The Impact of Text Reader Training and Teacher Strategies on a Six-Week Reading Program

by

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Master of Arts 2013

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Abstract

This study investigates the effects of intensive remediation in reading and assistive technology skills combined with the use of a computer based text to speech reader in a six-week intensive reading program for junior-age students with reading disabilities. The study reports on the strategies used by the teachers, week-by-week student progress, and the results of a criterion-referenced reading assessment. Other themes include student attitudes towards the technology and barriers to implementation. Findings indicate that a computer based text to speech reader provides significant compensatory support, resulting in improved fluency and comprehension scores. Students using technology were able to access paper and on-line text at a higher level. A model which builds on the work of Dyck and Pemberton (2002) and Edyburn (2004b, 2007) is proposed which provides a theoretical framework to assist schools in decisions about remediation or compensation for struggling readers in primary, junior, intermediate, and senior grades.
Acknowledgments

Sincere appreciation is expressed to Dr. Daphne Heywood, my Thesis Advisor, for her assistance with this research, and to Dr. Karyn Cooper for her contribution as a member of my Thesis Committee. Thank you to the teachers who participated in this research for sharing their time, commitment, and enthusiasm so generously. Their dedication to the needs of their students is truly immeasurable. Special thanks go to my husband Roger White, to our children Jason and Caitlyn, and to Dr. Lorayne Robertson for their support and encouragement.
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Chapter 1
Introduction and Purpose

The study described here investigates a six-week implementation of text to speech (TTS) computer-based reading software in a specialized six-week program which took place in a mid-sized school board in Ontario in order to: a) measure its impact; and b) document the implementation. In Ontario, school boards determine how to address the needs of special education students, including using various types of technology. Students can use assistive technologies (such as Kurzweil 3000™, Premier™, Co-Writer™, Inspiration™, Smart Ideas™, and Dragon Naturally Speaking™) to help them with reading, writing, mathematics, and organization. This particular study is important because it follows the progress of six elementary-age students over a six-week period by listening to the voices of their teachers recount student progress and mastery of one text to speech (TTS) technology program.

All of the students in this study have a learning disability and they are using assistive technology. The American National Joint Committee on Learning Disabilities (NJLD) defines learning disability as “a disorder in understanding or using language, spoken or written, resulting in impairments in one or more of the areas of reading, writing, spelling, speaking, thinking, or mathematical calculations” (NJLD, 1991, pg. 18). Assistive technology has been defined in the U.S. as “any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (Assistive Technology Act of 2004, Section 3).
This study is significant also because schools exist in an era where new technologies are continually emerging and studies are needed to explore exactly how assistive technologies are being implemented in classrooms to help students with learning disabilities.

This study contains a review of the literature which examines five areas in particular: assistive technology – the new imperative, students with reading disabilities, results from earlier studies of computer-based reading, text to speech research findings, and a theoretical framework for remediation versus compensation of reading difficulties.

TTS readers are available in portable and computer-based forms. They read text which is already in digital form on the computer aloud to the student, primarily through headphones. This may include email, digital books, and web pages, etc. The software also allows print to be scanned and converted from a print image to text by optical character recognition (OCR), which can then be read aloud. TTS readers may also include other study tools such as highlighting, summarizing, and the ability to insert comments by the teacher or student (Hasselbring & Bausch, 2005). Examples of commercial text readers include ReadPlease (www.readplease.com), Premier (www.readingmadeeasy.ca), and Kurzweil (www.kurzweiledu.com).

The literature review concludes with six findings indicating how the literature reports that TTS computer-based reading software helps students to access school materials, how successfully students have used TTS, conditions that make it more effective, wider applications for text to speech software, teacher use of TTS, and where the use of TTS has been investigated.
Some of the implementation of assistive technologies has been theorized by Edyburn (2003) who considers how students’ time should be spent in school, including whether teachers should focus on remediation or use technology to compensate for the identified area of difficulty. Dyck and Pemberton (2002) and Edyburn (2007) suggest a continuum of approaches to the use of assistive technologies in schools that provides a theoretical framework for the research. This framework is used again for the data analysis in this study.

This study investigates: the students’ progress, the methods used by the program teachers; student responses to the text to speech technology; and barriers which interfered with the use of the technology. A mixed methods investigation approach was used; the study is essentially qualitative, however, because the teachers’ voices and words provided detailed information about student progress and teacher activities through a week-by-week narrative. This narrative is presented in a case study format in the Findings section.

The participants in this study are teachers of students who were selected through a referral process. They were removed from their regular classroom setting to attend this program for six weeks. The students in this study were on Individual Education Plans (IEPs) which described continued reading difficulties despite significant previous intervention in the home schools. All were being considered for individual prescriptions for computer-based text to speech reading software, had a prescribed computer which hadn’t yet arrived, or had received a prescribed computer but weren’t successfully using it in their classroom setting.

This research study took place over a two-month period during which the researcher visited the classroom and interviewed the teachers weekly for six weeks. A seventh interview followed after the program ended. The data in this study include verbatim interview...
transcripts of interviews with the two teachers, observations, student artifacts, and results of reading tests at the beginning and end of the program.

In the discussion section, the findings of this study are considered relative to the theoretical framework of remediation vs. compensation (Dyck & Pemberton, 2002; Edyburn, 2007) and other current research. A model is proposed which extends the work of Dyck and Pemberton (2002) and Edyburn (2004b, 2007) to consider the timing for decisions about remediation and compensation for students in the primary, junior, intermediate, and senior divisions (White, 2013). The discussion section leads to some directions for future research and some recommendations related to the use of text to speech computer based readers in classrooms.
Chapter 2
Literature Review

The use of assistive technologies (AT) in school environments in Ontario is likely to increase due to Ministry of Education policies requiring school boards to provide assistive technology to students with disabilities (Ontario Ministry of Education, 2013). However, many questions remain regarding how assistive technologies can best support different types of learners. This literature review focuses on published research regarding the use of technology to assist students with reading disabilities, and considers the success of various approaches. Research on policy, on computer-assisted reading, and on text to speech (TTS) reading is reviewed, followed by a summary of the findings from these studies. Next, a theoretical framework that focuses on levels of intervention or compensation for students with reading difficulties is introduced. This framework provides a theoretical foundation for the data analysis and reporting of the findings. Finally, this review of the literature concludes with six summative findings.

Assistive Technology: the New Imperative

Student use of assistive technology can provide significant assistance to special education students in school and over their lifetimes. School boards and governments in Canada and the United States purchase various kinds of assistive technology in accordance with legislative and regulatory requirements (Alper & Raharinirina, 2006; Ontario Ministry of Education, 2004, 2013). Reading is one skill which is important for success in school and in life, yet many students have difficulty with reading. Research has suggested that computer-based reading may assist some readers to improve comprehension (Alper & Raharinirina,
2006). One type of AT which can support struggling readers is text to speech (TTS) computer-assisted reading software, which can be prescribed for special education students. Limited research has been done into the effectiveness of TTS or into the training challenges it presents (Stetter & Hughes, 2010). One factor in the success of students using TTS is the knowledge level of teachers regarding the integration of AT into the classroom (King-Sears & Evmenova, 2007).

New technologies have transformed the way many tasks are performed, allowing for the creation of new tasks which were previously not conceived (Hasselbring & Bausch, 2005; Puente­dura, 2008). King-Sears and Evmenova (2007) demonstrate that all students require the integration of technology into instruction because technological skills will be essential for their future careers. Students today are able to access information from around the world through Information and Communication Technology (ICT) measures such as the internet (King-Sears & Evmenova, 2007; Puente­dura, 2008). Information is available through multiple modes not imagined a few years ago, such as YouTube videos, or iTunes music. ICT skills may be essential to prepare for certain 21st century careers. However, many students may not benefit fully from these new tools because their learning disabilities could present a barrier to their access to this information. Digital technology such as TTS readers can open up this access for students.

As a result of legislative and regulatory requirements, both individual programs and government funding for appropriate assistive technology are mandated in Canada and the U.S. In the U.S., the Individuals with Disabilities Education Act (IDEA), 1990, and amendment of 1997 required that: a) students have an Individual Education Plan (IEP); b) be educated in regular classrooms if appropriate to the needs of the child; c) and that assistive
technology (AT) be considered as part of the student’s intervention plan (Hasselbring & Bausch, 2005; Individuals with Disabilities Education Act [IDEA], 1990 & 1997; Raskind & Higgins, 1998). The Technology-Related Assistance for Individuals with Disabilities Act of 1988 and its amendment in 1994 increased attention on the use of assistive technology in education environments (Alper & Raharinirina, 2006). The Individuals with Disabilities Education Improvement Act (IDEIA) of 2004 required early intervention by removing the requirement for a significant discrepancy between school performance and student ability before intervention could occur (Cortiella, 2004).

In Canada, education is a provincial responsibility, and each province develops its own regulations and practices. In Ontario, Canada’s most populous province, the Education Act sets government policy. Special Education regulations were introduced in 1980 (Bill 82) which require school boards to provide special education programs and services for exceptional pupils; these programs must be based on continuous assessment and described in an IEP with specific objectives and services to be provided, including assistive technology, in order to meet the needs of the exceptional pupil (Ontario Education Act, R.S.O., 1990; Ontario Ministry of Education, 2004).

Provision of services to students with learning disabilities is a major focus for school boards. Statistics Canada identified learning disabilities as the most common type of disability identified in children, adults, and postsecondary students in Canada (Statistics Canada, 2007). About 14% of students in publicly funded elementary and secondary schools in Ontario receive special education programs and services. Of these, over 40% are identified as having a learning disability. Approximately 82% of elementary special
education students and 86% of secondary special education students spend over half their day in a regular classroom (Zegarac, Drewett, & Swan, 2008).

Students in Ontario with learning disabilities are entitled to have assistive technology if needed and to access it through early intervention if appropriate. Research could assist school boards with designing policies to allocate AT funds. There are many choices of available software, each complex, and research is necessary to assist IEP teams to make the best decisions on behalf of the student.

**Students with Reading Disabilities**

Students whose learning disability involves reading face a number of challenges while in school. Many students with learning disabilities are expected to learn for much of their day in a regular classroom (Hasselbring & Bausch, 2005). The Ontario Language Curriculum (2006) establishes a focus for learning to read during grades 1-3, but for grade 4 and beyond, reading becomes a tool to learn information (Ontario Ministry of Education, 2006). After Grade 4, students with a reading disability are significantly disadvantaged when print is the primary mode for delivering content (Edyburn, 2007). If students are in the regular classroom for most of their day, they may have limited opportunity to receive remediation in reading. Edyburn recommends that schools consider the possibility of assistive technology among options to address reading delays (Edyburn, 2003).

**Computer-based Reading – Results from Earlier Studies**

Computer-based reading may assist some struggling readers to improve their reading skills. Higgins and Raskind (2005) report that researchers suggest that difficulties with phonological processing and decoding overtax other processes such as working memory,
resulting in reduced reading comprehension, but most struggling readers have no difficulty understanding oral language.

Montali and Lewandowski (1996) investigated whether a bimodal presentation of text (visual and aural) using a computerized reader would improve reading comprehension and word recognition for a group of Grade 8 and 9 students with low reading skills. Using this technology, passages could be presented visually on screen, aurally through recorded voice, or both together. Two thirds of the group had their highest scores with a bimodal presentation. Results were variable as some students did better with visual only or auditory only presentations. Students also reported that they felt more successful with bimodal presentations (Montali & Lewandowski, 1996). Higgins and Raskind (1997) report also that the comprehension benefit of a computer-based reader is significant for students with more severe reading skill deficits.

A computer-based reader may improve reading comprehension for some students, but it appears to interfere with comprehension for less disabled readers. Elkind, Cohen, and Murray (1993) used a computer-based reader, Bookwise, for one semester with 15 middle school students with dyslexia. A second group of 13 students did not use the program. During the second semester, the groups switched. The majority of students demonstrated significantly improved reading comprehension when using Bookwise, although some had lower scores with the program, and for a few there was little effect (Elkind, et. al., 1993). In another study which is discussed below in the review of the literature, Schmitt and colleagues (2012) similarly found that a student with a severe reading disability had a significant benefit from a TTS reading pen, while those with less significant reading problems did not have improved performance (Schmitt, McCallum, Hennessey, Lovelace &
Hawkins, 2012). These variable results suggest that careful evaluation of the efficacy of assistive technology is needed for each student (Edyburn, 2007; Elkind, 1993).

Two examples of computer assisted instruction available to students who struggle with reading are digitized texts and TTS readers. Digitized texts are books which are read on the computer, and may have embedded help features such as reading comprehension activities. Many systems are available in digitized format and are widely used.

In one study, Grade 4 and 6 students were motivated and demonstrated better comprehension using The Thinking Reader, one example of a digitized text system (Strangman, 2003). In an earlier study, Farmer, Klein, and Bryson (1992) compared the comprehension of 14 middle and high school students. One group had stories read to them on the computer using a program called DECtalk. Others read paper versions of the short stories. There was no significant difference in student comprehension between the two groups. The students did not choose to have the difficult words read to them very often, and some students found it hard to understand the computer voice (Farmer, Klein & Bryson, 1992).

Text to Speech Research Findings

Unlike systems which read only specified texts, text to speech computer assisted software (TTS) allows the student to access any paper or digitized text, and opens access to on-line communication such as the internet and email. Computer-based TTS technology involves scanning print materials into the computer, which then uses optical character recognition (OCR) to recognize the scanned image as text. In the final step, the student selects a voice and speed for the computer to read the text aloud, usually into headphones. Some examples
are Kurzweil 3000™, TextHelp™, and Premier™. TTS has the potential to improve student access to print, to support the writing process by reading back to the student what they have read, and to increase independence by removing the need for an assistant to read materials to the student. Text may also be saved as an audio file and played back on a personal MP3 player (Edyburn, 2003).

Few researchers have specifically addressed whether digitized readers or TTS software makes a difference in reading performance, and the factors which impact student success (Edyburn, 2007; Stetter & Hughes 2010). Edyburn (2004a) posits that there are significant issues in measuring AT outcomes in reading and that many efforts to use AT for struggling readers occur in response to marketplace developments rather than in response to research. A review of research into computer-assisted instruction to address reading comprehension by Stetter and Hughes (2010) finds only 26 studies published in peer-reviewed journals up to 2009 examined reading comprehension by school-age struggling readers using computer-assisted instruction. Of these, most of the studies were prior to the year 2000, which limits their relevance due to the changes in assistive technology over the last 10 to 15 years. Seven studies after the year 2000 involved supported text, using specific reading materials with study guides or reading supports such as definitions or guiding questions. Some of these did improve reading comprehension, and could work for those specific textbooks which are available in digitized form (Stetter & Hughes, 2010). Two of the reviewed studies since 2000 examined the use by students with a reading disability of computerized TTS readers, and are discussed below (Higgins & Raskind, 2005; Manset-Williamson, Dunn, Hinshaw, & Nelson, 2008).
Educators using assistive technologies must first decide whether AT is important for a student’s success in the classroom, and what type might work best for the individual student. Researchers have previously analyzed the TTS computer-based reading software for reading support in the classroom. The studies selected for this review of the literature examine the use of computer assisted reading with a variety of materials over a period of time.

One example of a portable TTS reading device is the reading pen, a handheld apparatus which allows the user to scan words individually or a line at a time. The device uses optical character recognition (OCR) to process the image into text, which appears on a small screen. Synthesized speech is fed into earphones. Higgins and Raskind (2005) studied the effect of the Quicktionary Reading Pen II by Wizcom Industries on the reading comprehension of students aged 10 to 18 years with learning disabilities. Participants were 2 or more years below grade level in reading comprehension. Students had significant improvements in reading comprehension when using the pen (Higgins & Raskind, 2005). Students were trained on the reading pen and given two weeks to practice decoding single words and using the dictionary and syllabication functions. They were tested twice using the Formal Reading Inventory test of reading comprehension in random order, with and without the pen, on successive days. Each test was administered using randomly assigned different forms. Each selection increased approximately one grade level in difficulty, and had five multiple choice comprehension questions. Students began at an easy level and advanced until they answered 3 of the 5 questions incorrectly. They demonstrated significant increases in correct responses to reading comprehension questions, scoring on average 7 points higher, or more than a grade level higher when using the pen).
According to Higgins and Raskind (2005) students read the easier passages more accurately and also were able to read more difficult passages while maintaining good comprehension. The printed format allowed them to refer back to the paragraph or questions as they wished. There was no significant reduction in comprehension for less disabled readers. Students were enthusiastic about the use of the reading pen. They accessed it to read individual words as needed, rather than lines of text, and were easily able to use the pen independently. However, the text reader did not raise access to text at a level comparable with their grade level. This study does not report on the physical challenge associated with holding the pen.

Schmitt and colleagues (2012) investigated the use of the Readingpen Advanced Edition (2006) by Wizcom Industries. This pen worked similarly to the Quickionary Pen. It was swept across the page before words or sections, and the scanned content appeared on an LCD screen. Pronunciation, syllabication, and definition features were also available. Participants were first trained on how to use the reading pen. Three university students with reading disabilities were presented with passages at college level difficulty followed by multiple choice questions which assessed factual and inferential comprehension. Conditions included a no-accommodation control when they read without the pen; a decoding accommodation when the pen was used without additional features; and a decoding and vocabulary accommodation. Unlimited time was available to complete the questions, but participants were not permitted to revisit the reading passage. An alternating treatment design was used to compare the effects of all three conditions.

Results indicated that all three participants had improved comprehension when using the reading pen. For two of them with less severe reading disabilities, it was a relatively
insignificant effect, although they reported that they enjoyed the use of the pen and would use it again. The third student, who had a severe reading disability, had significantly better comprehension when using the pen with decoding alone or with decoding and vocabulary features. However, she indicated that she only somewhat enjoyed using it, and therefore might use it again. The authors noted that one factor which could have affected comprehension was the students’ inability to access or reread passages. As well, the time cost to users was a potentially significant issue for the university students, as reading with the pen was slower for all three participants than without it (Schmitt et al., 2012).

These two studies suggest that a reading pen TTS reader may be helpful to some students with a severe reading disability in two ways: by maintaining or improving reading comprehension over reading without the text reader; and by increasing access to grade-appropriate text or text at a higher level than the student could read on their own.

Schmitt and colleagues investigated the effect on reading performance of a computer-based TTS software system with OCR and voice synthesis (Schmitt, Hale, McCallum, & Mauck, 2011). They used the Kurzweil 3000 TTS system to compare the effect of silent reading (SR) to listening while reading (LWR) on factual and inferential comprehension with grade level text. Participants were 25 grade 6, 7 and 8 students in a general education setting. All were in a remedial reading program and had been assessed by the teacher as having reading skills at least two grade levels below expectations. None were identified as special education students. Reading selections were graded for readability and at students’ grade level, not their reading level. Students read only in LWR or SR condition on each of two days, with order balanced among participants. Participants completed three grade level passages and accompanying questions per session.
In the LWR condition, passages were loaded onto the computer before students began reading. Text to speech software was activated and the font size was set to approximately 12 point so that the entire passage was visible without scrolling. Individual words were highlighted when read. Students listened to the synthesized speech through headphones. Every passage was read at default rate of 125 words per minute. In the silent reading condition, the passage was loaded into the computer using the text to speech software and displayed at a comfortable size so that scrolling was not required, but the visual and auditory features of the software were not activated.

In both conditions, when reading was finished, the passage was removed from the screen and multiple choice comprehension questions were provided to students on paper, consisting of 5 factual and 5 inferential questions. Results did not indicate a difference in comprehension between Silent Reading and Listening While Reading conditions. The authors noted that previous LWR studies involved participants with identified learning disabilities in private day schools and used passages near participants’ reading levels. This study instead used grade level materials with students not identified with a learning disability. The authors wished to discover whether struggling readers would benefit from TTS technology in a general education classroom. They noted that allowing students to revisit the reading selection might also have made a difference in comprehension scores. The authors concluded that eliminating barriers to decoding words is not enough for successful reading comprehension (Schmitt et al., 2011).

Manset-Williamson and colleagues (2008) attempted to add a self-questioning strategy to use of a TTS reader in order to improve reading comprehension. Six students in
grades 5 to 8 participated in a summer reading clinic four times a week for six weeks. All had reading disabilities and an average instructional reading level of grade 2.

Manset-Williamson et al. suggest that materials at the students’ reading level are not complex enough to use to teach higher level comprehension skills to students with reading disabilities. They examined whether students could understand text at or above their grade level if it was read to them by TTS software, and whether the use of a self-questioning strategy would improve their comprehension.

Participants mastered the software before the study began. Words were highlighted as read, and students could customize the words per minute speed from the setting of 150 words per minute (wpm). Students received one on one tutoring four days a week for six weeks, focusing on phonemic awareness, decoding and comprehension instruction. The students were also taught a self-questioning strategy and then read paragraphs with the Kurzweil 3000 text reader. The passages were at a grade 7 level, and were presented in random order. In the baseline phase, the students were able to complete less than 50% of the questions correctly. On average, students scored significantly higher on the multiple choice questions during the training and assessment phases of the self-questioning strategy.

Manset-Williamson et al. (2008) conclude that text reader software improves access to text, but may not be enough to establish comprehension. The authors note also that the TTS allows teachers to customize assistance to meet the interests and needs of struggling readers. Any print can be scanned into the system, and questions can be embedded into the material as needed. Therefore, student engagement can be improved, and consequently attention to the computer-read text (Manset-Williamson et al., 2008).
Some TTS software is open source and free to the public. Izzo, Yurick, and McArrell (2009) find improved reading comprehension by high school students with disabilities is possible using open source free TTS software called CLiCk, Speak in a special education classroom. The seven participants were enrolled in an on-line transition program emphasizing information literacy. All had significant disabilities of various types, including autism, traumatic brain injury, cognitive disability, emotional disability, and learning disability. All had significant delays in reading. The CLiCk, Speak software has other features such as screen magnification, but only the TTS capacity was used in the study. A reversal design was used, and students were told for each unit whether they would be using CLiCk, Speak or reading without it. Results indicated improved scores for 5 of the 7 participants. CLiCk, Speak may have benefits for some students, but the small number of students, variable nature of their disabilities, and specialized classroom environment suggest limitations in generalizing these results (Izzo, Yurick & McArrell, 2009).

From 2004 to 2007, the state of Iowa Department of Education and a team of researchers engaged in a three year, state-wide study of TTS software use with struggling readers. Dimmitt, Hodapp, Judas, Munn, and Rachow investigated the use of Kurzweil 3000 TTS reader as an accommodation to increase students’ access to core content curriculum through improved fluency and comprehension. Students had a mild or moderate disability, and had scores in the non-proficient range on reading subtests of the Iowa Test of Basic Skills, and IEP goals in the areas of reading comprehension, reading fluency, or vocabulary. Students used Kurzweil to access reading in content curricula such as social studies, science, and language arts or other subjects. Students were able to access almost twice the amount of text with Kurzweil than without it, and improved comprehension scores on reading passages.
which increased in difficulty. Scores on The Iowa Test of Basic Skills (ITBS) increased for reading comprehension, vocabulary, science, and social studies. Students and teachers liked using the Kurzweil 3000 software, and felt it improved student reading, independence, and time on task. Teachers expressed concern about the time commitment to scan and edit the text and to solve technical problems (Dimmitt et al., 2007).

Summary of Relevant Studies

The studies summarized (e.g., Dimmitt et al., 2007, Izzo et al., 2009) indicate that computer-based text readers can assist students with reading disabilities to access school materials at a higher level than without assistive technology. The results also show that TTS readers can open the door to any text, whether it is paper-based or digital. There are, however, mixed results. Careful assessment of the appropriateness and type of TTS reader is important as it may interfere with comprehension and speed of reading for some students (Schmitt et al., 2011). Investigation of the use of text readers in public school settings is still an underexplored area of study and needs further examination, as do the necessary conditions to result in the successful use of the TTS reader. Early access to TTS reader technology may prevent a widening gap in language development between skilled and struggling readers (Edyburn, 2007).

Skilled teachers in the use of TTS readers can make a significant difference to student success (Dimmitt et al., 2007). However, keeping up with new developments in assistive technology is a challenge for busy teachers (Edyburn, 2004b). Should time in class focus on learning to read, or should it focus on using reading-enabling software in order to learn? While many K-3 students focus their time in school on learning to read, when students enter the junior division (grades 4-6) they begin to need to use their reading skills in order to learn
about science, social studies, and mathematics. The question becomes whether to focus the
time in the junior division on remedial reading, to compensate for a student’s inability to read
through an assistive device, or divide time between remediation and compensation. The next
section of this review of the literature presents a theoretical framework that conceptualizes
this dilemma for teachers.

Theoretical Framework: Remediation vs. Compensation

Dyck and Pemberton (2002) posit a theoretical framework that teachers can consider when
examining student reading needs, describing a hierarchy for reading support, such as
providing easier texts, adding guiding questions, adding information, and decreasing the
amount of reading. When the understanding of the text is the goal, rather than the
development of reading skills, they suggest that consideration be given to bypassing reading
by offering the information in another way, such as listening to the text on CD, or a teacher
reading to the class (Dyck & Pemberton, 2002). Edyburn (2003, 2007) expands this model
to include AT (see Table 2.1). Edyburn notes that many factors may contribute to a reading
problem. The type of compensatory and remedial interventions chosen depends on the
analysis of the problem (Edyburn, 2003). According to Edyburn, students face a widening
achievement gap when they struggle for years with reading and the schools continue
unsuccessfully to try to remediate the problem (Edyburn, 2007). He suggests that denying
assistive technology to students with demonstrated impairment in the perceptual skills which
lead to reading competence is similar to forbidding assistive technology to a child who has
lost an arm in a farming accident. Edyburn describes a form of bias called “naked
independence” when academic work is valued more highly if done without assistive devices
(Edyburn, 2007).
The dilemma for teachers of whether to focus on remediation or compensation is not restricted to teachers of reading. The debate has continued for years regarding the use of the calculator, for example (Brunette, 1999). Schools must decide if a student will benefit from continued instruction in reading remediation, or should transition to the use of assistive technology to access curriculum content compensation.

Edyburn (2009) recommends a discussion about the explicit role of assistive technology during the development of the student’s IEP, and consideration of what proportion of the student’s time should be spent on remediation (such as extra instructional time or different teaching approaches) versus compensation, (using a calculator or a text reader program) (Edyburn, 2009). For example, a reading plan could assign 30% of instructional time to intensive reading remediation, and 70% to compensatory measures such as assistive technology (Edyburn, 2003). At some point, the IEP may call for the use of a text reader and computer to assist the student to process all text, allowing him or her to focus on the content of the subject instead of the challenge of reading (Edyburn 2006, 2007). Without technology tools struggling students may drop out of school unable to read, but also without the compensatory skills which might assist them to cope with reading difficulties for the rest of their life (Edyburn, 2003).
Table 2.1

Assistive Technology Interventions for Different Kinds of Text Adaptations

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Goal</th>
<th>Description</th>
<th>Low Tech Examples</th>
<th>Assistive Technology Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass Reading</td>
<td>Understand the text</td>
<td>The student avoids reading the text</td>
<td>Listen to book on tape or CD; Book read by teacher or other person</td>
<td>Digital book formats on computer; Computer text-to-speech scan and read technology reads print to the student and/or creates MP3 audio file; Text to speech web browsers for on-line reading</td>
</tr>
<tr>
<td>Decrease Reading</td>
<td>Read similar content at an easier reading level</td>
<td>The teacher provides easier materials to read</td>
<td>Other books; Different web pages</td>
<td>Executive summary of digital information through auto-summary software; digital texts enhanced with rebus (picture) symbols</td>
</tr>
<tr>
<td>Support Reading</td>
<td>Read and understand the text</td>
<td>Additional materials are provided to assist in understanding the text</td>
<td>The teacher provides pictures or vocabulary aids</td>
<td>On-line dictionaries and pictures</td>
</tr>
<tr>
<td>Organize Reading</td>
<td>Read and understand the text</td>
<td>Additional materials are provided to assist in understanding the text</td>
<td>Graphic organizers are provided to make relationships between ideas clear</td>
<td>Kidspiration and Inspiration are examples of software which students and teachers can use to create concept maps and other graphic organizers.</td>
</tr>
<tr>
<td>Guide Reading</td>
<td>Understand the text</td>
<td>Support guides assist with difficult text through notes and study skills training</td>
<td>Publications such as Cliffs Notes</td>
<td>Websites are available which provide assistance through character and plot analysis and chapter summaries.</td>
</tr>
</tbody>
</table>

(Adapted from Dyck and Pemberton, 2002, and Edyburn, 2003, 2007)
It is a significant challenge for educators to remain current in their knowledge of special education technology due to the rapid pace of change in commercial products available and the large amount of research published recently; as a new field of study, there is not an agreed upon set of common understandings (Edyburn, 2004b). As technology becomes less expensive and less complicated, many teachers are going to be faced with decisions regarding remediation (focus on teaching the student to read or calculate the mathematics) or compensation.

This theoretical framework, A Model for Remediation vs. Compensation in Reading (White, 2013) (See Table 2.2.) includes consideration of Dyck and Pemberton’s (2002) theory and research by Edyburn (2007), and incorporates assistive technology. Dyck and Pemberton (2002) suggest that reading be bypassed if necessary for the student to be able to learn, and they give the example of a teacher reading to the student. Edyburn (2004, 2007) advocates for the provision of assistive technology to students.

This theoretical framework is influenced by the Ontario Language Curriculum (2006) focus of learning to read K-3 and reading to learn in grades 4 to 6 and beyond. The model suggests that reading be the focus for instruction through the primary years (K-3), with technology made available to all students when relevant to curriculum goals. During kindergarten to grade 3 remediation is suggested as the priority for struggling readers. Compensation for reading problems could include listening to books on CD, buddy reading with a partner, and adult assistance. During the junior years, persistent and severe reading difficulties may require that reading be bypassed through compensatory assistive technology to avoid or reduce an achievement gap in content area subjects, or in vocabulary because of limited access to grade level text (Allen, 2002, Allington, 2006). Development of skill in the
use of assistive technology may become a priority. Intensive, evidence-based remediation may continue to be provided. As Edyburn suggests, the IEP team will consider how to divide the instructional time (Edyburn, 2003, 2007). During the intermediate and senior years (grade 7 and up), reading is primarily a tool for acquiring information and developing higher level thinking skills. Compensation through assistive technology becomes the main mode of reading for students with severe and persistent reading difficulties. Remediation may address the acquisition of complex skills in the use of AT to promote independence. AT will also impact other areas of literacy, such as writing.
Table 2.2

*A Model for Remediation vs. Compensation in Reading*

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Reading Instruction</th>
<th>Remediation vs. Compensation</th>
<th>Assistive Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary (Kindergarten to 3)</td>
<td>Curriculum emphasizes learning to read (alphabetic principle, phonemic awareness, vocabulary, comprehension. Sophistication of expectations rises with grade level. Reading to learn information begins.</td>
<td>Remediation is a priority for struggling readers. Compensation may involve reading along with books on CD or computer, buddy reading, or adult assistance.</td>
<td>Technology is available in the classroom to all students as relevant to the curriculum goals.</td>
</tr>
<tr>
<td>Junior (Grade 4 to 6)</td>
<td>Instruction in more complex forms of reading (vocabulary, comprehension) continues. Reading for information is increasing.</td>
<td>Compensation becomes a priority to avoid an achievement gap in content subjects such as social studies and science. Remediation may continue to be provided.</td>
<td>Assistive technology may be considered to bypass reading for content subjects. Development of skill in the use of assistive technology may become a priority.</td>
</tr>
<tr>
<td>Intermediate (Grade 7 to 9) and Senior (Grade 10 and above)</td>
<td>Reading is primarily a tool for acquiring information and developing higher level thinking skills.</td>
<td>Compensation for significant reading deficits is important. Remediation may focus on improvement of assistive technology skills to develop independence.</td>
<td>Assistive technology is a priority to compensate for significant reading deficits and promote independent learning.</td>
</tr>
</tbody>
</table>

(White, 2013)
Literature Review Summary

When the literature regarding TTS reading studies has been examined, the findings indicate that:

1. Computer-based text readers assist some students to access school materials at a higher reading level;

2. Access to ICT is important for students; only TTS readers with OCR allow students to access all print and on-line text, not just program materials;

3. Effective use of TTS readers is often not achieved by students;

4. Studies of the use of TTS readers in public school settings is rare and needs further examination;

5. Little exploration has occurred of conditions which will facilitate acquisition of TTS skills;

6. Teacher skill level in the use of TTS can make a difference in the acquisition of TTS skills by students.

In addition to these findings from earlier studies, Edyburn (2007) suggests that deeper theoretical considerations are at play. Specifically, IEP teams need to consider whether the need for remediation can or should be balanced with the need for compensating strategies. More can be learned regarding how teachers approach the use of assistive technologies to support reading. The research outlined in the next section explores how teachers describe how students learn and benefit from the use of a TTS computer-based program, Kurzweil.
3000, within the context of a six-week placement in an intensive assessment and remediation setting. Additionally, the study documents the voices of the teachers as they explain how they explore teaching methods to support the TTS system.

Based on this review of the literature, the following three research questions emerge:

1. What is the impact of a six week program of intensive training in the use of a text reader on students with a reading disability?

2. What are the effects on reading fluency, reading comprehension, and attitudes towards reading?

3. What strategies used by the teachers result in better outcomes for the students?

The methodology section which follows outlines the investigation to determine responses to these questions.
Chapter 3
Methodology

This study takes place in a medium-sized school board comprised of urban and rural areas in southern Ontario. The mainly urban population of over 50,000 students is clustered in several communities. This study focuses on a specialized, intensive six-week special education withdrawal program for elementary students offered in four locations across the school board. Candidates for the program are referred for assistance with a variety of learning difficulties not attributable to their cognitive level. Each class has two teachers, a half-time Educational Assistant, and typically, there are six students but occasionally one or two more.

 Students are selected from area schools through the referral process mentioned above. Cohorts have common elements of difficulty, such as reading, writing, spelling, and/or mathematics. Often students have additional difficulties such as task completion, self-confidence, or social problems, and may have one or more diagnoses such as Attention Deficit Hyperactivity Disorder (ADHD) or a specific Learning Disability (LD).

 Assistive technology (AT) is a significant part of the program. The technology is available in the classroom and some students also come equipped with a prescribed computer and assistive software such as Kurzweil or Premier (both TTS), used for reading difficulties) or Dragon Naturally Speaking (voice to text, used for writing difficulties). The program is designed to address the individual and common difficulties of each group of students. Objectives for each student are set by the sending school and the student, in consultation with the student’s program teacher, and might include goals such as: improvement in reading,
writing, spelling, and mathematics skills; development of time management and task completion skills; enhancement of self-confidence; development of coping strategies for learning difficulties, study skills; and improved computer and assistive software skills. Usually three main areas of focus are identified for the six weeks of remediation in the withdrawal setting.

At the time of the study, January to March 2010, the researcher held the position of team leader to the teachers who work in this program. This position was a role of coordination, collegiality and shared responsibility for the program. Supervision of staff involved in the program was done by the principals of the schools where the program was located.

The participants in this study are two teachers who teach in this withdrawal program. To avoid bias and maintain authentic responses, each teacher was provided questions in advance to consider, and they made independent notes and observations throughout the week. These notes were shared at a weekly recorded interview of the teachers which also provided opportunities for the teachers to reflect spontaneously on their experiences through the week.

The focus of the interview discussions was the progress of five students who all had reading difficulties addressed in their IEP’s. All students had received significant previous intervention for their reading problems but were continuing to struggle. They were referred to the program to improve their reading skills and to examine whether the use of a TTS reader and other assistive software would be beneficial for them. Their teachers observed
their use of software and computers in the program and made recommendations to the sending schools regarding prescriptions.

Two students already had prescribed computers, but were not yet using them successfully. All had some previous introductory experience with text reader software such as Kurzweil or Premier, but none had established a level of skillful or independent use. During the last week of the program teachers from each student’s sending school came for a half day visit to observe techniques and strategies which were effective for the student and to discuss the use of the techniques in a regular classroom. One student was not included in the study due to extensive absence.

This study uses a phenomenological approach. Lichtman (2012) explains that, “Phenomenology, as an approach, looks at the lived experiences of those who have lived with or experienced a particular phenomenon” (p. 85). Because the study of the two teachers working with one cohort over a six-week period is very detailed, a case study approach was chosen in order to provide an in-depth examination (Lichtman, 2012). This case study describes two teachers over a six-week program as they strive to develop reading skills among six students. The teachers explored teaching strategies to build student skill in the use of TTS computer-based software using both Kurzweil 3000 and Premier. The researcher visited the classroom a total of 8 visits – one visit pre and post, and six visits during the study itself. Data collected include verbatim transcripts of seven interviews of the two program teachers held over a seven-week period, observations and reflections written over each week by each teacher, two direct observations and field notes, and measurements of pre-and post-program reading skills using the Developmental Reading Assessment (DRA).
The researcher met with the teachers together to record the interviews. Verbatim transcription of each interview was completed and the researcher met with the teachers to verify validity (Creswell, 2008). Also included in the qualitative data set were the written reflections of the program teachers; student artifacts; and observations of some activities in the program.

The data analysis follows a method described by Creswell (2008). Data were gathered and analyzed. The material was read for overall content, and then detailed coding and analysis for themes occurred (Creswell, 2008). Broader links between themes emerged through the interpretation process. The four themes that emerged strongly were: Student Progress; Teachers’ Strategies; Technology Issues and Successes; and Student Attitudes towards Reading with and without Kurzweil. A case study, narrative description of the findings was prepared which provides a week-by-week description of the researcher’s summary of the events in the classroom, based on the teachers’ voices.

Another component of the study uses quantitative measurement of pre- and post-program reading skills using the Developmental Reading Assessment™ 4-8 Bridge Pack (2004) from Pearson Education Inc. The Bridge Pack version of the DRA is designed for use with students in the junior grades who are not reading at grade level. An additional assessment was performed during week 2 using the Developmental Reading Assessment™ (2004), which is designed for use with students who are reading at grade level. Both DRA kits were chosen because the school board requires that all students be assessed at least twice a year using the DRA, and this could be used more often for struggling readers. This testing tool was familiar to the teachers and the schools, and the assessment would replace the spring assessment which would be done at the home school.
The DRA assessment uses leveled books and includes measures of text level, reading engagement (student attitudes and interests towards reading), oral reading fluency, and reading comprehension skills and strategies. An overall score is obtained by combining the text level, reading engagement score, oral reading fluency score, and comprehension score. The level of text chosen for the first assessment was based on the previous DRA assessment completed with each student some months before at the sending schools. Teachers also recorded a “running record” of their observations during an oral reading selection, which indicates the type of errors the student is making, in order to adjust instruction. Teachers are able to decide if the students need to have their answers written (scribed) by the teacher to prevent writing difficulties from obscuring comprehension results.

All the students received scribing during the assessment in week 1. Some students used Kurzweil 3000 to record their answers in the week 6 assessment. In week 1, students read the story in booklet form first, followed two days later by a rereading using Kurzweil 3000. Their level was chosen based on information from their school about their previous DRA assessment level. As there are only four books available at each grade level, the DRA guidelines require that the same book be used for struggling readers until the student achieves a satisfactory overall score. During week 6, the students were assessed using the level of book suggested by their performance on the first week assessment and observed changes over the six weeks.

An additional assessment was completed in week 2. This time the book was chosen to reflect the student’s actual grade placement of either Grade 4 or 5. As the book was too difficult for the students to read on their own, they all read it using Kurzweil. For all assessments done using Kurzweil, an oral reading score out of 4 was assigned, based on the
teacher’s assessment of the student’s confidence and independence using Kurzweil. This number replaced the oral reading component of the assessment. The resulting overall score was prorated to obtain a total score for the assessment. This method was consistent with school board practice. The words-per-minute rate chosen by the students was recorded but not calculated as part of their overall reading score. Each assessment was administered in a quiet room with one teacher and one student.

At the next stage, the quantitative data were included within the case study narrative in order to elaborate on the qualitative findings, but also to build internal validity. Finally, these data were examined relative to the theoretical framework which has been proposed by Dyck and Pemberton (2002) (who suggest that teachers need to consider whether to spend student time on remediation or compensation), and Edyburn (2006, 2007) (who adds assistive technology to the compensation model in order to consider further recommendations.

The findings of this study relative to the theoretical framework suggest some ways forward. This consideration of the findings and theory is located in the discussion section and in the recommendations section of this study. The research is a close investigation of one program. Although it can’t be generalized to other situations, it may provide ideas for educators trying to address similar problems.
Chapter 4
Findings Final Week by Week and Summary

Week 1
This case study describes a six-week withdrawal program which addresses individual goals for a small group of junior-age students in a class with two teachers. These students had been selected by the teachers to be part of this program group because they had all been referred both to improve their reading and to explore assistive technology options to compensate for their reading problems. The teachers met with each student in their home school the week before the program began to discuss their personal goals. All of the students were hoping to improve their reading. The teachers described the excitement of the children as they entered the room on the first day. They had visited the program for an hour with their parents and teacher the previous week, and enjoyed playing with the games and learning materials that were set out. One student, M, was cautious for the first day, but soon began smiling and participating. All had received significant previous intervention in their home school. They needed to be convinced that they could improve, but they were hopeful that this could be the start of something new.

Student overview
This group of 5 grade 4 and 5 students had a common difficulty: a learning disability in reading. Other learning characteristics varied. One student had attention, articulation, and behaviour problems (A), one had language and articulation issues (G), and two had a personal computer and software but weren’t using them successfully (Z and M). T lacked confidence in her ability to learn. M had the most severe reading delay in the group but
excellent oral language and comprehension, while Z had adequate silent and oral reading but was below grade level in comprehension and writing skills. Three had received some training with Kurzweil 3000 text reader through a brief screening period, and two had participated in a one-day training session on assistive technology after they received their computers. One of these two students had been trained on Kurzweil, and the other had been trained on a different text reader, Premier. They were a friendly group who quickly settled into the program.

**Teaching assessment and strategies**

During the first week each student met with their teacher to set individual goals for the six weeks of the program. These were reviewed at the start of each week and revised according to the student’s progress. Teachers began by assessing student skills and interests through discussion and observation. A formal DRA assessment was also completed with each student.

Each day the teachers emailed a morning message to the students which required that they complete a task. At the beginning of the week, Kurzweil 3000 text reader was introduced to assist them with reading and responding to their mail, a highly motivating activity. They were encouraged to follow along with the highlighted sentences as the computer read them aloud. All technology training followed the model “I do, we do, you do”. Using a computer and data projector or interactive white board, the teachers modeled the technology, then the students and teachers applied it together, and finally, each student tried it independently on their own at a computer.
Each student was encouraged to choose a “just right” book for independent reading with or without Kurzweil. To widen the options, the teachers explored sources for interesting books that were already scanned into digital form. Lessons on topics related to social studies or science curriculum addressed reading and writing and content goals. A daily routine was established for the students to preview this simplified group reading material on Kurzweil before reading it together as a group. This repeated reading strategy was quite helpful for the students. Some needed 1 or 2 extra repetitions before they could be successful. Students were also taught to use Kurzweil study skills features such as highlighting key points and exporting the highlights to create dot jot notes.

The Developmental Reading Assessment™ 4-8 Bridge Pack (2004) was administered twice over the week. This DRA kit is designed to be used with students who are reading below their level. It has added prompts to assist students with comprehension, such as “In the beginning” and “Next” (see Table 4.1). On Tuesday, the students read the short story selected for them in booklet form. On Thursday, they reread the same book using Kurzweil (see Tables 4.1 and 4.2).

Every student had a higher fluency rate (word per minute) when reading with Kurzweil than with paper booklets (see Figure 4.1). All students moved up in comprehension when reading with Kurzweil (see Figure 4.2). Two students (A, G) accessed the text at approximately twice the speed with Kurzweil while maintaining or increasing comprehension scores. Another student (M) accessed the text using Kurzweil at over 5 times the rate that she read the paper text, while improving her comprehension score. Z and T also improved both fluency and comprehension scores. All students improved their overall...
scores. Four out of the five students improved their DRA Stage of Reading Achievement and equivalent grade level score (see Tables 4.3 and 4.4).

Technology issues and successes

Many significant technology issues arose during the first week of the program. The school was newly-opened and at the start of the program the wireless network was not yet set up, although hard-wired connections were available. This limited access to on-line audio book sources, but also prevented the computers, printers, data projectors, and interactive white boards from communicating with each other. Short-term solutions included the use of memory sticks for sharing, and the direct connection of one computer with all peripheral equipment. This computer was designated the “teacher computer”, and all students brought their work to a teacher for printing, logging on to email, and so on. Scheduling of technology support from the school board involved long waits. A plea for urgent assistance did obtain support to address some of the issues with individual student computers, as some of these had technical problems. For example, one student’s computer was flashing error messages for all its programs. That student used the teacher computer for the first two weeks of the program.

Another significant problem involved accessing interesting scanned books to use with Kurzweil. Individual books could be scanned one page at a time by the teachers, but this was very time-consuming and a last resort. A provincial resource library of scanned books funded by the Ministry of Education was a source for text books and approved course materials, but did not have popular fiction books for younger readers. Scanning of books could be requested, but required that the book be purchased and mailed to the service, followed by a wait of two weeks or more to receive it. It was decided to do this for some
books for future groups, and that the teachers would scan books for each student as required. This was time-consuming but did provide access to grade-level books for two students who wanted to read books that their friends were reading. There were some successes as well. One student began to recall what she had learned in some previous training, and was able to tell the others how to use two features of Kurzweil, text notes and sticky notes, which allow the student or teacher to add a comment to the text.

**Student attitudes about reading with and without Kurzweil**

Initially all the students were very interested to learn how to use Kurzweil. It was also used as part of the initial reading assessment. Once they were using it, reactions were mixed. Z, a grade 5 student, said, “I find it really helpful… I think it could be used by many children to help them… this is exactly like in the classroom.” He also learned quickly how to use Kurzweil voice notes to record his lengthy answers to the questions in the reading assessment, and liked how they saved him time. Another student, A, commented, “I like when the computer reads to me ‘cause I like when people read to me.” M remarked that using Kurzweil was less tiring for her. Two others disliked the monotone voice of Kurzweil, and one student still wanted to read grade level books well beyond his reading level by himself. He was not convinced that Kurzweil would be helpful to him.

**Week 2**

During week 2 of the program the momentum began to build as the students began to tackle their learning goals. Teachers commented that the students had fun all week while they were learning new strategies. At the end of the week the teachers described how surprised the
students were that the end of the day had arrived. They were busy and focused all day, and were starting to feel some success.

**Student progress**

The Teachers added new reading materials to the room in response to their survey of student interests in week 1. Each student tried the first chapter using Kurzweil to verify that s/he would enjoy the book. Teachers then planned to scan the book chosen, a major time commitment but crucial to maintaining student motivation. Reading goals varied widely. One student, Z, was learning how to identify the key ideas in any piece of text, as he tended to recall many details and share them indiscriminately. He understood a grade-level fiction book read with Kurzweil, and easily explained some complex vocabulary. Another student, A, was showing an aptitude for technology. G was using the computer successfully but only when assigned, and reading a book in paper form independently at his level. M, who was initially reluctant to read to a kindergarten buddy, rehearsed repeatedly with Kurzweil and at home and was proud of her success. At the end of week 2, the teachers commented that all the students were able to comprehend grade-level text when they read with Kurzweil, although the complexity of interpretation shown was greater for some than for others.

The students were all demonstrating much better comprehension in their day-to-day work when reading with Kurzweil. The teachers asked if they could do another DRA assessment using the first book from the Developmental Reading Assessment™ Grades 4-8 Canadian Edition (2004) at each student’s grade placement level. This kit is designed to be used with students who are reading at grade level (See Table 4.5). Unlike the DRA Bridge Pack 4-8, it does not have additional prompts to assist comprehension. As the students could not read it on their own, they were assessed only using Kurzweil. Both Grade 4 students, A
and Z, achieved a score of grade 3 (Extending) on a grade 4 booklet. All three Grade 5 students, M, T, and G, received a score of Grade 4 (Intermediate) on their grade 5 booklet. These grade levels represented a higher level of reading material than they could read on their own. The teachers also felt that the students were able to comprehend daily work at their grade level with some support, such as discussion of key concepts.

Fluency for all students was the word-per-minute rate they chose for the Kurzweil presentation. Two students chose 120 wpm and three chose 125 wpm. Four of the students had lower comprehension scores than they did with the easier test booklets used in week 1. One student had a higher comprehension score than week 1. His teacher reported that this student was inattentive during the week 1 assessment with Kurzweil, but was quite interested in this story and more comfortable with the software than he had been the week before. See Figure 4.5 for a comparison of comprehension scores across weeks 1, 2, and 6 using Kurzweil to read the DRA text.

The teachers were encouraged by the results of this assessment using DRA texts at the students’ grade placement level. The books represented a large jump in text complexity from those used for the first assessment, which were chosen based on their reading levels without Kurzweil on previous DRA assessments at the school. Their teachers believed that the students would have had higher comprehension scores if they had received some prompts similar to those in the DRA Bridge Kit, such as cues to talk about the beginning, middle, and end of the story when summarizing it. They were also concerned that the students could not access the pictures when only a Kurzweil version of the book was presented. The Kurzweil skipped over pictures and read only the words, unless technical adjustments were made page by page. The pictures provided cues regarding the content of the story. The teachers felt that
the students might be able to succeed with work closer to their grade level when discussion occurred in the classroom such as information about the context of the story. They decided to introduce some reading materials in daily work which would be at a higher reading level. They would observe the students’ success when using Kurzweil.

Teaching strategies

Strategies to develop deeper comprehension were introduced over the next two weeks. The focus this week was on visual strategies. Examples included “VIPs”, which involved highlighting “Very Important Points”, and drawing “quick pics”, where students did a quick sketch of simple picture symbols to represent key ideas. Teachers continued to work on remediation of reading through a variety of strategies. Throughout the week, the teachers found the students were often initially nervous about learning new skills, but usually gained confidence through support from the teacher. As the students mastered the skill, the teachers gradually stepped back.

All the students were slow at typing, an important skill when using many kinds of assistive technology. Interesting, free on-line typing programs such as Dance Mat (http://www.bbc.co.uk/schools/typing) were motivating and enjoyable for the students, who were assigned nightly typing homework once the websites were introduced.

Teachers also addressed writing, another area of concern. Students learned how to use word prediction in Kurzweil for writing. As they typed, the software opened a list of possible words which started with the letters entered. Typing could be sped up if the student found the word in this list and selected it. They also introduced Dragon Naturally Speaking, which produces text through voice recognition as the student talks.
Technology issues and successes

During week 2 many of the school technical issues began to be resolved. The wireless network was functioning, and all but one of the computers was able to log on to it. Unfortunately, when that computer was repaired, the student’s individual files were lost. The teachers discussed strategies to preserve data when computers are serviced. They tried to do some of the problem solving as technical staff had limited time to share across many schools. Gradually, they were learning the set-up requirements for many items of equipment through great persistence.

The teachers continued to find some challenges with Kurzweil. They found that scanned books often opened at great magnification of 300-500%, which meant that the whole width of the page wasn’t visible. Another problem was that Kurzweil skipped over all the pictures, and read print at the top and bottom of the page, such as page numbers and chapter titles. They found that “zone editing” could address these problems, but was very time consuming. To save time, they made the paper version of the book available and suggested to students that they look at the pictures before advancing a page. However, many of the students forgot to do that. Teachers anticipated that for future groups, professionally scanned books from the provincial agency would already have these problems addressed. They expressed hope that school libraries would expand their collection of scanned books, so that students could check out a book as spontaneously as other students do. The students were experiencing success with the software. One student was delighted to learn how to copy and paste her email into Kurzweil to read it and compose an answer.
Student attitudes about reading with and without Kurzweil

During week 2 the students had more experience with Kurzweil and began to build some skills through practice. All of them liked that it read to them, but when writing, they experienced some frustration when the word prediction feature couldn’t find the word they were trying to write. T liked using Kurzweil because it told her the words she had written and she could fix her work right away. The students also liked that they could change the voices and speed and enjoyed using the highlighting tool for note-taking. Z liked adding sticky notes for responses anywhere he wanted. However, he wished the voice note was longer than two minutes. Most found it easier to follow along in the text because the words are highlighted as they are read. Z preferred a cursor, which is not available in Kurzweil. T commented that Kurzweil sounded like a robot due to its lack of expression. They wished they could talk to it and it would write it down, like Dragon Naturally Speaking. The students requested more information about the specialized tool bars in Kurzweil, and the symbols. The teachers planned to provide that information in week 3.

Week 3

Student progress

By the end of week 3, the teachers noticed increasing confidence among the students in many areas, and enthusiastic participation in most activities. Teachers had established a routine of daily reading for each student on Kurzweil. Other organizational strategies were also becoming routine, such as daily use of a homework book and nightly reading with family. Those students who did not complete homework or were off-task during the day responded well to a discussion about their individual goals, and caught up over the week. This represented a change as several of the students were described by their home schools as
disorganized and reluctant to participate. Independence in the use of Kurzweil and the computer was developing in several students. Z was enjoying his grade level book on Kurzweil and becoming more succinct in his summary of main points from each chapter. G was proud that he finished his first book mid-week, and chose his next book from the same series. He was a competent user of Kurzweil for other activities, but preferred not to use the computer for independent reading. T was enjoying a book on Kurzweil downloaded from the provincial resource library, and reading along with a grade level audio book at home. Audio books were not as successful for M, the slowest reader, as she could not keep up when following along unless the book was at a lower level than her comprehension. Kurzweil remained her most successful reading strategy.

**Teaching strategies**

Teachers introduced new skills each week, while continuing to practice the previously-taught skills to mastery. The focus in the third week was tactile kinesthetic skills. By trying many ways of practicing and learning, each student found out which ones work best for them. Z’s teacher taught him how to scan into Kurzweil and he began helping with daily scanning of his book. Some students spent time doing additional voice training on Dragon Naturally Speaking so that the computer could recognize their words, and it began to be a useful tool for some students.

The students continued to begin each day by opening an email message from their teachers, and learned to download attachments and to email work for printing. All students began to prepare a talk about a book. Some were reading their book with Kurzweil, some with audiobooks, and some read a paper book at their level. M’s teacher used repeated reading for some text each day to help her overlearn words through repeated practice in
context. She previewed the text selection on Kurzweil a few times, and then read it with her teacher. She also took books home to practice for her kindergarten reading buddy, and practiced audio books from an on-line website. M was very motivated and read with her family each night for thirty or more minutes. Her teacher observed improvement in her word recognition this week. She continued to enjoy using Kurzweil with her email messages.

The interactive white board was engaging for students and teachers used it in activities such as dragging and dropping descriptors of two characters into a Venn diagram. Many activities required reading as part of the activity. Kurzweil was not compatible with the white board, but another text reader, Premier, could be used. Through shared reading, all the students practiced the vocabulary.

Technology issues and successes
Typing was a slow process for some of the students, while others were improving their speed with nightly practice. Some students were able to achieve accuracy rates for voice recognition on Dragon Naturally Speaking of over 80%. Kurzweil was working well for all the students for reading, and some were beginning to learn how to scan their own books. One scanner malfunctioned, and was sent for repair.

Student attitudes about reading with and without Kurzweil
Overall, the students were getting used to using Kurzweil and liked it, although they continued to find the voice mechanical. Many were trying out reading their book using Kurzweil during “D.E.A.R.” time (free reading time).
Week 4

Student progress

Teachers reported in week four that all of the students were continuing to improve with their use of computers and were comfortable with the programs. Most students preferred Kurzweil for writing, but Z chose to use Premier, another text reader, because he could turn off the word prediction feature on it. He did prefer Kurzweil for reading, and could take home his personal laptop to use it. His teacher read the same book each night at home and they met each day to discuss the newest chapter, which was very motivating for him.

A continued to type and print very slowly. His teacher decided to scribe his writing responses for him to help him focus and to get his ideas recorded. T was very happy that she would be able to access her book’s scanned Kurzweil file back at her home school so that she could read it there. Several students worked on decoding and word analysis using spelling activities and games, and showed improvement. The students enjoyed applying the quick picture strategy to organize their thoughts before writing with Kurzweil. M continued to show her strengths in comprehension, and began to enjoy grade-level audiobooks at home. She was able to retell the story and her teacher typed her summary for her.

Teaching strategies

During the literacy component of the day the teachers used different activities for students to practice the reading and writing programs and strategies they learned in the first half of the program: reading with Kurzweil, finding and highlighting key ideas, and practicing a drag and drop technique to move the highlighted points to make notes on an information article. A focus this week was making connections and providing proof for answers. Daily
construction activities maintained a tactile-kinesthetic focus and provided a topic for writing. Summarizing was simplified to finding three main points, “The Magic 3”, for the beginning, middle, and end. Another writing activity involved generating silly sentences using the 5 W’s (who, what, when, where, and why), which were fun for the students to write on the computer using Kurzweil and to share for reading. Teachers began to discuss the students’ return to their home school after week 6 by relating the strategies taught to regular classroom situations.

M and A, students who were still having difficulty establishing a core reading vocabulary, worked with a word bank on a ring this week. Each day the students each selected one word from their reading to add to their rings. Each generated a sentence using the word and reviewed it several times over the day. The next day each student returned to the word and composed another sentence. Sentences from the previous day were reviewed by randomly pointing to the words.

Technology issues and successes
Teachers noted that comfort with computers was growing in week 4. They found that Kurzweil was not necessarily faster than handwriting for students, and it was important to prioritize tasks for completion. Typing would remain an extra barrier until both keyboarding and Kurzweil were mastered. A limitation of the Kurzweil word prediction feature was that specialty words were not recognized, but teachers found they could be added into the word bank. Mouse size was an issue for one student, who did better when a smaller mouse was purchased.
Voice notes worked well to establish independence for two students, but were time consuming for their teachers to transcribe later. A continuing goal was for students to master Dragon Naturally Speaking sufficiently to be more independent for short writing pieces.

Student attitudes about reading with and without Kurzweil

During Week 4 one student continued to decline any computer assistance for personal reading (D.E.A.R. time), but became quite skillful with Kurzweil for assigned class reading. The rest of the students were happy to use Kurzweil every day.

Week 5

Student progress

During week 5 most students were consolidating their skills and preparing to return to their home school. Many students focused on new goals to master before the end of the program. Some who were slow to establish home routines were now following a homework regime every night with their family. A’s parents shared that it was very positive for the family to have reduced conflict over homework tasks. He was also very pleased to be bringing in completed work. Teachers were careful to assign an amount of homework which could be completed within the allocated time, to leave time to do reading every evening. A continued to have very laborious writing, but agreed to learn how to do a voice note to record his thoughts and was quickly successful using that strategy. He sent his principal a voice note email to respond to her email message, and she sent him back an email saying, “Wow!” He also used Kurzweil to create a note on a science article within 15 minutes, a big improvement in productivity. The word banking strategy was showing signs of slow but steady success for M and A. G was still reluctant to use Kurzweil to write, although his performance level was
much higher when using it. Many of his handwritten entries were difficult to read later by himself or his teacher.

Teaching strategies

Book talks were used as a strategy to practice summarizing key information using assistive technology. Three-colour highlighting was used to create a PBE chart (Physical, Behavioural, and Environmental) using Kurzweil for repeated reading and note-taking using three colours of highlighting and a drag and drop strategy to create the note. The first one was done together with the class, followed by independent work by students on their computers. Students used Open Office Impress to create a slide show to share their information with the class. They also added pictures, transitions, and sound effects for a dramatic result. Wordles were used for another note-taking activity. Some students used Dragon to make their notes to create the wordle graphic.

Technology issues and successes

By the end of week 5 all the students had experienced many successes with the use of several types of assistive technology. Use of the internet with Kurzweil was taught during week 5. Students learned to select a section on the web page and open up Kurzweil to read it. They found it convenient because they could keep Kurzweil minimized in the task bar and call it up as needed.

The two students who had previously trained on Dragon Naturally Speaking, M and Z, lost their individual files when the computers were serviced and updated. This meant that both of them had to retrain their voice recognition software. As their previous work in their home schools had not achieved successful use of this software, competency in its use was a
goal for their time in the program. Both had excellent oral language skills, which their teachers felt would contribute to their success with the software. The usual mode of training involved reading a selection into the microphone. Z was able to complete his voice training in about 10 minutes, with 86% accuracy of voice recognition vocabulary. His teacher wanted a higher level of accuracy, but felt that this was a good start.

M’s teacher had developed a training technique for students who had extreme difficulties with reading. She would rehearse the reading in five syllable bites, usually one to three words. Once rehearsed, she would turn the microphone on and record the student reading those five syllables. She described it as “very slow, and very clear, and chunked.” In this way M was able to achieve a 78% accuracy rate on her first attempt. The technique worked so well that A’s teacher tried it successfully with him as well. Z and M both chose to use Dragon to dictate their words into their slide show. Z used Dragon for some tasks and chose to type at other times. M was successful in entering all her comments into her slide show with Dragon, and was very proud of the result. She was able to check her work for accuracy by reading it back with Kurzweil. The teachers taught both students to save their files on memory sticks or their network file to avoid the need for voice retraining in the future. Both students could operate the basic commands in Dragon, which was enough to be able to use it.

Student attitudes about reading with and without Kurzweil
A was concerned that he wouldn’t be able to finish the book he was reading on Kurzweil before the end of the next week. His teacher was very pleased that he loved the book so much, and offered to send him scanned chapter files by email at his home school, which surprised and delighted him.
Week 6

Student progress

The final week of the program was both exciting and sad for the students. Some of them had transformative experiences, and all were far more successful than they had been at their home schools. They were happy to show off their new skills to their teachers and parents, but sad to leave the program where they had been happy and proud of themselves. M asked if she could stay a little longer, but that was not possible as a new group of students would soon be arriving.

During the last week, teachers from the home schools visited the program on a Wednesday to observe the progress of the students and discuss future strategies with each child’s program teacher. For most students, both their classroom teacher and special education teacher attended. That evening the parents were invited. Each student conducted a tour of the classroom and talked to their teachers and parents about what they had discovered about their learning style and the skills they had acquired. The program teachers added comments, and were available to meet at another time with home school staff.

The teachers felt that A had made the most progress in reading of the students in the group. They recommended that his home school teachers divide his work into segments that he could accomplish in ten-minute blocks, and choose the highest priority tasks for completion to address his attention and slow processing issues. His family planned to continue with his now successful homework and reading routine of ten-minute blocks for 40 minutes a night. His program teacher reported, “Dad said to me at Open House that he is a changed boy. He walked by his room the other night, and he was sitting there with a
flashlight, reading, in his room, under the covers.” A’s principal visited on Open House Day. [She] “…had tears in her eyes…[when] he was reading to her.” A’s special education teacher was surprised that Dragon was working for him. He knew he would have to fix words with the letters he couldn’t say, but he could do that with Kurzweil. He had shown aptitude for using the assistive technology throughout the program. All the students had learned to use assistive technology to help them with reading and writing. Z and M were reading grade-appropriate text with comprehension using Kurzweil. Both were able to use Dragon to express their ideas on paper, and enjoyed their new independence. M’s teacher said, “She depends on it. She knows this is her way of doing the same as everybody else.”

Teaching strategies
This week Movie Maker and Slide Show were added to the students’ repertoire in the “I do, we do, you do” method used to introduce any new technology. The students learned the programs quickly and were eager to try them out. The teachers continued to build familiarity with programs by incorporating them into daily routines such as journal writing and the morning message. The last week of the program provided opportunities to take knowledge of some programs from basic to more sophisticated uses.

Technology issues and successes
Equipment was running smoothly, and everyone was used to coping with any quirks of individual software programs. The teachers had learned that they could have different students use Dragon on the same computer if the voice files were on a memory stick which was plugged in before Dragon was opened. It took some weeks to discover this. Teachers were still thinking of ways to make the pictures more accessible in Kurzweil. One idea was to make a PowerPoint slide for each page, which could be read using Kurzweil. However,
this would also be time-consuming. Budget would be made available to acquire a library of scanned popular books for the program, and the teachers would encourage schools to add scanned versions of books to their libraries.

**Student attitudes about reading with and without Kurzweil**

M’s teacher reported that she was “very, very confident doing her assessment and using the Kurzweil and the Dragon. I think she was the most at ease with the use of Kurzweil.” M depended on Kurzweil and was very pleased that she could use it independently to find mistakes that Dragon was making when she dictated her work. A enjoyed reading for the first time in his school career. He completed his first chapter book and quickly moved on to another in the series. He enjoyed reading a grade-appropriate book with Kurzweil at the program. Multiple students wished they could take a computer back with them to their home school.

**Assessment Results**

The teachers administered the next assessment from the DRA Bridge Pack on Monday and Thursday of week 6. To minimize inattention, they offered a new story each time. The level of each text was the same, and was the next level up from the DRA text read in week 1. Students were able to go back to revisit the DRA text, although only the student with primarily a comprehension problem (Z) did so. Students completed the first text on Monday without Kurzweil, and a second text three days later with Kurzweil. Once again, the students were able to access text at a much higher word per minute rate using Kurzweil than print (see Figure 4.3). Comprehension scores were higher for four of the students when using Kurzweil, but lower for A (see Figure 4.4). This student’s teacher felt that this result was
inconsistent with his classroom performance and reflected his need to be able to access the pictures to fully understand the text. As in week 1 and 2, the Kurzweil skipped over the pictures.

Table 4.1

Assessment Materials Used Weeks 1 and 6: Developmental Reading Assessment™ 4-8 Bridge Pack (2004) Text Levels and Grade Equivalents

<table>
<thead>
<tr>
<th>Text Levels</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 28</td>
<td>2</td>
</tr>
<tr>
<td>30 - 38</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4.1 indicates the text levels available at each grade level in the DRA 4-8 Bridge Pack (2004), which is designed to be used with students in grades 4 to 8 who are struggling readers. The material includes extra support to complete the comprehension questions, such as sentence stems (At the beginning, next, then, after that, in the end).
Table 4.2

Text Levels Used with Students in Weeks 1 and 6: Developmental Reading Assessment™ 4-8 Bridge Pack (2004)

<table>
<thead>
<tr>
<th>Student</th>
<th>Week 1</th>
<th>Week 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student A</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Student Z</td>
<td>34</td>
<td>38</td>
</tr>
<tr>
<td>Student M</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Student T</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>Student G</td>
<td>24</td>
<td>28</td>
</tr>
</tbody>
</table>

Table 4.2 indicates which levels of text were used in the DRA assessment during weeks 1 and 6. This assessment followed the guidelines in the DRA manual, which suggest that students stay at the same level until a satisfactory score has been achieved. Typically the assessment would be some months apart. Once a satisfactory score is achieved, the next assessment is at the next level. Each of the students achieved a satisfactory score when using Kurzweil in week 1, and therefore moved up one level in week 6.
Figure 4.1 represents the Fluency scores for students during the week 1 DRA Bridge Pack 4-8 (2004) assessment. It compares Fluency scores between reading a paper copy of the DRA booklet and a digital one which was scanned into Kurzweil and read to the student by Kurzweil on the computer. The word per minute rate using Kurzweil was selected by each student at their comfortable listening rate. Book levels were individually selected according to DRA guidelines based on the previous assessment done at the school months earlier at the start of the school year. Each student read the same book first for print and two days later with Kurzweil.
Figure 4.2 represents the Comprehension scores for students during the week 1 DRA assessment. It compares Comprehension scores between reading a paper copy of the DRA booklet and a digital one which was scanned into Kurzweil and read to the student by Kurzweil on the computer. Each student read the same book first for print and two days later with Kurzweil.
Table 4.3

*DRA Reading Achievement Levels by Score Range and Grade Level*

<table>
<thead>
<tr>
<th>DRA Score Range</th>
<th>DRA Stage</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>42 - 53</td>
<td>Mid-Transitional</td>
<td>First/Second</td>
</tr>
<tr>
<td>54 - 63</td>
<td>Transitional</td>
<td>Second</td>
</tr>
<tr>
<td>64 - 73</td>
<td>Extending</td>
<td>Third</td>
</tr>
<tr>
<td>74 - 83</td>
<td>Intermediate</td>
<td>Fourth</td>
</tr>
<tr>
<td>84 - 93</td>
<td>Advancing Intermediate</td>
<td>Fifth</td>
</tr>
<tr>
<td>94 - 103</td>
<td>Middle School</td>
<td>Sixth</td>
</tr>
</tbody>
</table>

Table 4.3 indicates the DRA Stages and their equivalent scores and grade levels. It applies to both the DRA Bridge Pack Grades 4-8 (2004) and the DRA Canadian Edition Grades 4-8 (2004).
Table 4.4

*Student Stages of DRA Reading Achievement for Week 1 by Overall Score, Stage, and Grade Level*

<table>
<thead>
<tr>
<th>Student</th>
<th>Print Overall Score</th>
<th>Stage of Achievement</th>
<th>Grade Level</th>
<th>Kurzweil Overall Score</th>
<th>Stage of Achievement</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student A</td>
<td>42</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>46</td>
<td>Mid-Transitional</td>
<td>1/2</td>
</tr>
<tr>
<td>Student Z</td>
<td>66</td>
<td>Extending</td>
<td>3</td>
<td>72</td>
<td>Intermediate</td>
<td>4</td>
</tr>
<tr>
<td>Student M</td>
<td>47</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>58</td>
<td>Transitional</td>
<td>2</td>
</tr>
<tr>
<td>Student T</td>
<td>51</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>55</td>
<td>Transitional</td>
<td>4</td>
</tr>
<tr>
<td>Student G</td>
<td>52</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>58</td>
<td>Transitional</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4.4 indicates the individual student Overall Scores, DRA Stage of Achievement, and equivalent grade levels for the week 1 assessment using the DRA Bridge Pack Grades 4-8 (2004).

Table 4.5

*Assessment Materials Used Week 2: Developmental Reading Assessment™ (2004) Text Levels and Grade Equivalents*

<table>
<thead>
<tr>
<th>Text Level</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4.5 indicates which levels of text were used in the DRA assessment during week 2. The teachers chose books at the students’ grade levels to read with Kurzweil only, as the books were too hard for the students to read in print form.
Figure 4.3

Figure 4.3 represents the Fluency scores for students during the week 6 DRA Bridge Pack 4-8 (2004) assessment. It compares Fluency scores between reading a paper copy of the DRA booklet and a digital one which was scanned into Kurzweil and read to the student by Kurzweil on the computer. The word per minute rate using Kurzweil was selected by each student at their comfortable listening rate. Book levels were individually selected according to DRA guidelines based on the previous assessment done at the school months earlier at the start of the school year. Each student read a different book at the same level, first for print and two days later with Kurzweil.
Figure 4.4 represents the Comprehension scores for students during the week 6 DRA assessment. It compares Comprehension scores between reading a paper copy of the DRA booklet and a digital one which was scanned into Kurzweil and read to the student by Kurzweil on the computer. Each student read a different book at the same level, first for print and three days later with Kurzweil.
Figure 4.5 represents a comparison of comprehension scores over weeks 1, 2, and 6 using Kurzweil. Book levels used for weeks 1 and 6 were individually selected from the DRA Bridge Pack Grade 4-8 (2004) according to DRA guidelines based on previous assessments (see Table 4.2): grade 2 for A, M, T, and G, and grade 3 for Z. The Bridge Pack has comprehension cues to assist students to recall and summarize the story (see notes under Table 4.1).

The DRA text assessed during week 2 was a grade level text selected from the DRA Canadian Edition Grades 4-8 (2004): grade 4 for A and Z, and grade 5 for M, T, and G. Comprehension scores were lower during week 2. The student response sheets in this assessment did not have comprehension cues, unlike those available in the Bridge Pack.

Comprehension scores were higher than print in week 6 for all students except A (see Figure 4.3). A achieved his highest comprehension score when reading the grade level test booklet in week 2.
Table 4.6

*Student Stages of Reading Achievement for Week 6 by Overall Score, Stage, and Grade Level*

<table>
<thead>
<tr>
<th>Student</th>
<th>Print Overall Score</th>
<th>Stage of Achievement</th>
<th>Grade Level</th>
<th>Kurzweil Overall Score</th>
<th>Stage of Achievement</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student A</td>
<td>55</td>
<td>Transitional</td>
<td>2</td>
<td>58</td>
<td>Transitional</td>
<td>2</td>
</tr>
<tr>
<td>Student Z</td>
<td>72</td>
<td>Extending</td>
<td>3</td>
<td>76</td>
<td>Intermediate</td>
<td>4</td>
</tr>
<tr>
<td>Student M</td>
<td>52</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>64</td>
<td>Extending</td>
<td>2</td>
</tr>
<tr>
<td>Student T</td>
<td>60</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>65</td>
<td>Extending</td>
<td>4</td>
</tr>
<tr>
<td>Student G</td>
<td>56</td>
<td>Mid-Transitional</td>
<td>1/2</td>
<td>64</td>
<td>Extending</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4.6 indicates the individual student Overall Scores, DRA Stage of Achievement, and equivalent grade levels for the week 6 assessment using the DRA Bridge Pack Grades 4-8 (2004).
Figure 4.6 represents a comparison of overall DRA scores over weeks 1 and 6 using print and Kurzweil. All students achieved a higher overall score for Kurzweil over print in each of weeks 1 and 6. All students improved their overall score using print from week 1 to week 6. All students improved their overall score using Kurzweil from week 1 to week 6. See Tables 4.4 and 4.6 for grade level equivalents.

Post-Program Discussion with Teachers

During the week after the group left the program, the researcher and teachers reviewed the six weeks. During this week the teachers had visited many of the students in their home schools. They reflected on the changes they had observed over the six weeks, the strategies they had used, the challenges they had faced, their judgement of the advantages and disadvantages of Kurzweil, and their recommendations for future practice.
Student progress over six weeks

The teachers recalled the students’ reading behavior at the beginning of the six-week program. Four of the students did little reading, and the remaining student could repeat back what he had read but with comprehension which was limited to the facts explicitly stated in the text. T stated that two of the students didn’t read at all when they began the program. She remembered, “They were just what I would like to call a browser. They made it look like they were reading, but they weren’t reading….And they collected a whole series of books on their desk that looked like big books [to show], ‘Look what I’m reading’…but they’re not, they are just flipping.” L described her students, “I know T and M preferred to be read to at home by parents…Neither one wanted to take the risk, and they wanted to hear grade level text…G avoided reading.”

Other than M, previous student experience with Kurzweil was limited to a brief trial period using a computer in the special education office, mainly for scanned notes or tests. L said that M had used the computer and “was pretty good at using it, because she did show how to use the page scanner. She did know how to make a text note.” She had had training, but was not using it well in the classroom.

By the end of the program the teachers described the changes in the students. L said, “My two girls love reading with Kurzweil…M has finished Charlie and the Chocolate Factory. When I sent her home with her computer on Friday, she took advantage of it and finished reading. Her mom says, I don’t know what you’ve done, but she’ll…spend hours …keyboarding and reading.” L explained that she had given a 30-day trial version of Kurzweil to T’s school so that she could also finish reading Charlie and the Chocolate Factory on Kurzweil using a computer that was in the classroom. T described her visit with
A at his school this week. “He had to tell me that he is reading Geronimo Stilton, so he brought that over to show me.” A had developed an interest in reading during his time in the program.

Summary of teacher strategies

The teachers recalled several important strategies which were used during the program. Goal-setting, building of self-esteem and self-advocacy, and techniques for building reading comprehension and higher level thinking skills were discussed. Technology strategies were also discussed. Finally, they described a strategy they had recommended to the staff of the students’ home schools.

First, the teachers regarded goal-setting as a significant strategy in the program. All the students had wished to improve their reading, and all did so. The teachers reviewed each week with the students, using sentence stems such as

- “Something I need to continue to work on”,
- “Activities you liked or had fun doing”,
- “What tools or strategies introduced so far would you like to continue using”,
- “Something I’m proud of this week”, and
- “One thing I need to work harder at is –”.

The teachers reflected that these sentence stems helped them to steer the conversation towards appropriate goals. Both had tried goal-setting strategies in their previous teaching roles, although with some modifications in a regular class.

Secondly, both teachers felt that the strategic establishment of self-esteem and self-advocacy was closely connected to the progress of the students. Schools had also identified
that self-confidence as a learner was a goal. The children had experienced extensive failure as they learned to read, in spite of many previous attempts by their schools to address their reading and other needs. T commented, “Self-esteem and self-advocacy are first and foremost, I think. Getting them to ...believe in themselves, and having success – if they can leave feeling good about themselves, then they are far better off.”

Thirdly, reading comprehension strategies were discussed. The teachers observed improvement in students’ reading comprehension and thinking skills, but felt it was important to continue to work on this area at their home school. T noted that Z showed growth in his understanding and was able to use VIPs to select important points from his reading. L shared that G was able to summarize well when sentence stems were provided. “Quick pics” helped students to visualize and make connections. One of the students had asked his home school teacher if he could use “Quick Pics”, an example of the self-advocacy the teachers had encouraged in the children.

The teachers also described their best strategies to teach Kurzweil. After a skill was introduced using the “I do, we do, you do” model, it was applied in a curriculum context. For comprehension they liked to have the students answer the 5 W’s (who, what, when, where, and why) using Kurzweil three colour highlighting, then dragging the highlighted answers over and dropping them into a new note. For reading vocabulary they had the students read the selection three times on Kurzweil, then do a reading game called Smartie tracking. The first student would start reading, and when ready call out another student’s name to continue reading. For correct reading, they received a small candy. They helped each other during the game and followed closely to be ready to take over when called. L
recalled, “Knowing that they were going to do Smartie tracking after they listened to it three times, on Kurzweil, was an incentive for them.”

Finally, the teachers described previewing, a strategy they had recommended to the families and schools of the students. Previewing involved reading about concepts and vocabulary at home before the lesson at school. L stated, “It’s my number one strategy for every kid to do better in school… and all the teachers agreed to it.” A talked to T about his excitement that his nightly parent conference was now a preview time, “looking at what is coming up, or checking out websites together, or playing a game.” This strategy would enhance student background knowledge and rehearse reading vocabulary before a lesson was presented in school, increasing understanding similarly to the pre-reading and discussion done during the program. The schools would send home information in advance of the lesson so that the students could preview it with their families.

**Technology challenges and successes in the program**

A number of challenges which occurred during the program were reported. Technology skills of the home school teachers and access to scanned books were factors in student interest in reading. L reported that “M had a prescription since grade 4 with Kurzweil….She knew how to use it, but I don’t think anyone thought to get books from [the provincial resource library agency].” T and L found that home school teachers lacked the skills and knowledge to access scanned books on-line from the resource agency. T stated, “Yesterday when I brought that up [at a meeting at the school] I asked if they had ever sought a book out from there – No.” L agreed that the teachers of her students had heard of the resource library but didn’t have any experience with it. One of the home school teachers had made an appointment with L to see how to access the resource library for her students. T felt that
“sometimes the changeover [in special education staff means that] …technology is being doled out faster than staff is able to consolidate [their knowledge].”

Technical issues were also a problem during the six weeks. It was not possible to find enough time to adjust the scanned books and DRA test materials on a page-by-page basis. L described the issue with the size of scanned pages for the DRA. “I forgot to make the pages 100%. When you scan, for some reason it scans and a 339% view comes up…So we were all fixing it.” They wished they had had the time to do zone editing to correct the pages in advance.

Despite the technical problems, both teachers were convinced of the advantages of providing Kurzweil to struggling readers. T identified that “Kurzweil…levels the playing field. [It] makes those higher level texts available to them, [and] opens up a little bit of a new world.” Audiobooks, when available, were an alternative, but L indicated that they read too quickly for her students. Control of the pacing was an advantage of Kurzweil. T described how important Kurzweil was to her students:

We take for granted that our children…can read the instructions or read the morning message, and our kids can’t. So, right away…I showed M [how to copy and paste] the text into Kurzweil…and every day she cut and pasted the morning message into Kurzweil and had it read to her.

This immediate mastery and pay-off was very motivating for the students. She continued, “When a teacher…hands out an activity, just the fact that they can go and slip it in their scanner and have it brought up [on the screen] and read to them, [means they can] do it
right on the sheet.” They considered the challenges of library research. Digital materials can be read using other text readers, but T identified Kurzweil as

…a much more powerful tool for kids to have access to materials and resources.

The value in Kurzweil is if they go to the library and they find a book on polar bears, and they can’t read it, they can scan that book, or two or three pages, right then and there.

One day the teachers hoped to see digital resources provided for downloading at the library, or from home.

Kurzweil also helped the teachers to manage student needs when there were simultaneous requests for assistance. When students had difficulty writing they could use Kurzweil to record their reading response on a voice note. T said, “It does allow you to get this one [student] going, and go over to [another one].”

**Teacher recommendations**

The teachers had a number of recommendations to the receiving schools and to the school board. They discussed student access to Kurzweil; scanning issues for DRA and library books; home school teachers’ access to Kurzweil for training sessions, lesson preparation, and evaluation of student work; and priority service for students with prescribed assistive software.

One teacher was previously concerned about introducing Kurzweil to students who might not receive it when they returned to their home schools. A new process allowed the program teachers to add their recommendation for Kurzweil or other software, when it was
successful, to a school request for assistive technology for a student. The other teacher shared the students’ desire for assistive technology. “Both T and G, the first thing they said to their teachers when they got back was, ‘When do I get my prescription?’...They are excited about getting their prescriptions, because [they] loved having Kurzweil.”

The teachers recommended that the school board have all the DRA materials scanned and zone edited and available to all staff. The teachers of special classes were already sharing their scanned versions with each other, but this was not happening across the school board. They also suggested that all teachers participate in Kurzweil training with their students. For best results the home school teachers require a computer to use during the training and later to use in the classroom to create scanned activities and assess student work done with Kurzweil. This could mean accessing the student computer overnight, although that would mean the student wouldn’t have access to it for homework and reading. They suggested that Kurzweil be available for group reading if there is a class computer and more students need it. They thought it could be set up as a centre that students visit. Finally, they recommended that schools request priority service for prescribed student computers. They had discovered that some teachers weren’t aware that there is a priority button to click when requesting service.

The teachers described their participation in the study as satisfying. They would be presenting their strategies and results at the next meeting of the team from all four program sites so that improvements to the technology aspects of the program could be shared. Additionally, they intended to continue meeting with their program partner on a weekly basis. They had always talked briefly each day, but they enjoyed the weekly in-depth discussions about strategies and student progress.
Summary of Findings

Over a six-week intensive program, teachers demonstrated that students could improve their reading skills through remediation while learning to compensate for their reading disability through assistive software. All students were able to access text at a higher level by using Kurzweil 3000 TTS software, and attained enough skill to be able to use it with occasional assistance. Two students were able to read and comprehend grade-appropriate text and achieved proficiency and considerable independence in both reading and writing tasks. Kurzweil was able to assist them in checking their writing by reading it back to them and facilitating self-correction. Dragon Naturally Speaking worked well for two of the students, who were able to dictate their ideas, and then check the results for accuracy using Kurzweil. Another student had some success with Dragon but faced extra challenges due to articulation difficulties. The students also learned to use Kurzweil to search the internet and access their email. They found Kurzweil convenient to use on the internet because they could minimize the task bar and call on it as needed.

The students were previously described as discouraged by their home school teachers. This was not surprising, as they had received reading support for years, but still faced daily reading struggles. During the program, four of the five students became excited about reading. They were also increasingly open to trying new challenges. They learned new assistive technologies quickly, and all but one found the computer motivating to use. Proficiency was established through the integration of assistive technology into many daily classroom tasks.

The program teachers developed many games to make more traditional reading remediation also fun for the students. Auditory, visual, and tactile-kinesthetic modalities
were presented to the students as ways to learn. With parental cooperation, routines were established at home and at school to reinforce new learning nightly. One child’s parents reported that previous homework battles had ceased and the home atmosphere was positive about schoolwork and reading.

Assessment results were similar to teacher observations for most of the students. Students could read much faster with Kurzweil. Fluency scores were higher for all the students when they used Kurzweil. Two students accessed text twice as fast and one student could access text at a rate over five times faster with Kurzweil than without it. Students were able to access higher level text using Kurzweil than without it, and some of them were able to read materials with comprehension close to their grade level. Comprehension scores were higher with Kurzweil for four of the students. One student did not improve his comprehension with Kurzweil over print except in week 2, when he was reading text at his grade level. All students improved their DRA overall scores significantly over the six weeks (see Figure 4.6). Students did benefit from supportive prompts such as cues to summarize the beginning, middle, and end of the text. Classroom observations also demonstrated that students required cues to help them organize their reading responses when writing using Kurzweil 3000 or Dragon Naturally Speaking.

Technical problems were a significant concern throughout the program. Some early problems were caused by delays in setting up the wireless network in a newly-opened school and in adding program equipment to the school network. The number of pieces of equipment and programs running seemed to lead to some problems, and teachers acquired increasingly sophisticated problem solving skills as they sought advice and support to keep everything working to top capacity. By the third week most equipment was running smoothly, although
intermittent problems occurred with one student’s personal laptop computer. Kurzweil was enabling for all of the students, but required considerable teacher time to scan books so that they could be read on the computer. A provincial organization had few popular fictional books available for young readers, and was not able to respond quickly enough to make new books available when the teachers needed them. One book requested by a student, a popular Canadian classic novel, was available and her teacher was able to download it quickly. The teachers devoted as much time as they could to scanning books, but could not take the extensive time required to make each page run smoothly by adjusting type size and picture presentation in advance. Instead, they adjusted the appearance of the scanned materials as the students used them, when necessary.

The teachers recommended to the schools that all five students receive a personal computer and assistive technology software. This information would be added to the schools’ applications for AT for the students. The teachers would also inform the board office of the names of the students who had been successful with AT. They could be fast-tracked to receive a computer, in order to apply their new learning as soon as possible. It would still take some months for the process to be complete, but some of the students could have their new computers before the end of the school year.
Research into the use of TTS reader technology is limited, but information is needed to assist schools to make effective decisions about assistive technology on behalf of students (Edyburn, 2003, 2007). Governments have provided legislative and regulatory imperatives which require that schools address the special needs of students through early intervention and assistive technology as appropriate (Ontario Ministry of Education, 2004, 2013; Individuals with Disabilities Education Act [IDEA], 1990 & 1997). Results of previous research into the use of computer-assisted reading devices have been mixed. TTS readers have shown potential to improve student reading (Dimmitt et al; 2007; Higgins & Raskind, 2005; Manset-Williamson et al., 2008; Schmitt et al., 2012). TTS readers can assist students with reading disabilities to access both paper and digital text, an important factor as researchers have called for all students to develop skills with ICT to prepare them for the future (King-Sears & Evmenova, 2007). Teacher skill has emerged as a component in student success with assistive technology (Dimmitt et al., 2007; Edyburn, 2004b). Schools consider how to allocate support to struggling readers, and whether to prioritize remediation or compensation (Dyck & Pemberton, 2002; Edyburn, 2007). After Grade 3, reading is used increasingly as a tool for the acquisition of information (Ontario Ministry of Education, 2006), which leads to an achievement gap for struggling readers (Edyburn, 2007).

This study is significant because it adds to the literature by addressing several areas relevant to the issues above:

- use of text readers to assist students to read at a higher level,
• effective use of text readers,
• capacity to access all text whether in paper or digital form,
• conditions which contribute to or interfere with successful student use of TTS readers,
• teacher skill levels with TTS technology, and
• development of a theoretical framework which addresses the decision-making process by which schools allocate time between remediation of reading problems and compensation for them when they are severe and persistent.

This case study describes the experiences of two teachers over a six-week program as they applied strategies to teach skills in reading and the use of Kurzweil, a computer-based TTS reader, to five junior-age students with reading disabilities. This research demonstrates that students are able to improve their reading skills through remediation while learning to compensate for their reading disability through TTS assistive technology.

Previous research has shown that effective use of TTS readers may not be achieved by students (Schmitt et al., 2011), or may take lengthy instruction to master (Dimmitt et al., 2007). In this study, all students learned within a six-week period to use Kurzweil for reading and writing. Two of the students were able to read and comprehend grade-level curriculum materials independently and provided occasional assistance to the other students. By the end of the program, all the students were using Kurzweil effectively every day. One student used it primarily to improve comprehension and to access grade-level text. The rest of the students had more severe delays in their ability to read, and employed it daily to help them read and write. The teachers also observed that the students could read much faster
with Kurzweil, and had better comprehension. Students also used Kurzweil word prediction features to help them to speed up their writing. The reading function allowed them to check their writing for accuracy and to correct it themselves.

Improvement was noted in observed student skills in the use of Kurzweil, student reading fluency scores, and reading comprehension scores. Fluency improved dramatically for two students who accessed twice as much print with Kurzweil, and one student accessed over five times as much print with Kurzweil. DRA comprehension scores improved for four of the five students with Kurzweil. The fifth student did improve comprehension when reading a grade level DRA text with Kurzweil. Overall reading scores on the DRA also showed improvement. Student scores on the DRA improved over six weeks without Kurzweil, but the highest scores were obtained with Kurzweil.

These findings are consistent with other studies which show that TTS text readers assist students with severe reading disabilities to access school materials at a higher level than their current reading skills allow (Dimmitt et al, 2007; Higgins & Raskind, 1997; Schmitt et al, 2012).

There are some differences between the current study and previous ones. This study demonstrates that the four students with severe reading deficits and one student with a significant comprehension deficit experienced improved reading comprehension scores with Kurzweil. Some previous studies showed a reduced effect for less disabled readers (Higgins & Raskind, 1997; Schmitt et al, 2012). However, these studies did not allow students to revisit text during the assessment. Students in the current study were able to go back to revisit the DRA text, although only the student with primarily a comprehension problem did
so. Higgins and Raskind (2005) allowed students to revisit the text when answering questions. They found that students with varying levels of reading disability were able to use a TTS reader to read easier text more accurately and maintain comprehension for more difficult passages (Higgins & Raskind, 2005). Another study which showed no difference among delayed readers also did not allow students to revisit the reading selection (Schmitt et al., 2011).

In this study, teachers found that supportive comprehension prompts such as sentence stems and organizers for main ideas were important for reading with and without Kurzweil, and recommended that ongoing support be provided in this way. A number of studies are consistent with this finding. Schmitt and colleagues concluded that decoding alone is not enough to improve reading comprehension (Schmitt et al, 2011). Manset-Williamson et al. (2008) found that a self-questioning strategy combined with use of Kurzweil 3000 improved comprehension as measured by summarizing the reading selection. They also concluded that ongoing instruction in summarizing was needed beyond the time frame of their intervention group, a similar finding to the present study.

This study finds that students improved their scores in reading with and without the Kurzweil reader. Kurzweil 3000 presents text in a bimodal manner; students were encouraged to follow along with the highlighted words as the computer read them aloud. Previous research has suggested that bimodal presentation of text improves reading comprehension and word recognition (Montali & Lewandowski, 1996).

Teachers observed many uses for Kurzweil in the program. Access to library and curriculum materials in paper form was made available through the TTS. Students could
read books of their choice because teachers scanned them using Kurzweil, and significant increased interest in reading was noted. Students were able to use Kurzweil to communicate with friends and teachers at their home schools, and to find and select information on the internet to use in their writing. Previous research is consistent with these findings (Edyburn, 2003), and other researchers suggest that all students require technology instruction and access to ICT because their future careers will require technological skills (King-Sears & Evmenova, 2007).

Very few studies to date have investigated the effect of TTS software in a small remedial setting; the present study adds to the literature in this area (e.g., Edyburn, 2004a; Stetter & Hughes, 2010). Additionally, little exploration has occurred of conditions which will facilitate mastery of TTS (Edyburn, 2007). This study assists in expanding the available information about the use of TTS readers in public schools, and the conditions which support success with TTS readers.

The teachers in the program devised many strategies as they attempted to create ideal conditions for the students to improve their reading and writing and to learn and apply Kurzweil skills. For six weeks, interesting activities which required reading and writing were provided throughout the day, and the text reader was integrated regularly into these tasks. At the beginning of the program the students learned to use Kurzweil for their email, a motivating activity which engaged them in reading and writing. As the students’ skills grew, teachers introduced more complex Kurzweil skills such as using the study tools and finding information on the internet. Teachers also developed enjoyable games to work on reading skills such as word recognition and word analysis. Communication with parents fostered home support for nightly reading practice. The strategies employed by the students and the
teachers in this study will also add to the literature surrounding the use of TTS software in elementary classrooms.

Another factor affecting implementation success revealed in the current study is student attitudes towards use of the technology. Student feelings towards reading with Kurzweil were varied. By the end of the program, four out of the five students enjoyed using Kurzweil to read and write and requested that their scanned book files be sent to their home school so that they could finish the books they were reading at the end of the program. Students commented on the mechanical nature of the voices, but became accustomed to them. Some parents reported their surprise and pleasure that their children enjoyed reading for the first time. However, one student did not enjoy reading with Kurzweil, although his reading performance was higher when using it. Previous studies also find varied responses to Kurzweil, including difficulty paying attention due to the monotone nature of the digitized voice, and initial difficulty understanding it (Manset-Williamson et al., 2008). The teachers commented that the success of the students with Kurzweil depended on finding books to read that interested them. They persisted with Kurzweil because they wanted to read their chosen books, and became accustomed to the Kurzweil voice over the first three weeks of the program.

Technology challenges presented some barriers to the successful implementation of Kurzweil in the program. A shortage of popular books in digital form meant that teachers spent many hours scanning books that students wished to read on Kurzweil. The characteristics of Kurzweil caused pages to open in magnified form, and it read only text, skipping rapidly over pictures which students needed to enhance their understanding of the story. The teachers did not have time to adjust each scanned book a page at a time to
eliminate these problems. Previous research found similar concerns by teachers about the time commitment to scan and edit the text and to solve technical problems (Dimmitt et al., 2007).

Previous research has also shown that teacher skill level in the use of assistive technology can make a significant difference in the acquisition of AT skills by students (Dimmitt et al. 2007; Edyburn 2003, 2004b), but that it is a challenge for teachers to stay current in their knowledge of assistive technology due to the rapid pace of change (Edyburn, 2004b). The program teachers were accomplished in the use of all types of assistive technology, and were able to solve many problems with equipment and materials. They were persistent in searching for solutions and support for technical issues. Meetings with home school staff also revealed some gaps in technological skills. Some of the teachers from the home schools could visit the program to learn how to access scanned books through the provincial resource agency. The program teachers also recommended that home school teachers have improved access to Kurzweil for training sessions, lesson preparation, and evaluation of student work in order to fully integrate Kurzweil use into the class instruction.

Edyburn has described the bias of naked independence, when work completed without assistive technology is valued more than work done without such assistance (Edyburn, 2009). However, society doesn’t denigrate work done by people wearing glasses or an artificial arm. Edyburn suggests that a severe ongoing reading disability which persists after significant intervention has been demonstrated by research to also have an organic cause (Edyburn, 2009). Teachers have also debated over the use of other types of technology, such as the calculator in mathematics classes (Brunette, 1999). Edyburn recommends that the use of assistive technology be discussed during the development of a
student’s IEP, with consideration regarding what proportion of the student’s time should be spent on remediation vs. compensation for learning difficulties (Edyburn, 2009).

In summary, this study demonstrated that grade 4 and 5 students can successfully learn Kurzweil 3000 TTS technology and use it to compensate for reading fluency and comprehension difficulties in order to access text at a higher level than they are able to read without it. Students became comfortable with the technology after three weeks of use, and most liked using it. However, schools continue to struggle with decisions about when to introduce a TTS reader, and how much time to devote to remediation of reading versus compensation through assistive technology (Edyburn 2003, 2007). In this research study, a Model for Remediation vs. Compensation in Reading (White, 2013) is proposed to assist schools to make decisions about remediation versus compensation for students in the primary, junior, intermediate, and higher grades (see Table 2.2). The model suggests that remediation is a priority through the primary grades (kindergarten to grade 3), but that assistive technology should be considered in the junior years (grades 4 to 6) to avoid an achievement gap in content subjects such as science and mathematics, especially if the student has significant and ongoing reading difficulties. Remediation in reading skills could continue to be provided; however, instruction in assistive technology could also occur. The model calls for compensation for reading deficits to be the priority in the intermediate division (grades 7 to 9) and senior division (grade 10 and above), in order to reduce or avoid an achievement gap, promote higher level thinking skills, and develop independence as a learner. At this stage, remediation may focus on student improvement in assistive technology skills. The Model for Remediation vs. Compensation in Reading suggests that students at the junior level, such as those in the current study, are best supported by provision
of sophisticated reading technology to compensate for their persistent and severe reading disability (White, 2013). The findings of this study indicate that at this time Kurzweil 3000 is an effective choice to address this need when combined with skillful teaching and integration throughout the instructional day.

**Limitations and Suggestions for Future Study**

Several limitations of this study should be noted. This study involved a small group of students with similar learning needs in a specialized, withdrawal setting, and results may vary with other groups. Students in this program willingly used Kurzweil and other assistive technology, but students in a regular class setting may be more reluctant to try devices not available to the rest of the class. Teachers had the support of the school board special education department and were provided with many technological resources such as one computer for each student and one for the teachers plus a data projector, interactive white board, scanner, printers, and a budget for books and materials. Typical elementary school classrooms may not have this level of technology resources. Staffing was provided at a high level due to the intensive, short term nature of the program; six students were taught by two teachers. Additionally, the program teachers were highly skilled in the use of assistive technology and instructional strategies, and often provided professional development to other teachers. Researchers have commented on the challenges of keeping up to date with assistive technology due to the rapid evolution of AT devices (Edyburn, 2004b).

Additional research is needed into the implementation of TTS readers and other assistive technology in public school settings. Investigation could follow to see whether the students in an intensive program receive assistive technology once they return to regular classes in their home schools, and if so, how this occurs. Exploration of the consequences of
The long-term use of TTS text readers would help to clarify further remedial and/or compensatory effects. Investigation of text reader usage with struggling readers in a regular classroom could indicate whether the effects of this study can be replicated in an integrated setting. Further comparisons between types of TTS readers could clarify the advantages and disadvantages of portable versus computer-based systems and differences between computer-based systems as new versions appear on the market.
Chapter 6
Conclusions and Recommendations

This study demonstrates that the implementation of a computer based TTS reader can be successful in a public school at the junior level if resources, teacher strategies, and supportive conditions are in place. Significant improvements in reading skills and improved access to grade-level materials in both paper and digital form were achieved. This research supports the early provision of appropriate assistive technology to students in order for them to be able to access the complete curriculum through the junior grades and beyond. Dyck and Pemberton (2002) have suggested that students bypass reading if they are able to learn better when they don’t have to struggle with access to reading and complete their school work. Edyburn (2007) advocates that assistive technology be considered as a compensatory strategy.

The theoretical framework of this study, a Model for Remediation vs. Compensation in Reading (Table 2), proposes that students who have significant and ongoing reading difficulties begin receiving assistive technology as a compensatory strategy during the junior grades. Careful assessment of student response to both remediation and assistive technology is an important part of the IEP process. This study finds that grade 4 and 5 students are able to master a TTS computer-based reader in six weeks and show significant improvement in reading fluency and comprehension when using it. Students became engaged with reading, showing their enthusiasm by requesting that they take their scanned book files with them back to their home schools. One grade five student, M, who read very slowly at a late grade one/early grade two level was able to read grade five school materials with a high level of
comprehension. Her teachers described her joy at using the technology to read books at her intellectual level. Students were able to use the text reader to access information on paper and on-line for content subjects such as science and social studies. They were able to work more independently by using Kurzweil to write their notes, reading them back to self-correct their errors. They prepared a slide show to present their information to the class, and were able to use Kurzweil to assist them in importing pictures and their written work to produce a sophisticated format with which to share their learning. Two students demonstrated a higher level of efficiency and independence when they learned to dictate their ideas using Dragon Naturally Speaking voice to text software, and then checked their work using Kurzweil.

Early access to grade level text may assist language development in other ways. While peers are broadening their vocabulary and comprehension, students with learning disabilities are struggling to read simple text that does not challenge them in terms of language development (Allen, 2002; Manset-Williamson et al., 2008). Access to a TTS reader removes this barrier and allows students to participate more fully in the integrated classroom (Edyburn, 2007).

Program teachers observed that students required teacher support through cues and organizers to develop their comprehension, and observed that student performance was better in a classroom environment with supports in place than in the DRA assessment environment, where coaching could not occur. Many strategies were implemented throughout the six weeks to address both remedial and compensatory measures for reading and comprehension. Teachers recommended that the schools continue to actively cultivate reading comprehension skills. Previous researchers have observed that simply removing the requirement for
decoding is not enough to allow students to improve reading comprehension (Schmitt et al., 2011). Students will require teacher assistance to develop these additional skills.

Researchers have noted that teacher skill is an important factor in student success with assistive technology (Dimmitt, 2007; Edyburn 2003, 2004b), but that keeping up with technological developments is a significant challenge for busy teachers (Edyburn, 2004b). The program described in this study provides an effective model which remediates and compensates for persistent student difficulties while providing professional development for home school teachers.

This case study of the experience of six students and two teachers demonstrates what can be achieved when resources and time are allocated to achieving proficiency with assistive software, even for junior students who have had years of reading remediation. It is important to monitor students’ reading performance, and to consider assistive technology early in the junior grades, before a sizable and persistent achievement gap is established. A short term, intensive program such as the one in this study is one effective way to address reading difficulties in a timely way to the benefit of both students and teachers. Skillful use of assistive technology in the junior years may enable students to fulfill their academic potential during their years in elementary, secondary, and post-secondary education, as well as in the workplace and beyond.
References


Appendix A: Letter to Parents of Students in the Program

Dear Parents:

I am a graduate student at the University of Toronto: Ontario Institute for Studies in Education (OISE) and I am conducting a research study that looks at children’s reading skills with and without intensive training in the use of Kurzweil text reader software. Children’s reading skills affect many other areas of their education. Text reader software can improve students’ ability to read with understanding. Students receive training in the use of the software at their home school, but some continue to struggle with reading. The [program] offers an intensive, technology focused six-week program which addresses specific goals for each student, including improved skill in the use of their computer and Kurzweil. I hope that this project will lead to a better understanding of how best to teach students to use their technology to improve their reading. I would like to include your child in the study.

The information gathered will be shared with the [Special Education] Department, [program] teachers, and the schools of the participating students. It will also be incorporated into the professional development offered by the [program] staff to the teachers of future students attending the [program].

During the six-week [program], your child will be asked to participate as usual in the program. Teachers will observe their progress and discuss with your child the strategies that work best for him or her. Teachers will share their observations as part of the study. Your child’s responses will not be identified by name and I will not use information from the Ontario School Record. With your permission, I will look at the referral form to the program, which contains information regarding your child’s learning profile and the goals for the session.

The [school board] Research Advisory Committee and subsequently your child’s school Principal have officially approved this study. When the study is completed a report on the findings will be available from the [program] for interested parents.

Please complete the form on the second page of this letter and return it to your child’s [program] Teacher when you visit during the week before the program. I will be at the [program] at the time of your visit and will be available to answer any questions you may have. If, during the research project your child is unwilling or unable to participate, his/her feelings will be respected.

I sincerely appreciate your co-operation. If you would like to receive more information about the study, please contact me at ….. or my OISE faculty supervisor, Dr. Daphne Heywood, at …..

Thank you,

Heather White
Appendix B: Parent Consent Form

Child’s Name ____________________________________________

Indicate your choice by checking the appropriate box:

☐ I give permission for my child to participate in the OISE/University of Toronto research study conducted by Heather White and my child’s [Program] teacher.

☐ I do NOT give permission for my child to participate in the OISE/University of Toronto research study conducted by Heather White and my child’s [Program] teacher.

Signature of parent/guardian ____________________________________________

PLEASE RETURN TO YOUR CHILD’S [PROGRAM] TEACHER BY JAN. 15, 2010
Appendix C: Post-program Interview Questions for Teachers of Program Students

1. Describe the reading behaviour of your students at the start of the 6 week [Program] session, with and without the Kurzweil text reader software and computer:

2. Describe the reading behaviour of your students at the end of the six-week [Program] session, with and without the Kurzweil text reader software and computer:

3. What text reader experience did your students have before the start of the session?

4. What goals did your students have for themselves at the start of the session?

5. What goals did you have for yourself when you began the project?

6. Are there advantages to using this kind of text reader?

7. Are there disadvantages to using this kind of text reader?

8. How did the project impact students’ reading comprehension?
   (Probe if needed: What assessment methods did you use?)

9. Did this approach impact your ability to meet different students’ needs?

10. What problems did you experience through the project?

11. Do you think this experience changed how your students look at reading?

12. What strategies did you feel worked best to teach students to use the text reader software?

13. Do you have any other advice for teachers who are using a text reader in their classroom?
Appendix D: Likes and Dislikes: Student Comments About Kurzweil

Comments from a discussion with program teachers during Week 3

*Things we like:*

“Our it reads to you”

“It Kurzweil highlights the words as you read”

“Can listen to a voice you like”

“It has a highlighter”

“You can change the speed of the voice”

“It helps me with writing”

“It helps me fix words I spell wrong (you can hear the words)”

“It helps me with new vocabulary”

“I can use sticky notes to add facts I know”

*Things we don’t like:*

“When you can’t find your word on the predictor”

“It tries to read pictures, symbols and page numbers”

“The pronunciation of some words”

“No expression”

“Voice note is not long enough”

*Things we need to work on:*

“Understanding and using the toolbars”

“Using Dragon Naturally Speaking with Kurzweil”
Appendix E: Sample Artifact of Student’s Top Ten Strategies

M’s Top 10 Strategies

1. DRAGON ~ “It helps me with my writing because I would rather talk than write it down and sometimes I talk too fast when others are writing for me.”

2. TEACHER CONFERENCE ~ “I’m able to talk to my teacher and do stuff with her.”

3. KURZWEIL ~ “If I need something scanned to read or if I need to write a test with my voice recording, I can use Kurzweil.”

4. GEM BOX ~ “I know my goals have been set and I have worked on them.”

5. I’M DONE CHART ~ “I know if I’m done or not. I like to see if it is something I need to work on. It’s good to keep track.”

6. QUICK PICS ~ “It helps me remember what to read and what I will need to write. It’s like Hank Zipzer but only as a movie.”

7. HOMEWORK TRACKING ~ “I know I’ve done my homework when I get a sticker.”

8. RAZ-KIDS ~ “I can read the book by myself or have it read to me. When I’m reading by myself and I get to a big word I don’t know, it will tell me the word.”

9. TOP 10 STRATEGIES ~ “I liked being able to choose what works best for me. People usually tell me what will work best for me and sometimes that doesn't work. Now I know for sure what works.”

10. D.E.A.R. ~ “I can read while it is quiet. I can read a C.D. book on the computer.”
## Appendix F: Technology Summary from Program Teachers

### Technology (and Assistive Software)

| **AlphaSmart or Neo** | * simple, portable, low cost, computer companion (like a little laptop)  
Both systems are easy to use, lightweight and affordable. They provide a wide range of word processing capabilities and integrate effortlessly with desktop and laptop computers. Both offer a full-sized keyboard and extraordinary battery life. Neo is the updated version of AlphaSmart, providing a 50% larger display screen and twice as much memory. |
| **CHATT (FirstClass 9.1)** | * enables schools to create collaborative online learning communities that enhance communication between students, parents, teachers and administrators  
Student email: FirstClass delivers a powerful messaging platform that is cost-effective, easy to maintain and designed to ensure the safety and security of students.  
*Download the FirstClass client from the [School board] website [omitted]. Click on Student Resource -> CHATT web access -> Select operating system -> Download Now* |
| **Comic Life** | * fun, easy and powerful application that expands what you can do with digital photos  
This software lets you create astounding comics and beautiful picture albums. It is easy to use and works easily with your photo collection. Drag in pictures, captions, lettering text and speech balloons. Comic Life also gives you fun and professional templates for instant and impressive photo layouts. |
| **Co:Writer** | * a word prediction software used to increase independent writing skills (Ministry licensed)  
Co:Writer makes predictions for spelling, grammar and vocabulary while a student types using a word processor or email program. Students with writing difficulties produce quality, content-rich sentences that exceed the expectations of teachers, parents and…even themselves. From the first letter a student types, the program generates possibilities for the word by combining knowledge of spelling (phonic and dictionary), grammar rules, context clues, student history, and letter cues. With this writing and typing support, students are better able to overcome mechanical barriers that then allow them to focus on conveying ideas. |
| **Digital Voice Recorder** | * portable digital dictating machine  
A removable memory stick records all dictation on a small, compact, high capacity recorder. Allows for over 100 minutes of recording time. |
|---------------------------|--------------------------------------------------------------------------------------------------|
| **Dragon Naturally Speaking** | * speech to text software (Ministry licensed)  
A fast, easy and accurate way to turn speech into text more than three times faster than typing. Dictate into virtually any windows-based application at up to 99% accuracy. Helpful for those who have good ideas and a lot to say but have difficulty getting it down on paper. |
|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| **Franklin Talking Dictionary** | * portable talking dictionary  
This small device looks a lot like a calculator and allows you to check your spelling accuracy. It will read the word out loud and spell the word letter by letter for you. |
|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| **Kidspiration** | * appropriate for primary and junior students  
Kidspiration is a computer program that can be used to create graphic organizers. These visuals may include pictures, text, and spoken words to represent thoughts and information. Kidspiration can be used for a variety of applications such as:  
  - brainstorming  
  - organizing ideas for writing  
  - grouping ideas into categories  
  - expressing thoughts  
  - working through the writing process  
  - developing reading comprehension  
  - remembering information |
|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| **Kurzweil 3000** | * text to speech software  
A premiere computer program that reads text to you. The text can either be scanned in, if it’s a book or magazine article you want to have read to you, or you can import an existing electronic file. In addition, you can type directly into the Kurzweil screen and the program will read back what you’ve typed. This software includes decoding, study skills, writing and test taking tools designed to adapt to an individual’s learning style and minimize frustration for both the learner and educator. |
|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| **OpenOffice (Impress)** | * a presentation program similar to Microsoft PowerPoint  
Impress is an innovative tool for creating effective multimedia presentations (or slide shows). Presentations will stand out with 2D
and 3D clip art, special effects, and high-impact drawing tools.

| **SMART Ideas** | * graphic organizer software (Ministry licensed)  
Smart Ideas software brings the power of visual learning to the classroom. Students can better analyze and understand complex ideas by building multi-level interactive maps in this fun, colourful software. |
| **SMART Notebook SE (Student Edition)** | * combines the simplicity of a whiteboard and the power of a computer  
This easy-to-use software allows teachers to create, deliver, and manage interactive lessons for their students using SMART Board interactive whiteboards.  
This interactive learning software helps students complete school work, take notes, and organize digital material. |
| **Premier** | * Premier AT Home provides assistive technology to all [School Board] students and staff  
Software includes the following applications and more:  
- **Scan-and-Read**: allows a document to be scanned and then read back to the user (text can also be summarized and notes can be extracted)  
- **Universal Reader**: reads any electronic text, including websites  
- **Talking Word Processor**: allows the user to hear what he or she has typed  
- **Word Prediction**: assists with spelling  
- **Talking Calculator** |
| **WordQ** | * helps you write independently with confidence  
WordQ is a software tool used along with standard writing software. It suggests words for you to use and provides spoken feedback to help you find mistakes. Predictions are based on creative spelling. |
| **WordQ/SpeakQ** | * for those who can type but have trouble with reading and writing  
SpeakQ plugs into WordQ and adds simple speech recognition. It features a simple training interface where the computer prompts you by voice what to say. You can then dictate directly into any document or dictate into WordQ’s prediction list. To keep it simple, there are no verbal commands. |
| **Windows Movie Maker** | *a video creating/editing software*  
This software is fun and easy to use with a few drag-and-drops. It contains features such as effects, transitions, titles and credits. |
| **Write:Out loud (SOLO)** | *a talking word processor used to help students self-correct their writing (Ministry Licensed)*  
This easy to use word processing software gives immediate speech feedback to students as they type words, sentences and paragraphs. As they draft their assignments, they see and hear if their writing makes sense. They can listen for proper word usage, tense, inflection, omitted words, and misspellings. Students with writing difficulties can hear, as well as see, what they write so that they can compose, review, revise and correct their work independently. |
Appendix G: Favourite Website Summary from Program Teachers

**Great Web Sites**

### Reading
- http://www.raz-kids.com/
- http://www.audiobookconnection.com/
- http://www.storylineonline.net/
- http://www.guysread.com/

### Keyboarding
- Dance Mat Typing
- http://www.bbc.co.uk/schools/typing/
- http://www.powertyping.com/

### Math
- http://www.coolmath4kids.com/
- http://www.funbrain.com
- http://cemc2.math.uwaterloo.ca/mathfrog/
- http://www.numbernut.com/
- http://www.aaamath.com
- http://www.boxcarsandoneeyedjacks.com/

### Other
- http://nationalzoo.si.edu/
- http://www.howstuffworks.com
- http://www.factmonster.com/
- http://funschool.kaboose.com/

### Words and Spelling
- http://www.wordplays.com/
- http://www.wordle.net/