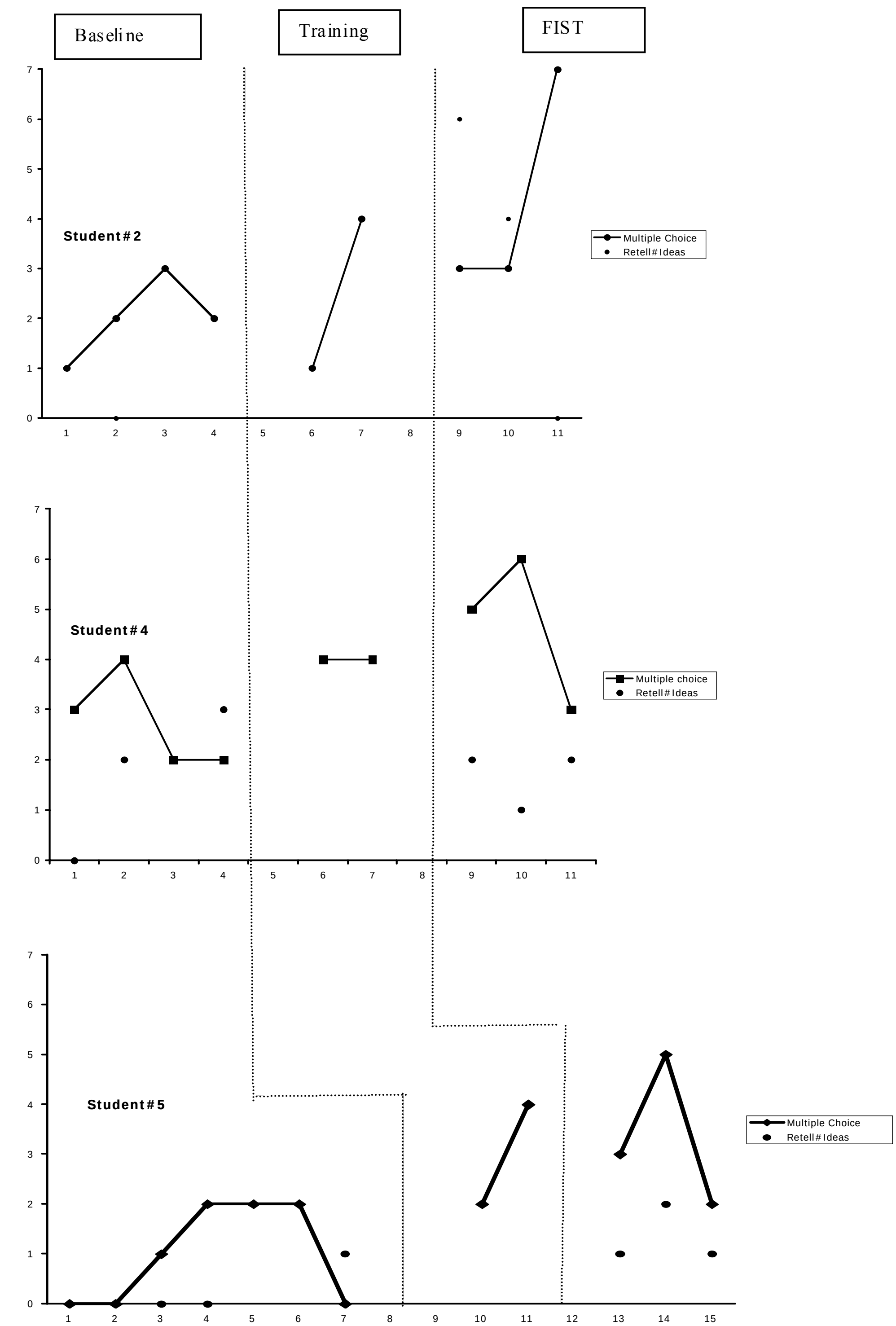

Figure 5.

Cohort 2: Number of correctly answered multiple-choice inference questions and number of ideas expressed during retell for baseline, FIST training, and FIST.

preparing to enter from fifth to eighth grades, came to the program with deficits so significant in decoding and word identification that they struggled to read passages above a third grade level. With the aid of the text-reader software, their ability to simply complete passages of this length and readability is an indication that the text-reader software's potential as an accommodation tool. After reading the passages, students were able to answer on average 2.37 questions out of a possible 7 and to retell a few ideas from the passage. While these scores suggest students were able to access the passage to some degree, outcomes would result in a failing grade in the typical classroom. Clearly these students' difficulties with reading comprehension were not solved by using text-reader software alone. This modest impact of text-reader software alone was comparable to those found in research cited earlier.

The addition of self-strategy practice improved students' ability to comprehend text and to answer related inferential multiple-choice questions. Findings from the repeated-measures ANOVA and single-subject analysis of the multiple-choice question task indicated a significant effect of the FIST strategy training for at least some of the students using computer-reading assistance. Results were variable between and within students, suggesting there are other factors contributing to students' ability to comprehend text.

None of the students demonstrated an ability to fully elaborate on a summary of the passages. There also did not appear to be any functional relationship between the introduction of strategy use and the ability to create a *retell.* This finding is consistent with Leonge (1995), who felt that the ability to summarize required additional instruction and was not necessarily addressed by the addition of technology. Systematic instruction in summarizing does make a difference in a student's ability to retell what they have read (Manset-Williamson & Nelson, 2005) . Adding more explicit strategy instruction related to summary may further enhance outcomes for students.

The contribution of the reading strategy is consistent with other research in the use of cognitive strategies to improve comprehension skills in students with learning disabilities. What makes this study unique is the *combination* of the both text-reader software and self-questioning strategy instruction. Together, they represent opportunities for creating powerful interventions for students with RD who have significant deficits in word reading ability. Often, studies with reading comprehension strategy instruction with older students with RD exclude those students who did not have a minimal level of word reading ability because they could not access the words of the text used for the comprehension strategy instruction. With text-reader software, all students would be able to actively participate in comprehension strategy activities.

There were several limitations to this pilot study. Because this study included only a small sample of white male students who volunteered for this project, there is limited ability to generalize to students with RD in general. These students also represent a subset of students with RD with significant deficits in all areas of reading- word identification, reading fluency, and comprehension- and the findings might not apply to all students with learning disabilities. The FIST intervention was not completely effective as well. While students did better, they did not in general demonstrate mastery in their comprehension of the text. The intervention could possibly be combined with other approaches found to enhance comprehension, such as a discussion of key vocabulary.

Even with these limitations, the results suggest important implications for practice. Technological advances have provided options to students with disabilities that were not available in the recent past. Because of this promise, there is a temptation to immediately apply these advances before educators truly understand them. This study demonstrates that while text-reader software provides some access to text, it does not necessarily guarantee that students will actually comprehend text. The findings here and in earlier research support the integration of text-reader software with other established interventions that target comprehension strategies in order to maximize outcomes for students with RD.

An additional insight that could be gleaned from these findings is that although students shared similar reading profiles as defined by standardized tests, they differed in their ability comprehend while using text-

reader software, even after providing strategy instruction. The use of text-reader software in assessments may provide additional means of sub-typing students with learning disabilities in ways that maximize the match between intervention and student needs, in addition to assisting students in reaching their highest potential. A student who comprehends when using text-reader software is different in a meaningful way than a student who does not comprehend, even if they share the same standardized test profile.

In piloting this study, the authors realized additional benefits of text-reader software. In contrast to reading comprehension instructional software, text-reader software can be customized to meet both the instructional needs and interests of individual students. Text-reader software not only allows for any scanned in or web-based text to be read, but instructors can embed customized prompts, such, as in this case, those used to remind students to create a question. The ability to customize better ensures meaningful student engagement. In addition, easily customized technology allows for teacher control coupled with student independence; both beneficial when instructing in large and diverse classrooms. Potentially, this novel way in which students can engage with text and the computer may contribute to their motivation to attend to computer-read text.

Finally, any research in comprehension has associated with it problems with assessment. Simple comprehension tasks like answering multiple choice questions are worth practicing because it mirrors in-class and standardized tests. However, reading to answer multiple-choice questions narrows that practice of reading and does not allow for the development of reading strategies for other types of comprehension, such as in research tasks. In addition, reading passage and answering questions can become tedious and boring. Given the need to support the motivation to read for these students, building in authenticity to the comprehension task, such as through inquiry tasks, can address the need to practice extracting meaning while at the same time increasing the motivation to read (Elder-Hinshaw, Manset-Williamson, Nelson, & Dunn, 2006). The text-reader software has the potential to allow more students meaningful and valid participation in both the assessment and learning activities.

References

Crawford, L., & Tindal, G. (2004). Effects of a read-aloud modification on a standardized reading test. *Exceptionality, 12*, 89-106.

Elbaum, B., Arguelles, M. E., Campbell, Y., & Saleh, M. B. (2004). Effects of a student-reads-aloud accommodation on the performance of students with and with out learning disabilities on a test of reading comprehension. *Exceptionality, 12*(71-87).

Elder-Hinshaw, R., Manset-Williamson, G., Nelson, J. M., & Dunn, M. W. (2006). Engaging Older Students with Reading Disabilties: Multimedia Inquiry Projects Supported by Reading Assistive Technology. *Teaching Exceptional Children, 39*(1), 6-11.

Elkind, J. (1998). *Computer Reading Machines for Poor Readers*: Lexia Institute.

Fletcher, J. M., Francis, D. J., Shaywitz, S., Lyon, G. R., Foorman, B., Stuebing, K., et al. (1998). Intelligent testing and discrepancy model for children with learning disabilities. *Learning Disabilities Research and Practice, 13*(4), 186-203.

Hasselbring, T. S., & Bausch, M. E. (2005/2006). Assistive Technology for Reading: Text Reader Programs, Word-Prediction Software, and Other Aids Empower Youth with Learning Disabilities. *Education Leadership, 63*(4), 72-75.

Hecker, L., Burns, L., Elkind, J., Elkind, K., & Katz, L. (2002). Benefits of Assistive Reading Software for Students with Attention Disorders. *Annals of Dyslexia, 52*, 243-272.

Higgins, E., & Raskin, M. (2005). The Compensatory Effectiveness of the Quicktionary Reading Pen II on the Reading Comprehension of Students with Learning Disabilities. *Journal of special education Technology, 20*(1), 31-40.

Leong, C. K. (1995). Effects of On-Line Reading and Simultaneous DECtalk Auding in Helping Below-Average and Poor Readers Comprehend and Summarize Text. *Learning Disabilities Quarterly, 18*(2), 101-116.

Littleton, K., Wood, C., & Chera, P. (2006). Interactions with talking books: phonological awareness affects boys' use of talking books. *Journal of Computer Assisted Learning, 22*, 382–390.

Manset-Williamson, G., & Nelson, J. M. (2005). Balanced, Strategic reading instruction for upper-elementary and middle school students with reading disabilities: A comparative study of two approaches. . *Learning Disabilities Quarterly, 28*, 59-74.

Montali, J., & Lewandowski, L. (1996). Bimodal Reading: Benefits of a Talking Computer for Average and Less Skilled Readers. *Journal of learning disabilities, 29*(3), 271-294.

Reinking, D., & Schreiner, R. (1985). The Effects of Computer-Mediated Text on Measures of Reading Comprehension and Reading Behavior. *Reading Research Quarterly, 20*(5), 536-552.

Scruggs, T. e., & Mastropieri, M. A. (1998). Summarizing Single-Subject Research. *Behavior Modification, 223*, 221-242.

Swanson, H. L., & Trahan, M. F. (1992). Learning disabled readers' comprehension of computer-mediated text: The influence of working memory, metacognition, and attribution. *Learning Disabilities Research and Practice, 7*, 74-86.

Underwood, J. D. M. (2000). A comparison of two types of computer support for reading development. *Journal of Research in Reading, 23*(2), 136-148.

Wise, B. W., Ring, J., & Olson, R. K. (1999). Individual Differences in Gains from Computer-Assisted Remedial Reading. *Journal of Experimental Child Psychology, 77*, 197-235.