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The role of technology in overcoming disability : an individualized technology plan for students with dyslexia

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The Role of Technology in Overcoming Disability:

An Individualized Technology Plan for Students with Dyslexia

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THE ROLE OF TECHNOLOGY IN OVERCOMING DISABILITY;

AN INDIVIDUALIZED TECHNOLOGY PLAN FOR

STUDENTS WITH DYSLEXIA

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ABSTRACT

The purpose of this study was to identify the technology skills and strategies that students with dyslexia use to overcome their learning disability. The literature suggests that there are many technologies that help students with dyslexia. However, the problem is that many students, families, and teachers do not know the skills and strategies that are most effective. The literature suggests many strategies that aid dyslexics performance in reading and writing. This research uses an Individualized Technology Plan to identify the technology skills and strategies that eighth grade students are using at a technology enriched independent school for students with language-based learning disabilities. This study compares student performance on the Test of Written Language (TOWL) when administered with a handwritten narrative and with a word processed narrative. The results indicate that students improve an average of 2.3 grade levels when they use a computer on written conventions and written language. All students use at least one technology strategy to help them with reading and an average of three technology strategies with writing. In conclusion, teaching students with dyslexia technology strategies for reading and writing makes a significant difference in their performance.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

Introduction

In 1979, Apple Computer ran the advertisement, "What every educator should know about desktop computers." It signaled a new age of technology and innovation in the field of education, with "drill and practice, tutorials, problem-solving games, simulations, and more." The age of technology in education had begun.

Surprisingly, many technologies were being used in Special Education long before the appearance of computers in schools: the Perkins Brailler, which prints large-type books, the megascope to project and magnify print, a device which compressed speech to more than 320 words per second, and a talking calculator were all invented before the invention of a personal computer in the mid-1970's (Blackhurst, 2005). Many different devices were invented to provide access to learning for people who could not hear, see, or read because of different types of disabilities.

Assistive Technology

With the emergence of the microcomputer, the field of "assistive technology" expanded rapidly. Computers created the opportunities for incredible new applications for students with learning differences, such as: multimedia and

computer-assisted instruction, synthetic speech, text-to-speech synthesis, enlargement of text, voice recognition software for those who cannot write, online multimedia to enhance learning, as well as many other technologies (Blackhurst, 2005). Computers provided students with disabilities opportunities to learn and achieve by providing support in reading, writing, and learning new information. In 1988, the first law which *mandated* assistive technology for students with disabilities was passed: Public Law 100-407, the Technology-Related Assistance Act for Individuals with Disabilities. As early as 1988, the federal government recognized the importance of assistive technology for all students.

It made available "funding for statewide systems and services to provide assistive technology devices and services to individuals with disabilities." (Blackhurst, 2005).

In 1997, the Individuals with Disabilities Education Act (IDEA) mandated that every IEP team consider assistive technology for *every* student.(Blackhurst, 2005). Assistive technology had to be addressed as part of every IEP. This act provided monies for assistive technologies for students in Special Education programs. The Assistive Technology Act of 1998 provides states with federal discretionary grants to help with State Assistive Technology Act Projects. These grants must be equally available to all individuals with disabilities, regardless of their type of disability (Bailey, 2005). This law requires that individuals have equal access to assistive technology, regardless of their disability. Money from the federal government for assistive technology was made available through different

departments in each state. These monies became available to the first nine states, starting in 1989 and last state, the U.S. Virgin Islands, in 1995. Grants are available from these monies to assist individuals with disabilities in accessing assistive technology devices and services. However, many students have difficulty obtaining needed assistive technology for use at school. (Bailey, 2005) This begs the question, "Why are students with all disabilities not getting equal access to assistive technology, even though it was required by law under IDEA and money was provided to states through the State Assistive Technology Act?"

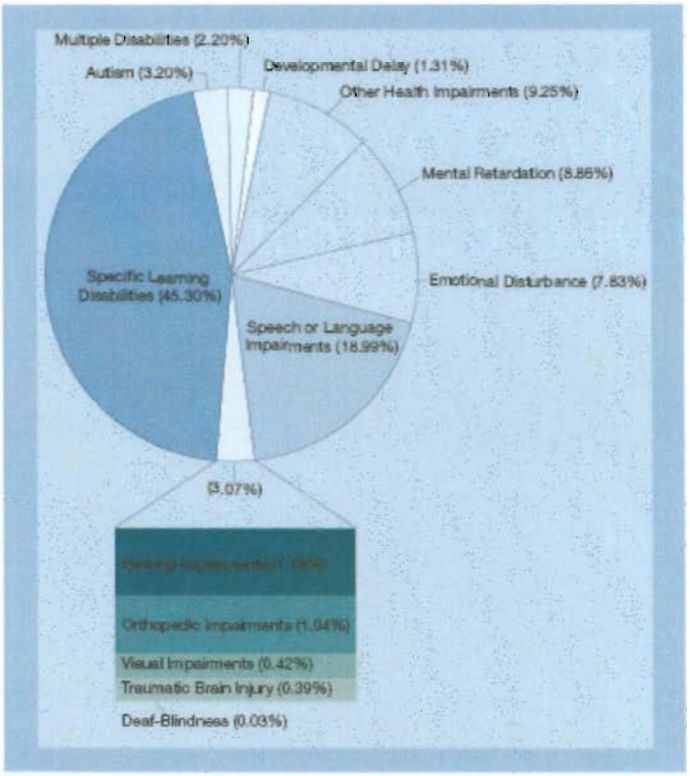
Researchers associated with Quality Indicators for Assistive Technology, such as Zabala, 2005, cited three realities which complicate the development of assistive technology services for educational settings: (a) the complexity of issues and processes related to assistive technology, (b) large numbers of diverse individuals involved in the processes, (c) lack of a unifying set of standards of descriptors to aid members of IEP teams and school districts in the development, provision, selection and evaluation of quality assistive technology services. These three reasons, the complexity, large numbers of people, and lack of standards, all make it difficult for teachers and schools to incorporate assistive technologies into schools (Zabala, 2005)

Types of Students in Special Education

Special Education comprises a large number of diverse individuals (Figure 1) There are thirteen different exceptionalities which qualify students to receive services from Special Education programs. Forty-five percent of the students in

Special Education programs have specific learning disabilities which are often called "learning disabilities" or learning differences. Twenty-one percent of students in special education programs are diagnosed with speech and language impairments. These two categories, specific learning disabilities and speech and language impairments, are often considered "language-learning disabilities." These two categories comprise what are called "high incidence disabilities" because they occur most often. Students with high incidence disabilities are the most likely, of all the categories of disability, to be educated in mainstream educational environments (Holland, 2008).

Figure 1. Percentage Distribution of Students (Ages 6-21) With Disabilities, 2005



Source: www.IDEAdata.org, Table B2A. Children Served in the 50 States and D.C. (including BIA schools) Under IDEA, Part B, Ages 6-21 by Age Group and Disability.

Low-incidence disabilities are the eleven types of disabilities which occur less frequently: Other Health Impairments 9.25 %, Mental Retardation 8.9 %, Emotional Disturbance 7.8 %, Autism 3.2 %, Multiple Disabilities 2.2%, Developmental Delay 1.3%, Hearing Impairments 1.2%, Orthopedic Impairments 1%, Visual Impairments 0.4%, Traumatic Brain Injury 0.4%, and Deaf-Blindness 0.03%. Students with both high-incidence and low-incidence disabilities are both entitled to a Free and Appropriate Public Education (FAPE) by law, in the Least Restrictive Environment (LRE). That means that all students have a right to be taught in the most mainstream school program that meets their educational needs.

Each student in each disability category (listed above) could benefit from specific types of assistive technology. Within each disability grouping, student needs vary, as will assistive technology needs. This complexity makes it extremely complicated for special education teachers to understand and choose the correct technology for each student.

Furthermore, large numbers of teachers leave education. The National Commission on Teaching and America's Future reported that one-third of all new teachers leave the profession after three years, and forty-six percent are gone within five years. (Kopkowski, 2008) This high turnover rate makes it very difficult to maintain a high number of trained teachers, which Zabala (2005) cited as a hinderance to assistive technology development.

Lastly, the lack of standards for assistive technology mean that teachers often do not know what might be possible or necessary for students in the area of assistive technology. Many teachers do not have the standards they need to make effective judgements about which technologies would be most effective for students (Zabala, 2005). Teachers often do not have a specific set of standards to apply to individual students during the writing of an IEP or during instruction.

Statement of the Problem

Many students with learning disabilities could be educated in the mainstream environment with the use of assistive technologies (Golden, 1999; Edyburn, 2001; Male, 2006). However, as Zabala (2005) noted, teachers often do not know which technologies would be most effective for specific students because of the complexity of students and types of technologies, large number of teachers, and the lack of standards for assistive technologies. To simplify this problem, it makes sense to narrow down the research to one type of disability. For the purpose of this study, it will be the category with the largest percentage of students with disabilities, students with specific learning disabilities.

What about students with specific learning disabilities? Often these students are identified as having problems with reading, writing, and/or math. They are diagnosed as having a processing difficulty, such as visual-motor, physical, and or auditory, and possess an average or above average intelligence. Within this category are students who struggle with language learning disabilities, such as dyslexia. To

further narrow down the problem, this research will focus on students with language-learning disabilities, who will be grouped in the general category of dyslexia.

Many researchers have found that technology makes difference in the quality of education for students with dyslexia. Studies have found that text-to-speech, audiobooks, multimedia integration, speech-to-text, and electronic graphic organizers, transform the educational experience for students with learning variations (Blair, 2005; Edyburn, 2005; Higgins, 2004; Lewis, 2005; Male, 2006; Shaywitz, 2003; Sitko, 2005). However, it appears that very few students on the central coast of California have access to this technology, nor do they know how to use it.

Often, school districts do not want to pay, or are not able to pay for computers for all students to use, nor all students with disabilities (Edyburn, 2001). Money for technology usually provides computers or software for all students, such as in a technology lab in a general education environment. Students with high-incidence disabilities, such as specific learning disabilities and dyslexia may have access to that technology, but often do not receive instruction in how to use that technology to help mitigate their own personal learning challenges. Instead, they learn to use word-processing programs, or digital media programs in a general way, with their peers through the state mandated technology courses or middle school and high school.

As depicted in Table 1, money for assistive technology is often spent for students with the most need, which has historically been considered students with low incidence disabilities, (Edyburn, 2001, Golden, 1999). Edyburn (2001) finds that

of the many students who currently use assistive technology, the most common

Table 1. **Anticipated Assistive Technology Use**

Disability	% Expected AT Use
Deaf and Hard of Hearing	100%
Blind and Visually Impaired	100%
Physical Disability	100%
Deaf/Blind	100%
Multiple Disabilities	100%
Traumatic Brain Injury	50-75%
Autism	50-75%
Learning Disability	25-35%
Health Impairment	25-35%
Cognitive Disability	25-35%
Speech/Language Disorder	10-25% *
Emotional Disability	10-25%

* Most students who need and/or use augmentative communication devices have an identified disability other than "speech/language," thus the lower projected usage for this diagnostic category.

Source: Golden, D. (1999). Assistive technology policy and practice. What is the right thing to do? What is the reasonable thing to do? What is required and must be done? *Special Education Technology Practice*, 1(1), 12-14.

applications involve technologies that overcome physical challenges or enhance communication abilities. Golden (1999), a researcher in this field, created a table to help school districts anticipate the use of assistive technology by disability category. She suggests that 25-35% of students with Learning Disabilities should be using assistive technology, whereas 100% of students qualified as Deaf and Hard of Hearing, Blind and Visually Impaired, Physically Impaired and Multiple Disabilities should receive funding for assistive technology. In theory, students with high incidence disabilities receive funding for assistive technology 65-75% less often than

students with high incidence disabilities.

It appears that students with dyslexia are much more infrequently provided with the technology that would allow them to perform up to their potential. Edyburn (2001) suggests that current assistive technology delivery systems are not able to be expanded to respond to the needs of students with high incidence disabilities. The influx of students would overrun the system.

The irony is that many families have computers at home that students can use. The National Center for Educational Statistics suggests that 71% of students use computers at home (National Center for Education Statistics, 2007). However, many students do not know the specific technology strategies, nor own specialized software that would be helpful for them because most assistive technology specialists spend time assessing students, and implementing technology for students who qualify, rather than teaching students the necessary technology skills and strategies for home computers. (Edyburn, 2001) Many students could use text to speech, word prediction software, writing organizational tools, and/or spell check on their own computers, as previously suggested by researchers in the field, yet students are not taught the correlation between technology and their own personal needs. Often, computer classes focus on students learning software programs, rather than utilizing technology to help a personal mitigate their own personal struggles with learning. Students in Special Education could be taught in a special education setting if teachers had adequate training and support.

The field of Special Eduction has a term for technology that helps people

with daily life activities: Assistive Technology. Colleges offer rigorous certification programs in assistive technology, where specialists conduct Assistive Technology Assessments for students to identify the skills and technologies necessary for individual students. Lisa Wahl, in conjunction with WestEd, wrote a report called, *Alliance for Technology Access Report on the Need for Assistive Technology Expertise in Education and the Creation of New Models.* She reports, a concern about the lack of available specialists who can conduct effective assistive technology assessments (Wahl, 2002). While her report was conducted in 2002, it appears similar to today: not many teachers can conduct competent assistive technology assessments. The promise of assistive technology is still unfulfilled.

Purpose of the Study

The purpose of this research is to study students with dyslexia who are successfully using technology to overcome their disabilities at an independent, elementary-middle school on the central coast of California. Students enter this independent school with a diagnosed language learning "disability," which means that they have a processing disorder and are statistically significant below their grade level in reading, writing, math, and/or oral language. After two to four years, over 85% of students reenter mainstream education and no longer qualify as "learning disabled." My goal is to identify how some of these students are using technology to overcome their disability.

Based upon research about technology for students with learning differences and common practices at this independent school, an Individualized Technology Plan

was developed. This one-page Individualized Technology Plan identifies the most successful technology skills and strategies for students with dyslexia and provides space for teachers to include testing data about reading, writing, research, organization, and typing speed. The purpose of the Individualized Technology Plan is for teachers, students, and families to identify student technology needs and obtain the necessary skills before a student transitions to a mainstream educational environment. For the purpose of this study, this Individualized Technology Plan serves to tie student assessment data in reading and writing to technology skills and strategies that support students in reading, writing, organization, multimedia, and research.

Research Questions

1. What skills and strategies in the Individualized Technology plan do eighth grade students with diagnosed language learning disabilities use to guide and improve their reading and technology?

2. What strategies in the Individualized Technology plan do eighth grade students with diagnosed language learning disabilities use to guide and improve their writing and technology?

3. What technology skills do eighth grade teachers explicitly teach in their classroom to help these students succeed?

4. What technology skills and strategies do alumni think are most important for these students who are transitioning to high school?

Definition of Terms

Accessibility-The degree to which software can be used comfortably by a wide variety of people, including those who require assistive technologies (online at www.sun.com)

Assistive Technology- Equipment that enhances the ability of students and employees to be more efficient and successful.

Dyslexia- a language-based learning disability. Dyslexia refers to a cluster of symptoms, which result in people having difficulties with specific language skills, particularly reading. Students with dyslexia usually experience difficulties with other language skills such as spelling, writing, and pronouncing words. Dyslexia affects individuals throughout their lives; however, its affect can change at different stages in a person's life. (online at http://www.interdys.org)

Language-Learning Disability- a disorder that may affect the comprehension and use of spoken or written language as well as nonverbal language, such as eye contact and tone of speech, in both adults and children (online at http://www.ldonline.org)

Learning Difference or learning variation- for the purpose of this study, learning difference and learning variation acknowledge the lack of precision of the term "learning disability." The terms learning difference and learning variation signify the ways in which students with dyslexia and language-learning "disabilities" process information is different in the brain. With successful instruction, these students are not necessarily disabled and can possess unusual talents.

Multimedia- A combination of multiple media types, including text, graphics, animation, audio and video.

Technology Skills- For the purpose of this study, technology skills refer to specific ways that a student uses technology software to be successful in school

Technology Strategies- For the purpose of this study, technology strategies refer to a plan of action designed to mitigate student learning differences.

CHAPTER II

Literature Review

Assistive technologies have enhanced the lives of people with low incidence disabilities such as deafness, blindness, and other physical disabilities since the 1800's (Blackhurst, 2005). Assistive technology also makes a difference for students with high incidence disabilities, such as dyslexia (Edyburn,2001). This chapter is a review of the literature published between 1992 and 2008 about how the technology enhances learning for students with dyslexia. It is organized into two sections, Reading and Technology and Writing and Technology.

Dyslexia manifests most frequently as a difficulty with reading and writing; meanwhile the student with dyslexia often appears to fit in intellectually, verbally and socially. Dyslexia is a specific learning disability of neurological origin that is characterized with difficulties with accurate and/or fluent word recognition, spelling and decoding abilities. (International Dyslexia Association, 2000). Fifteen to twenty percent of the population has a reading disability. Of those, eighty-five percent has dyslexia. Furthermore, dyslexics can be very bright, and are often gifted in areas that do not require strong language skills, such as art, computer science, design, drama, electronics, math, mechanics, music, physics sales, and sports. (International Dyslexia Association, 2000). Thomas West, author of *In the Mind's Eye*, opens his book with the following:

> Several years ago, I was intrigued to learn that some neurologists were coming to believe that certain forms of early brain growth have beneficial effects at the same time that they produce notable difficulties in brain function. As I had considered the lives of a number of especially creative historical persons, I was impressed by the frequency with which they had curious deficiencies mixed with the more obvious gifts and special talents. (West,1997, p.7)

He goes on to suggest that while dyslexics have deficits in areas that effect language, spelling, and automatic recall, they have great talents in being able to convert almost anything to pictures in their mind. This strength has incredible benefits in areas of visualizing science concepts, the visualization and manipulation of three dimensional objects in their mind, and graphical representations. No matter how great the talents in visual processing, all students must attend school. Here, the first hurdle is reading.

Reading and Technology

Most programs which successfully teach students with dyslexia to read and write use a multi-sensory approach such as Slingerland (Sears, 1993) Orton-Gillingham (Oakland, 1998), or Lindamood-Bell (Torgesen, 1999). These programs allow dyslexics to code and decode words using a structured, multi-sensory approach. Once children learn to read, they then practice reading to learn (Edyburn, 2005). However, struggling readers, such as dyslexics often struggle with reading fluently enough to understand and comprehend what they are reading (Pressley, 2006). Struggling readers often lag behind their peers in their ability to read fluently

and understand what they have read. As the reading gets more difficult, students with dyslexia are often placed in increasingly more restrictive classroom environments as they get older for remediation purposes. As a result, many creative, visual-thinking, students with dyslexia remain in the throes of remediation instead of reaching their full potential (West, 1997).

Reading is the most important academic skill for students to learn, influencing not only their success in school, but their eventual opportunities for employment, civic contribution, and personal enrichment. For many students, poor reading achievement constitutes a major barrier to learning and opportunity (Strangman and Dalton, 2005). For a dyslexic student, reading is the first threshold to cross toward academic success.

Computer skills and strategies can assist students in all areas regarding reading: phonemic awareness, vocabulary, reading fluency, and reading comprehension (Shaywitz,2003). The first building block of reading is phonemic awareness:

> The ability to notice, think about, and work with the individual sounds in spoken words. An example of how beginning readers show us they have phonemic awareness is combining or blending the separate sounds of a word to say the word (*/c/ /a/ /t/cat.*)(www.ldonline.org)

Phonological awareness is an of understanding the relationship between sounds, word parts, and letters. It is often the first building block for people learning to read (Shaywitz, 2003).

Phonological Awareness and Technology

Many computer software applications have been proven to be effective to improve phonemic awareness (Blok, 2002; Edyburn, 2003; Strangman, 2005; Male 2006). These software programs allow students to learn to understand the role sounds play in words and practice skills at their instructional level. Training that involved explicit instruction in sound manipulation was most effective. (Strangman and Dalton, 2005). According to Edyburn (2005)and Shaywitz (2003), some promising software titles that address phonemic awareness are as follows in Table 2:

Table 2. Software Companies and Software Titles for Reading

Software Company	**Software Title**
Lexia	Early Reading Primary Reading Strategies for Older Students
Intellitools	Balanced Literacy
Scholastic	Wiggleworks Balanced Literacy
Riverdeep	Destination Reading
Talking Finger	Read, Write, Type!
Don Johnston	Simon Sounds it Out
Laureate Learning	First Words
Tom Snyder	Reading for Meaning

These computer programs adjust the lessons according to students mistakes and successful completion of activities. They are considered Computer Aided Instruction (CAI) (Blok, 2002) and have been found effective to help students learn phonemic awareness, especially for at-risk students (Blok, 2002).

Vocabulary

Vocabulary has long been known to be important to reading. Both oral vocabulary and written vocabulary are important to the understanding of written texts (National Reading Panel, 2000):

> The studies reviewed suggest that vocabulary instruction does lead to gains in comprehension, but that methods must be appropriate to the age and ability of the reader. The use of computers in vocabulary instruction was found to be more effective than some traditional methods in a test studies. It is clearly emerging as a potentially valuable aid to classroom teachers in the area of vocabulary instruction. (National Reading Panel, 2000)

Figure 2: Using Google to define words

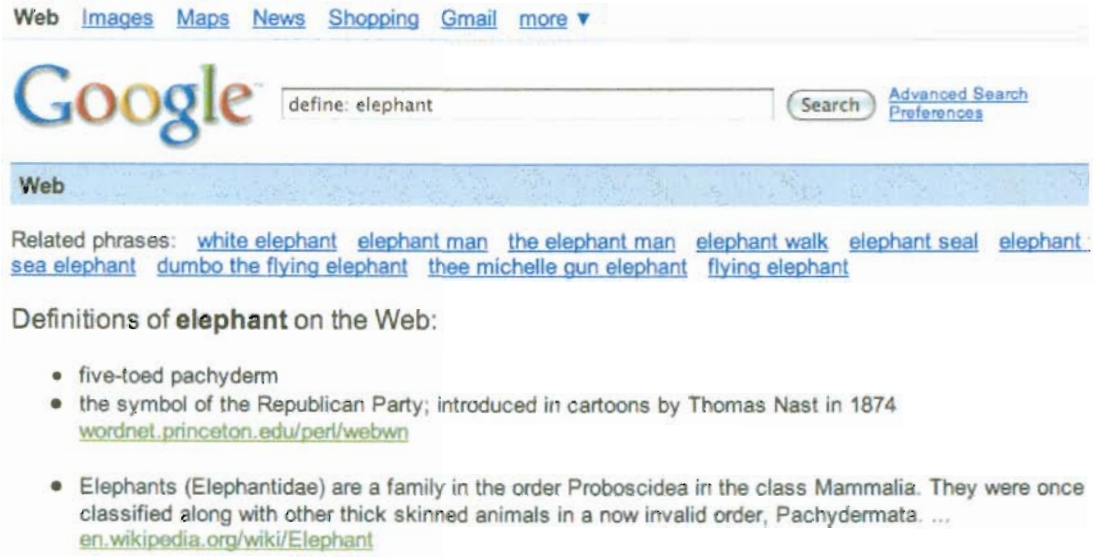


Figure 3. Using Google to display images of words

Computers and technology can be an effective tool for vocabulary instruction. Students can read text online or use hypermedia guides (Swanson & Trahan, 1992; Boone & Higgins, 1993, Strangman, 2005). Digital text provides students with auditory support, such as having the words read aloud, and providing visual representations for word meanings. Further research is necessary in this area, specifically with the advancement of the internet.

New tools on the internet provide students with significant support in the area of vocabulary. Students use the search engine Google to define words (Figure 2) and find images to support a visual understanding of the words (Figure 3). For instance, a student can type: define: elephant into the Google search window and press return. An entire page of definitions will quickly be shown. Students can highlight the definitions and have them read aloud through the built in features of both Mac and Windows Operating Systems. They can then click the Images tab in the Google search engine and see images on the internet of Elephant. More research needs to be conducted on the role that the internet can play in this new way of using technology to look up works and find an image to support the text.

Reading Fluency

Fluency, as the automatic recognition of words is important for the understanding of text meaning. It allows readers to understand the meaning of words and therefore the comprehension of a text. Oral reading with feedback has been shown to enhance fluency for students (National Reading Panel, 2000; Blok, 2002; Shaywitz, 2003; Pressley, 2006). Many software programs allow students to improve their reading fluency because they provide instant feedback to students as they read. Research has shown that certain software programs can increase student reading fluency. Read Naturally, Great Leaps Reading and Read It are all software titles that help students improve their fluency (Shaywitz, 2003; Male, 2006). These software programs provide students with repeated readings with accurate feedback to increase fluency.

Many technology strategies exist to help them compensate for lack of fluency. Repeated readings have long been shown to increase student reading fluency (National Reading Panel, 2000; Blok, 2002, Shaywitz, 2003). Shaywitz (2003) suggests that Reader's Theater is an enjoyable strategy for students to increase their reading fluency. The practice of reading and re-reading a script to practice for a performance provides a natural pathway for students to increase their fluency. In a digital version of this strategy, students can record the play into a multimedia software such as GarageBand or Audacity, edit the audio to remove errors, add pictures, and burn it onto a disk to take home.

Lastly, audiobooks provide compensation for students who struggle with fluency. Rather than read material themselves, students can be given an audio version of a text. Students who listened to a tape and followed along in a book showed as much growth as students who read with teacher assistance (Strangman & Dalton, 2005). Many different agencies and companies provide audiobooks, including: Readings for the Blind and Dyslexic, Audiobooks for Free, American Printing House

for the Blind, Audible,iTunes, and Books Aloud. (Edyburn, 2003; Shaywitz, 2003; Male, 2006) Some of these are free and some are not.

Reading Comprehension

The purpose of reading is to understand what has been captured in print. It is the culmination of phonemic awareness, reading fluency, and vocabulary and difficulties with any of the previous components can effect a student's understanding of a text. Furthermore, background knowledge and text structure effect students' comprehension. (Strangman & Dalton, 2005).

According to Strangman and Dalton (2005), Text-to-Speech was shown to positively effect reading comprehension. Text-to-Speech is the ability of a computer to convert text into spoken words. A study by Elkind, Cohen, & Murray in 1993 found that text to speech has a positive effect on reading comprehension. After reading literature with text to speech for a semester, 70% of the students improved comprehension on a text to speech supported version of the Gray Oral Reading Test by approximately on grade level, and 40% realized even greater gains (two to five grade levels). (Elkind, Cohen, & Murray, 1993, as found in Strangman and Dalton, 2005). Audio support for students who struggle with reading can increase comprehension for written texts.

Writing and Technology

Writing is often a stumbling block for students with dyslexia. Difficulties with the writing process, including pre-writing, drafting, and revising have all been identified as difficulty for students with dyslexia (Montgomery & Marks, 2006). Technology provides support for students throughout the writing process (Chang, 2001; Blair, 2002; Male, 2002; Edyburn, 2003; Sitko, Laine, Sitko, 2005; Montgomery & Marks, 2006) Sitko, Laine, and Sitko (2005) report that when all learners are given access to assistive technology tools for writing, students score better on state assessments:

> Results of the preliminary study so far show that 58.7% of students who scored as "not proficient" on a standardized state assessment on the initial writing sample scored "proficient on the final writing sample. In addition, students felt better about themselves as writers (Sitko, Laine, & Sitko, 2005, pg. 581).

Within this article, the authors suggests that the process approach to teaching writing is the most common instructional method for teaching writing skills. The steps in the process approach to writing include:

(1) Planning or prewriting - generating and organizing ideas and setting writing goals

(2) Drafting - translating ideas into print

(3) Post-writing or reviewing- evaluation, revising and editing written work.

Technology allows a student with dyslexia to perform at a higher level at all three stages of the writing process (Sitko, Laine & Sitko, 2005).

Planning Phase

Technology is not fairy dust for helping students improve their writing. According to Edyburn and Gardner (1999), word processing alone has been found to have very little effect on the quality of writing unless it is accompanied by instruction in specific strategies in pre-writing, revision, peer revision, and collaborative writing. However, when word processing is taught explicitly, it has been found to positively effect the accuracy of writing of students between grade 4-12. (Sitko, Laine and Sitko, 2005).

Using a planning software program such as Inspiration, Kidspiration, or DraftBuilder (Don Johnston) in the prewriting stages greatly increases the amount of ideas students generate and the organization of their writing (Montgomery & Marks, 2006). Inspiration and Kidspiration organize information both visually and as an outline, so students can see the way their ideas are organized and make changes easily. Furthermore, students add ideas as keywords, and add details later on in the process which decreases the chances for plagiarism (Montgomery & Marks, 2006),

Inspiration and DraftBuilder software can be set to speak written text, which provides the auditory support necessary to be successful. Furthermore, students do not need to rewrite their outline after brainstorming. They can directly paste their ideas into a word processor from Inspiration, eliminating the frustration of "double work." Much research has been focused on Inspiration Software from Anderson-Inman & Ditson (1999) at the Center for Electronic Studying (Anderson-Inman & Ditson, 1999, as cited in Sitko, Laine and Sitko, 2005).

Drafting Phase

The drafting phase in writing refers to the "getting down to business" part of writing. This phase is when different drafts of writing take place-the creative work of the process. Many softwares exist to help students who struggle with this phase of the writing process, including word processing programs, speech recognition software , and word prediction programs (Sitko, Laine & Sitko, 2005).

Technology which aids in the actual drafting, or writing can be a simple word processor such as Microsoft Word, Pages, or Text-Edit. Simply word processing a piece of writing allow students to create a visually pleasing piece of work that is easily edited for spelling, punctuation, and grammar (Behrman, 2002).

Word Processors allow students to check spelling as they type and use integrated tools such as a thesaurus, word count and color coding, which provide students with easily accessed tools to boost the vocabulary and lower the number of errors (Sitko, Laine & Sitko, 2005).

Draft building software, such as Don Johnston's DraftBuilder, TextHelp's Read and Write Gold, Intellitools Classroom Suite, and Kurzweil 3000 all help students with the drafting process by providing highlighters, word prediction, customizable dictionaries, text-to-speech synthesis, and vocabulary support while students are engaged in the writing process (Sitko, Laine, & Sitko, 2005). Digital highlighters allow students to color code and transfer key ideas in specific colors to aid in organization. They then can add details and explanations for responding to text.

Word prediction software opens the door to writing for students who struggle with word finding. Software such as Co:Writer 4000, Text HELP,, Write Away 2000 and WordQ allow students to type a few letters of a words and have the software generate the most logical word to fit into the sentence, starting with the letters that have been typed. This software helps students who struggle with word finding to use advanced vocabulary and get out of writer's block (Berhman, 2002; Montgomery & Marks, 2006; Sitko, Laine & Sitko, 2005). When word prediction is paired with speech output, students increase the accuracy of spelling and word choice (Montgomery & Marks, 2006).

Speech recognition software allows students to speak their written work into a microphone and the computer reads it back. In some ways, this is the software that students dream about. All they have to do is say their essay, and the software does the work. The catch is that speech recognition software is difficult to train and requires a higher cognitive functioning level as well as a good oral language ability for it to be an effective writing tool (Sitko, Laine & Sitko, 2005). Students must be able to speak accurately, tell the software when to capitalize words, where to place punctuation, and how to edit the typed words carefully. This software needs to be trained to a person's voice for many hours before it becomes more reliable, making it difficult for students who are impatient. Some studies report that Speech recognition software is not effective with students under fourteen (Edyburn, 2005).

Editing Phase

Technology provides an incredible support for struggling writers when the time comes to edit a piece of writing. Spell check, text to speech, and thesaurus contribute to student success when writing. Spell checkers allow struggling spellers to use more advanced vocabulary, knowing that the software will correct the spelling of the word (Lewis, et al, 1998). However, much research has shown that students must be taught to choose the correct word in spell check (Sitko, Laine & Sitko, 2005). Students must learn to choose an accurate replacement for the misspelled word, including having the text read aloud to increase the accuracy of word replacement. Montgomery and Mark (2006) suggest the following strategies to teach students to accurately use spell check: (a) Provide a word processing file that contains misspelled words and have students spell check (b) Provide a procedural strategy for spelling checker use (c) Provide non-computer activities, games, or worksheets that mimic the spell checker's suggestion format (d) Provide students to cooperatively spell check each other's typewritten work

Similarly, students can access the grammar check in word processing programs. Past research suggests that teachers need to be wary of grammar checkers (Lewis, 2005; Montgomery & Marks, 2006). According to Montgomery (2006) problems found with grammar checkers include:

- They identify problems that may not really be errors, but stylistic suggestions

•They fail to identify certain types of errors, such as pronoun agreement or pronoun modifiers commonly found in the writing of struggling writers.

However, she also suggests some strategies that teachers can implement to offset the difficulties with grammar check. They are:

•Teach students how to read the option box

•Coordinate grammar-check use with grammar instruction

•Provide a hard copy reference that explains the grammar rules and has examples

•Customize students' grammar checker so it identifies common errors made by specific students

•Use the grammar checker to teach solutions for homophones

•Teach different styles of writing and ask the students to critique the word choice using a grammar checker

•Activate the proof-as-you-go option. (Montgomery & Marks, 2006)

These strategies can improve the use of the grammar checker. It appears that over time, the use of grammar check has become more commonplace. In the late 1990's it appears that grammar checkers were not especially effective. However, in 2006, Montgomery and Marks suggest that using grammar checkers as a teaching tool and then as an assistive technology make its use more effective.

Another useful editing tool for writing is text-to-speech. Edyburn (2005) said that text to speech synthesis is probably the most used and the commented upon assistive technology tool today. Text-to-speech is a computer functionality or

software program which allows students to have their typed text read allowed to them with a key command. Both Apple Macintosh and Windows operating systems now have text-to-speech built in to their operating systems (Apple, 2006; Microsoft, currently online). As a result, students can highlight any text they have written, text on the internet or text on the internet, and have it read allowed to them. (Apple, 2006) When students use text-to-speech synthesis they identify more errors than when they read and edit text without text to speech (Espin & Sindelar, 1988). That being said, younger students have more difficulty using text to speech synthesis than older students (MacArthur 1998, as found in Edyburn, 2005). In practice, this may mean that younger students need to be taught specific steps for using text to speech. For instance, younger students may need to be taught to highlight one word at a time and listen to it to get used to the synthesized voice (Forgrave, 2002 as found in Edyburn 2005). Edyburn suggests that more research is necessary to fully understand the implications of text to speech with younger students.

Lastly, the thesaurus allows students with limited writing vocabulary and word-finding difficulty to increase word-choice, and therefore the quality of a piece of writing. Students can be taught to use a thesaurus to improve the quality of their written work. Montgomery and Marks (2006) suggest that students be taught explicitly to use the thesaurus before they use it with their own compositions. Students can (a) find the synonyms and antonyms of a list of words, (b) take a given story with repetitive adjectives and change them to make the story more interesting (c) take a list of immature words and replace them with more advanced vocabulary

(d) use the thesaurus to replace repeated vocabulary in their own essays (e) write stories with repeated verbs or adjectives and then use the spell check to replace the words (Montgomery & Marks, 2006). The thesaurus is a useful to for helping students to increase the vocabulary in their essays or narratives. They must be explicitly taught how to use it effectively.

Publishing Phase

Providing students with an authentic audience for their writing has long been known to make a difference for students' writing. Because of technology, there are more opportunities for students to publish, present, or share their writing skills than ever before. (Lee, 2000) Students can creating multimedia projects such as movies, podcasts, and presentations. (Rozeman, 2007; Witte, 2007; Lee, 2000). They can publish writing as wikis, blogs, and webpages with relative ease. They can use writing to communicate with people around the world using student email programs such as ePals. (McClanahan, 2001). With technology, teachers can provide students with an authentic audience for their writing.

While these studies demonstrate the effects of authentic audience on general education students' writing, more research needs to be conducted to identify the effects of digital publishing on the writing of students with dyslexia. However, it has been established that many students with dyslexia possess strengths in visual processing (West, 1997) These strengths provide an opportunity for students with dyslexia to shine in our digital age.

> In a marvelous coincidence of historical change, new opportunities are currently unfolding that may require special talents and abilities in just those areas where many individuals with learning difficulties often have their greatest strengths, such as in the visualization of scientific concepts and the analysis and manipulation of complex, three-dimensional information graphically displayed on these same personal computers. As new opportunities continue to unfold, it is not hard to imagine that skill with the manipulation of images may become more important, in some unexpected areas, than skill with words and numbers (West, 1997, p. 7)

More research needs to be conducted about the effects of multimedia use with dyslexic student writing samples. Does writing movie scripts and podcast scripts improve dyslexic student writing? How does email with international peers affect dyslexic student writing? What effect does the inclusion of digital still pictures in essay writing have on dyslexic student writing performance? How does blogging effect the quantity and quality of dyslexic student writing?

Specific Writing Software

Many different software tools are available which help students with the writing process. Many companies market software that make invaluable difference for students who have difficulty in writing. Some of the most promising ones are listed below in Table 3:

Table 3. Writing Stage Correlated with Software Tools and Titles

Stage	Tool	Products
Computer Mastery	Typing Tutorial	Mavis Beacon 2008 (Software MacKiev) Type to Learn
	Word Prediction	Co:Writer SOLO edition (Don Johnston Inc.) Read & Write Gold (TextHelp) Kurzweil 3000 (Kurzweil Educational Systems, Inc.)
	Speech Recognition	iDictate (Mac Speech) Dragon Naturally Speaking (Nuance) Via Voice (IBM for Mac OS X)
	Alternative keyboards	Intellikeys (Intellitools) Clicker 4 (Crick Software) IntelliTalk II (IntelliTools)
	Word processors with picture support	Writing with Symbols 2000 (Mayer-Johnson)
Brainstorming	Outliners & Graphic organizers	DraftBuilder (Don Johnson Inc.) Inspiration, Kidspiration (Inspiration Software)
First Draft	Portable Keyboards	Alpha Smart 3000 (AlphaSmart Inc) Laser PC6 (Perfect Solutions)
	Speech Recognition	Dragon Naturally Speaking (Nuance) Via Voice (IBM) Speech Recognition (Apple Mac OS X)
	Word Prediction	Co:Writer SOLO edition (Don Johnston Inc.) Read & Write Gold (TextHelp) Kurzweil 3000 (Kurzweil Educational Systems, Inc.)
Proof-Reading	Spell checkers	IntelliTalk II (Intellitools) Microsoft Word (Microsoft) Read&Write Gold (TextHelp)
	Text to Speech	Dictionary (Apple, built in) Text to Speech (Apple, Built in) TexEdit Plus Write:Out-Loud (Don Johnson Inc.) IntelliTalk II (Intellitools) Read&Write Gold (TextHelp) Write:Out-Loud (Don Johnson Inc.) Kurzweil 3000 (Kurzweil Educational Systems, Inc.)

Publishing	Desktop Publishing Graphics or multimedia	Word (Microsoft) Text Edit Kid Pix Deluxe (Software MacKiev) PowerPoint (Microsoft) Keynote (Apple) Pages (Apple) iWeb (Apple) iLife Applications (Apple) InDesign (Adobe) Adobe Photoshop

Table 3 Adapted from Computer Tools for the Stages of a Writing Process Model, Silko, Lane & Silko (2005)

Implementation Recommendations

Choosing the correct technology strategies and software is only one part of implementing technology. Implementation of those software strategies is just as important. According to Edyburn (2005), four factors effect the efficacy of technology use for writing:

1. Students need to be explicitly taught the structure of writing, and the practice the steps of the writing process.
2. Students must receive intensive training, especially in word-processing and skills
3. Teacher must instruct students in specific strategies for proficient writing and for effective us of the tools that the technology provides.
4. Sufficient staff development must occur before the technology is introduced into the classroom with continuing and ongoing support afterwards.

Edyburn goes on to say that these steps must not slow down the implementation of new technologies. Most schools do not implement new technologies for twenty years, which means that students often miss out on tools which could make a difference for them:

> However, these four steps should not push back the implementation time for new technologies. Teachers and schools need to take risks with new tools to provide access for students with learning challenges. It is our job to improve the implementation time for new technologies. Twenty-five years is too long for our students to have to wait to get the technology they need (Edyburn, 2005, pg. 253).

Teachers have the seemingly impossible task of implementing technology solutions both effectively, and quickly, so that students get what they need.

Summary

Technology offers students with dyslexia access to success through support in reading and writing. Software programs and technology strategies provide necessary supports for reading and writing. New technologies such as Google free applications and digital media tools provide opportunities for further study about how digital media affects dyslexic readers and writers. The biggest hurdle to providing education to diverse learners in the classroom is providing teachers with understanding and support so they can to teach students the skills they need to overcome their learning challenges.

CHAPTER III

Methodology

Most students with disabilities are not receiving the assistive technology that would allow them to be successful in school. Teachers do not know which technologies would be most effective for specific students because complexity of the students and types of technologies, large number of teachers, and the lack of standards for assistive technologies. Teachers, students and families often do not know which technologies to teach their students. Most students attend a technology class that helps them learn word processing, typing, or digital media, but these do not address trouble with students individual learning challenges. Consequently, the assistive technology mandate in IDEA is not being fully implemented by school districts. Technology is not being implemented for a majority of students with disabilities.

The purpose of this study was to analyze how a technology-rich, independent school for students with language-based learning differences is using technology to help students overcome their individual learning challenges. Each eighth-grade student completed an Individualized Technology Plan that records academic skills and assistive technology skills (Appendix D).

For this study, a qualitative action research method was employed. "Qualitative research uses narrative, descriptive approaches to data collection to

understand the way things are what it means from the perspective of the research participants,"(Mills, 2007, p.4). This method allows a story to be told about how students acquire technology skills, which skills are being used, and which ones still need to be taught, as identified on the Individualized Technology Plan.

Setting

This research was conducted at a kindergarten through eighth grade independent school for students with dyslexia and other language-based learning differences. This school provides a technology-rich educational environment for students to acquire necessary skills in technology and therefore is an ideal place to conduct this research. This school provides laptops for every child to use in every academic class, grades 5-8, as well as a technology class for all students at least an hour and a half per week. This school's goal is to use diagnostic teaching methods, so that students are learning at own their individualized ability level to acquire the skills they need to succeed. Students typically stay at this school for three years and 85% of students are able to successfully return to mainstream education. The infusion of technology into the academic program plays an important role in student success.

Participants

Participants in this study were eighth-grade students, high school alumni and eighth grade teachers from an independent, kindergarten through eighth grade school for students with language learning disabilities. Ten transitioning eighth grade

students were randomly selected to participate in this study. In order to choose students to be part of the study, students names in each of the two eighth-grade homerooms were put in a hat and five names from each homeroom were drawn to be part of this study. Students who were chosen to take place in the study took home a permission slip. If students did not return the permission slip, their parents' were called to ask their permission. If parents agreed, they were sent a permission slip and the Individualized Technology Plan and those students participated in the study. If parents did not agree, another student's name was pulled from the hat, and a permission slip was sent home (see Appendix A-D). Participants were called Subject A-J. All students presented in this study have been diagnosed with language learning disability, such as dyslexia.

Three alumni students who graduated from this school within the last two years comprise another group involved in this study. One student from each of three area high schools were selected to discuss their use of technology to help them succeed. They were sent assent forms to complete, and their parents filled out consent forms. All three families agreed to participate in the study. Alumni were called Alumni A-C. Finally, faculty who work with eighth graders were asked to be part of this study. Five of them were chosen to be part of the research and they signed consent forms (see Appendixes A-C). Teachers identified the skills that need to be included on the Individualized Technology Plan, and then provided comments on the Individualized Technology Plan after implementation (see Appendix A& D). Teachers at this site have ten years experience incorporating technology goals in their

Individualized Education Plans. They provided invaluable information about which skills are necessary. Teachers were called Teacher A-E.

Procedures

First, middle school teachers were surveyed to identify the technology skills and strategies they believe to be most useful for students to overcome their disability. These surveys helped shape the final Individualized Technology Plan document to be used with students. During the initial meeting, students filled out an Individualized Technology Plan that identified the student's level of technology proficiency. Afterwards, the researcher put all the students names from Homeroom A and Homeroom B in two different piles and chose five names from each pile. Letters of Consent were sent home with those families. All families signed the consent form. Students recorded the technology skills and strategies that they use to help them be successful in school (Appendix D). The students in the study took the Test of Written Language (see Appendix E) to ascertain their writing performance with a pencil and paper, and a writing prompt about early humans. They were then administered the same test, according to the directions, with the use of a laptop. The topic on the second test was a a futuristic colony in space. Students also tested their reading comprehension and reading fluency subtests with the Woodcock-Johnson III.

Next, alumni were interviewed to find out which technologies they use in their mainstream environments, and which technologies they think are important for students to know before they transition to high school. Students were interviewed

individually, on the phone, with a set of predetermined questions (see Appendix H) Students interviews lasted fifteen to twenty minutes. This feedback allowed this school to improve the efficacy of the Individualized Transition Plan and change any necessary components.

At the students' conferences, parents, students, and teachers, revisited the Individualized Technology Plan to note student progress. The team then identified software, skills, and hardware students and families needed to obtain or purchase.

Finally, eighth grade teachers provided feedback using an initial teacher survey and post teacher survey (see Appendix I-J) to discuss the effectiveness of the Individualized Technology Plan. This survey asked how much growth students showed throughout the semester, how much the teacher felt prepared to teach, which technologies he/she explicitly taught over the semester, and the effectiveness of the Individualized Technology Plan.

Data Collection

This study uses three different methods of data collection, an Individualized Technology Plan, a faculty survey, and alumni interviews. First, the Individualized Technology Plan identifies the key technologies available for students with dyslexia and other language learning differences. These technology skills, strategies and software were chosen based upon research and are organized by the following themes: Reading, Writing, Organization, Multimedia, and Research. These plans identify which skills students have.

Second, an online faculty survey identified key information about the value of technology for students. For instance, what technology skills and strategies do students need to know to successfully transition to high school in each of the following areas: Reading, Writing, Organization, Multimedia, Research.

Faculty were asked the following questions: Where do these skills and strategies need to be taught? What training do you personally need to help students with technology? What role do you think technology plays in students' success at this school and later at high school? Do you have any other comments about student use of technology? (see Appendix I)

Alumni interviews were conducted with their assent and parental consent, The interviews took place over the phone. Alumni were asked how they use technology in the areas of reading, writing, organization, multimedia, research, and other uses. Next, they were asked the following questions: How often do you use technology for your schoolwork at home? How often do you use technology at school? What kind of access do you have to computers at school? Where are they located? What kind and how many? What technology do you use to help you with reading? What technology do you use to help you with writing? What technology do you think is important for students to learn when they are at (the independent, K-12 school for students with language-based learning differences)? What technology skills are important for students to know before they transition from the independent school? What creativity tools do you use for school?(see Appendix H)

Lastly, teachers were asked about the efficacy of the Individualized Transition Plan (Appendix D). They were then given a copy of the Individualized Technology Plan and asked to mark any of the skills or strategies that they taught over the semester.

Data Analysis

Data analysis was coded and analyzed throughout the data collection process. The initial faculty survey, the initial and final Individualized Technology Plan, the interview, and the final survey were all put into tables to identify trends in the data. They were coded according to the categories of the Individualized Transition Plan, with the most emphasis placed upon Reading and Writing. These codes were used to identify themes about the importance of technology in students' academic lives.

Before starting the research and using the Individualized Technology Plan, the school administration agreed to its contents, its use with eighth graders, and to the research All data was locked up in a cabinet to keep it safe.

Summary

Students with learning differences, such as dyslexia, often do not learn to use technology to overcome their learning differences in school. This study investigates how eighth grade students at an independent school use technology to overcome their learning differences, which technology skills eighth grade teachers teach, and which

technology skills alumni use once they enter high school. Data was coded in regard to reading and writing skills.

CHAPTER IV

Results and Discussion

The purpose of this study was to analyze how a technology-rich, independent school for students with language-based learning differences is using technology to help students overcome their individual learning challenges. Ten, eighth-grade students completed an Individualized Technology Plan to record their technology skills in the areas of reading, writing, organization, multimedia, and research. Afterward, the students' assessment data was recorded in reading and writing.

For this chapter, each research question will be listed, and the data will be presented, followed by any relative discussion. The implications for further research concludes this chapter. This chapter is organized according to the four research questions:

1.What skills and strategies on the Individualized Technology plan do eighth grade students with diagnosed language learning disabilities use to guide and improve their reading and technology?

2.What skills and strategies on the Individualized Technology plan do eighth grade students with diagnosed language learning disabilities use to guide and improve their writing and technology?

3.What technology skills do eighth grade teachers explicitly teach in their classroom to help these students succeed?

1. What technology skills and strategies do alumni think are most important for these students who are transitioning to high school?

Research Question I

What technology skills and strategies on the Individualized Technology Plan do eighth grade students with diagnosed language learning disabilities use to guide and improve their reading?

Reading encompasses many different skills. Phonemic awareness, reading fluency, reading comprehension, and vocabulary are important building blocks of reading (National Reading Panel, 2000; Shaywitz, 2003). The following table, Table 4, shows the assessment data from ten, eighth grade students at a technology-rich, independent school for students with language-based learning differences, followed by the assistive technology strategies students reported they used for reading. Students' reading fluency and reading comprehension scores were obtained from the Woodcock-Johnson Revised, III, and normed by grade level. The assistive technology skills and strategies were noted by students on the Individualized Technology Plan.

The data suggests that all students have used or are using at least one technology strategy to help improve their reading. Seven out of ten students have experience using audiobooks of some type, either RFB&D, (Recording for the Blind and Dyslexic) a CD, or an online vendor and six out of ten students are currently using them. Two out of ten students reported that they used Read Naturally reading

software to help them improve their reading scores over two years ago. Nine out of ten students used at least one technology strategy to help them improve their reading. The only technology strategy that students are not using is computer books. Students are not using specialized computer books from companies such as Don Johnston or Tom Snyder, that highlight text as students read, and contain built in questions to help guide student comprehension.

Table 4. Reading Assessment Data and Technology Skills and Strategies Used

Student	Reading Fluency Grade Level	Reading Comp. Grade Level	Text to Speech	RFB&D	Audio books	Reading Software	Computer Books
A	3.3	3.8	✓		✓	✓	
B	7.3	PHS			✓	* Read Naturally	
C	4	4.2			✓		
D	5.8	8.3		✓		* Read Naturally	
E	13	PHS	✓	✓	✓		
F	6.2	5.3-7.8	✓				
G	6.9	PHS			✓		
H	4.9	2.4-2.6		**			
I	7.5	10.9	✓		✓		
J	7.5	5.1	✓				

✓Indicate items students are currently using
* Indicate items students used two years ago
** Indicates items students used five years ago

Discussion

Students are using technology in reading to help them with both reading comprehension and productivity. Technology often improves many students' reading comprehension because they are using two learning modalities, auditory and visual, when they use text to speech or audiobooks while following along in printed text. The research suggests that text-to-speech synthesis is effective in helping students with their reading comprehension (Elkind, Cohen, & Murray, 1993; Strangman & Dalton 2005). When most students hear a written text read aloud to them, they are more likely to understand it. This study finds that half of eighth grade students at this school are using text-to-speech to help them with their reading, regardless of their reading ability level.

Furthermore, students are using technology to help them with their productivity in reading. Dyslexics spend more time decoding words when reading than non-dyslexics because their visual memory is impaired (Shaywitz, 2003). Technology can increase dyslexics' speed in reading and therefore increase their productivity. In this study, seven out of ten students currently use audiobooks (either RFB&D, or another type of audiobook) and eight out of ten students have used audiobooks at some point in their educational career. They have the skill to read the text, it just takes them longer than a non-dyslexic.

Fortunately, the literature suggests that using technology improves students' reading skills. In one study, students who listened to a tape and followed along in a book showed as much growth as students who read with teacher assistance

(Strangman and Dalton, 2005). This study neither corroborates nor refutes the literature, but suggests that students with dyslexia use audiobooks to read more in a shorter amount of time. Moreover, there is no correlation between student reading level and their use of audiobooks. Students with all skill levels in reading used audiobooks for support. This may indicate that students are using audiobooks as a way to read more than they would without the support of audiobooks. The National Reading Panel (2000) reports that students who read more are better readers, and the students who read less fall further and further behind. Audiobooks provide additional opportunities for reading.

Fewer students from this study are using software programs to help them improve their reading. While many computer software applications have been proven to be effective in teaching phonemic awareness (Blok, 2002; Edyburn, 2003; Strangman, 2005; Male 2006), this study indicates that students at this site are not using any of this software. This may be due to the fact that every student in this school has an

entire class period every day dedicated to Language Training, a class that teaches students phonemic awareness and language skills in a structured, small class setting, in conjunction with a second Language Arts class. Students are receiving daily instruction by trained teachers in phonemic awareness, in place of computer software.

Two out of ten students reported that they used Read Naturally software in the past, which helps students improve their reading fluency and comprehension.

While they are not currently using this software, they reported it on their Individualized Technology Plan. The literature suggests that Read Naturally can successfully support students improving their reading (Shaywitz, 2003; Male, 2006). Students did not report using any other reading software.

Research Question II

What skills and strategies on the Individualized Technology plan do eighth grade students with diagnosed language learning disabilities use to guide and improve their writing and technology?

Students' writing skills were assessed three different ways. First, students' handwriting speed was compared to their typing speed on the same expository text. Next, students were assessed with Test of Written Language-3 (TOWL) using pencil and paper, and then a computer. Lastly, students were asked to identify their use of technology on the Individualized Technology Plan.

First, students were asked to copy an expository text from the Kim Marshall Series: Reading Book I, entitled *A Rogue Wave* (see Appendix E), for three minutes by handwriting. After writing their name on a piece of lined paper, they were then given a copy of the story and asked to write for three minutes. When finished, this procedure was repeated, except students were asked to use a computer to type the expository text. The following table (Table 5) demonstrates that eight out of ten students typed the passage faster than they hand wrote the passage. The two students who were not faster, were only one word slower when typing. However, the three

fastest typists typed between ten and seventeen words per minute and were between one and a half and two times faster at typing than handwriting. The two slowest typists were able to type between one to two words faster per minute than handwriting. This data indicates that even the slowest typists would be able to type up to sixty more words in an hour.

Table 5. Student Copying Speed: Handwriting versus Typing

Student	Handwriting	Typing	Times Faster
A	11.3	**22.7**	**2**
B	**17.3**	16	0.92
C	9	**10.3**	**1.14**
D	**16**	15	0.94
E	19	**36**	**1.89**
F	7	**8**	**1.14**
G	18	**26.3**	**1.67**
H	**5.1**	**7**	**1.4**
I	10.6	**21**	**1.98**
J	12	**18**	**1.5**

Second, ten students took the Test of Written Language (TOWL), a fifteen minute timed test, first by hand, and then with a laptop. They were given a picture prompt first of an early human scene, and the following instructions:

> This exercise is designed to see how well you can write a story. Look at the picture before you. You are to write a story about that picture. Before you begin writing, take time to plan your story. A well-written story usually has a beginning, middle, and end. It also has characters that have names and perform certain actions. Use paragraphs to help organize your story. Correct punctuation and capitalization will make your story easier to read. After you have made a plan for your story, begin writing, Try to write as long a story as you can. If you need more paper, just let me know. You will have only 1 minutes to think about your story and to write it. Write the best story you can. Ready? Begin. (TOWL manual, p.13)

Students repeated the process with a picture of a space scene using a laptop. Each student's handwritten and typed essay was assessed for the number of words in each story, contextual conventions, contextual language, and story construction. The latter three subtests are defined in the TOWL manual as:

> *Subtest 6: Contextual Conventions*. The student writes a story in response to a stimulus picture. Points are earned for satisfying specific requirements relative to capitalization, punctuation, spelling, and other arbitrary element in writing (e.g., paragraph indents).
>
> *Subtest 7: Contextual Language.* The student's story is evaluated relative to the quality of its vocabulary, sentence construction, and grammar.

Subtest 8: Story Construction. The student's story is evaluated relative to the quality of its plot, prose, development of characters, interest to the reader, and other compositional aspects. (Hammil & Larsen, 1996)

The first section, the contextual conventions, are commonly considered the mechanics of an essay, including punctuation, spelling, and paragraph structure. The second section, contextual language is commonly referred to as grammar, vocabulary and sentence structure. The third section, story construction consists of the elements of a story, such as character development, dialogue, and plot completion.

When looking at the assessment data (see Table 6), eight out of ten students wrote more words in their story with a laptop, although Student B had trouble with the computer becoming unplugged during the assessment period and lost time due to restarting it. Eighty percent of students were able to type more words in a fifteen minute period than with a pencil.

This data suggests that eighty percent of students were more efficient when they use a laptop. Two students wrote twice as many words with a laptop. This increase in speed could be responsible for an increase in test scores in conventions, language or story construction, because the increased time to include larger words, more advanced sentence structure, character development, conversation, or a more complete plot.

Table 6. Writing Assessment Data and Technology Skills and Strategies Used

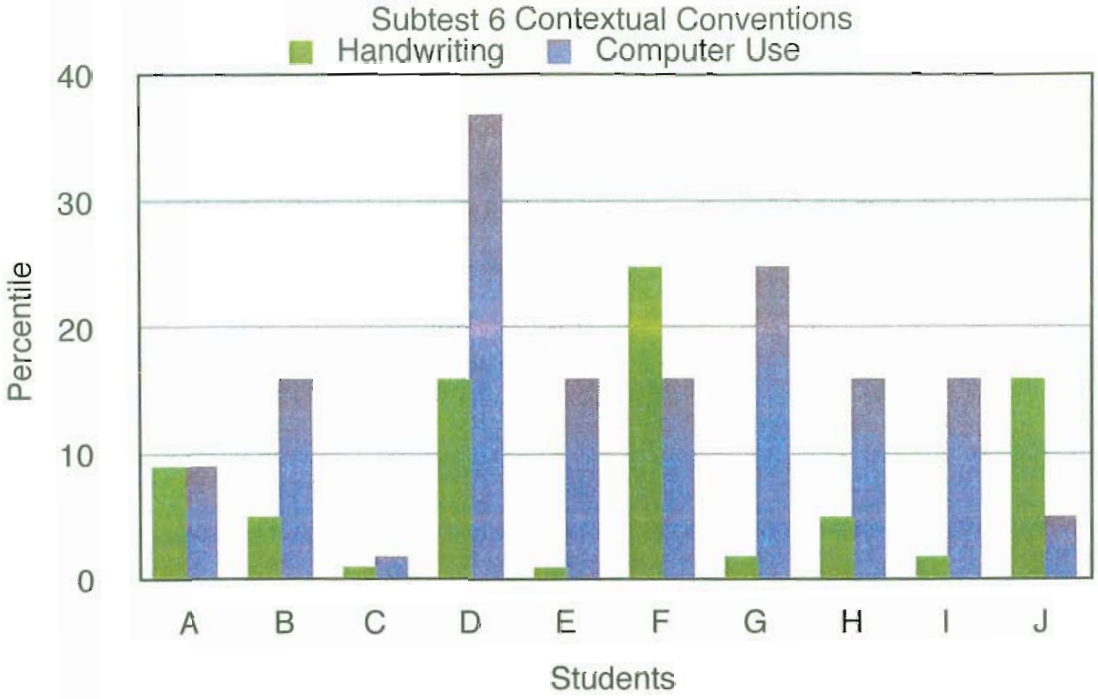
Student	Words Hand/ Typed		Contextual Conventions		Contextual Language		Story Construction		Touch Typing	Multiple Drafts	Spell Check	Readability Index	Speech to Text	Franklin Speller
A	87	**202**	3	**3.4**	4.7	**10**	3.4	**4**		✓	✓			
B	**176**	158	2	**4.7**	PHS	**PHS**	8.4	**11**		✓	✓			
C	70	**93**	∠2	**4.7**	3.4	**6.2**	6	**6**	✓	✓				
D	124	**134**	5	**6.4**	12	**PHS**	4	**4**	✓	✓	✓	✓		
E	191	**393**	∠2	**4.2**	12	**PHS**	PHS	**PHS**	✓	✓	✓			
F	**103**	83	5	**4.7**	4.7	**5.2**	11	**11**		✓	✓	✓	✓	✓
G	169	**242**	∠2	**5.4**	10	**PHS**	PHS	**PHS**	✓	✓	✓	✓		
H	68	**70**	2	**4.2**	2.2	**5.2**	2.7	**8.4**		✓	✓*	✓		
I	160	**241**	∠2	**4.7**	7	**PHS**	11	**PHS**		✓				
J	63	**128**	4	**2.4**	5	**7**	3	**4**	✓		✓			

Contextual Conventions

The following graph represents the data found for Subtest 6: Contextual Conventions. This subtests refers to capitalization, punctuation, and spelling. On this subtest, students scored an average of two grade levels above their scores with handwritten essays (Figure 4). Eight out of ten students increased their scores by at least one and a half grade levels. Two students' scores decreased.

When using Microsoft Word to type their essay, the computer is set to automatically correct capitalization of the first word in a sentence. However,

Figure 4. Handwriting versus typing scores on Contextual Conventions



students' scores in capitalization did not drastically improve. In punctuation, however, two students did demonstrate a greater variety of punctuation when using a computer, including questions and quotation marks. More variety of punctuation marks increased their raw score on the TOWL, even though the exclamation mark and the question mark are hard to find on the keyboard. Students often have to hunt and peck to find the correct keys.

Spelling mistakes in the handwritten essays were more common words with predictable spelling, such as mammoth, their, elephants, and hairy. When writing by hand, students used significantly simpler vocabulary, and misspelled simple words. However, when using a computer, misspellings were due to homophones, or near

homophones such as their,there; ere/are; billed/build; cretain/certain; and looner/ lunar.

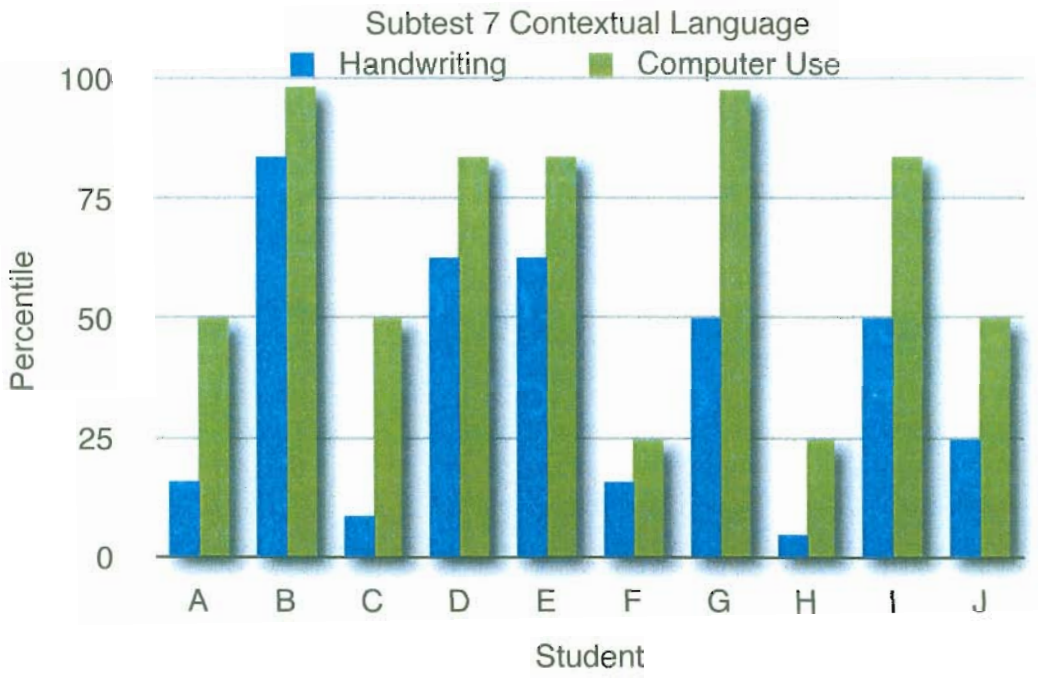
This data suggests that students use spell check to catch their mistakes on common words with the help of spell check. Students also used larger words when writing on a computer. When those words had homophones, or near homophones, they sometimes mistook one word for another. Their misspellings may have been the result of choosing the incorrect word through spell check. The literature suggests that students need to be taught how to use spell check effectively to avoid this problem (Lewis et al, 1998). However, at this school site, students are taught to recognize parts of speech, and root words to correctly identify correct spelling when they are spell checking. Students' scores increased an average of two grade levels on conventions, despite their difficulty with homophones.

Six out of ten students in this study jumped from one equivalency group to another, such as borderline to low average, or low average to average, in the area of Contextual Conventions. They moved up one standard deviation, or 33 ⅓%. Student D jumped two equivalency groups. Two students showed less proficiency when using a computer, which resulted in them moving down an equivalency level. It is note-worthy that these two students have had less exposure to using technology. One of these students has been at this school for only one year, and the other student had a teacher in language arts the previous year that did not frequently use the computer for language arts.

Contextual Language

In the TOWL, Subtest 7: Contextual Language, evaluates students' vocabulary, grammar, and sentence structure. This test reveals the area in which students demonstrate the greatest improvement between handwritten and word-processed essays.

Figure 5. Handwriting versus typing scores on Contextual Language

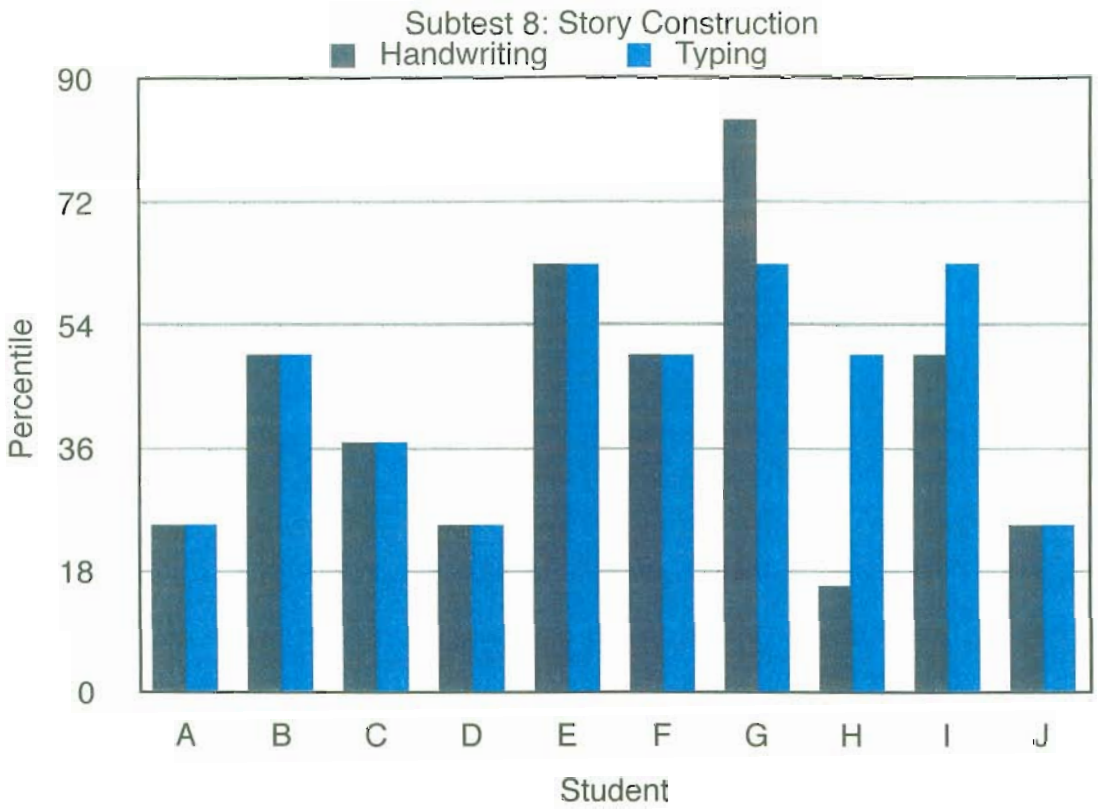


As depicted in Figure 5, all ten students improved their scores when using a computer. Two students jumped two equivalency levels, one from borderline to average, the other from average to superior. Every student scored higher with the use of a laptop in grammar, word choice, and sentence structure.

Story Construction

This subtest of the TOWL reflects how well a student tells a story, including character development, having a beginning, middle and end to a story, and dialogue.

Figure 6. Handwriting versus typing scores on Story Construction



When writing a narrative, computers had little effect on this area. As shown in Figure 6, only two out of ten people did better when using a computer, and only one out of ten students did any better when using handwriting. It is likely that this data has little to do with students' use of a computer. Instead it may represent individual student preferences for the prompts or fatigue when writing the second essay, or getting warmed up and writing better on the second essay.

Overall Increase in Equivalency Levels When Using Computers

When analyzing the results of testing, several trends become apparent. One way to look at data is to look at equivalencies. Equivalencies are based upon score ranges, as shown below (McLaughlin & Lewis, 1994). Many Individualized Education Plans (IEP's) report equivalencies when referring to testing data. The testing data from this study reveal some interesting trends in equivalencies. Table 7 demonstrates the Score Ranges, Standard Scores and Percentiles.

Table 7. Score Ranges and Equivalencies

Score Range or Equivalency	SS (Standard Score)	PR (percentile)
Very Superior	130+	95%
Superior	120-129	91-97%
High Average	110-119	76-90%
Average	90-109	25-75%
Low Average	80-89	9-24%
Borderline	70-79	2-8%

Furthermore, Table 8 demonstrates the increase students made by equivalency level, also called a standard deviation. Student G jumped two equivalency levels in both Contextual Conventions (capitalization, punctuation, and spelling) and Contextual Language (vocabulary, sentence structure, and grammar), when given the opportunity to use a computer to write a narrative. This data represents a sixty-six percent increase in both subtests, and two standard deviations. Furthermore, Student H increased two standard deviations in the area of Contextual Language, moving from the lowest category, Borderline, to Average. This student increased a standard deviation in all subtests.

Table 8. Student Performance by Equivalency Levels

Student	Number of Words	Contextual Conventions	Contextual Language	Story Construction
Student A	**Increased**	Same	**Increased**	Same
Student B	Decreased	**Increased**	**Increased**	Same
Student C	**Increased**	Same	**Increased**	Same
Student D	Decreased	**Increased**	**Increased**	Same
Student E	**Increased**	**Increased**	**Increased**	Same
Student F	**Increased**	Decreased	**Increased**	Same
Student G	**Increased**	**Increased (2)**	**Increased(2)**	Decreased
Student H	**Increased**	**Increased**	**Increased (2)**	**Increased**
Student I	**Increased**	**Increased**	**Increased**	Same
Student J	**Increased**	Decreased	Same	Same

Student F and Student J demonstrated lower performance in Contextual Conventions when using a computer. There is no clear expectation for the data. However, neither of the two lowest performing students had a language arts teacher who spent much time on teaching computer use last year. Similarly, both students use a Windows-based computer at home and a Macintosh at school. Another possibility is that these students were fatigued after writing the first essay, since they wrote the essays back to back.

Discussion

When using technology, students with dyslexia from this study achieve more. First, they type more words per minute than they handwrite. This data is consistent with Edyburn's (2005) recommendation that students need to be taught keyboarding skills and word processing skills. Five of these students reported that they could touch type without looking at the keys. However, on careful observation, only three of these students could type without looking at the keyboard, and they make up the first, second, and fifth fastest typists. When students can type without looking at the keyboard, they free up the working memory that they would normally spend remembering how to form each of the letters with a pencil, or find the letters on a keyboard. This automaticity allows students to use their working memory for the task of creating ideas, spelling, and organizing when writing an essay or a story.

The data from the narrative essay on the TOWL supports the claim in the literature that dyslexics have deficits in the areas of language that affect spelling (International Dyslexia Association, 2000; Shaywitz, 2003; West, 2007). This research suggests that students can improve their contextual conventions of writing (capitalization, punctuation, and spelling) by an average of two grade levels when using a computer.

In the research, spell check has been proven effective in helping students improve their writing, as long as students are taught to use it effectively (Edyburn, 2005). This study corroborates that research. Students must use all of their language strategies to correctly choose the homophone they are spelling. For example, when

using a computer, students misspelled words such as build/billed, which would not be caught by spell check. In order to make a difference, students need to understand word endings, root words, and parts of speech to accurately choose the correct words.

Students demonstrated the most improvement with a computer in the area of Contextual Language. This subtest consists of grammar, vocabulary and sentence structure. The irony of this is that the research suggests that students have the greatest amount of trouble accurately using a grammar check (Lewis, 2005; Montgomery & Marks, 2006). In this study, students improved the most on a subtest which had criteria for grammar, vocabulary, and sentence structure. Students used Microsoft Word for this assessment which was automatically set up to check grammar. The results suggest that students access their higher levels of spoken vocabulary when using a computer. When handwriting, students take fewer risks and choose words that they already know how to spell. For example, Student I used only one word that had seven letters or more when handwriting and twenty-one words that were seven letters or more with the use of the computer.

When using a computer, a majority of students increased the number of words in their narratives, used many more words with seven letters or more, and included advanced vocabulary and longer words. Similarly, when students used a laptop, they included more three-syllable words that are spelled correctly. Two students showed no significant difference when using the computer, which may be attributed to a lack of familiarity with the technology tools, fatigue, or a decrease interest in the writing prompt.

Students did not show any significant improvement in their ability to construct a story. Word processing programs do not have components which prompt students to improve their ability to include a beginning, middle, and end, nor include dialogue, or develop their characters. There are programs, such as Inspiration, which include templates to prompt students to develop these aspects of a story, but students did not use this software. The data on this subtest suggests that seven out of ten students are within the average range on this subtest. Dyslexics typically are able to tell stories that are rich in content, but struggle with the conventions of writing (Shaywitz, 2003).

Research Question III

What technology skills do eighth grade teachers explicitly teach in their classroom to help these students succeed?

All teachers appear to be teaching students to use laptops to write assignments, back up work, organize files and use the spell check and dictionary. Four out of five teachers are teaching students to build multiple drafts of essays with the use of Inspiration software. They are also teaching students to use text to speech to have digital text read aloud. Finally, eighty percent of teachers are teaching students how to answer questions using the internet. Three out of five teachers are teaching Cornell Notes, how to make a song or MP3 file, how to use the internet efficiently, and how to write information without plagiarizing (see Table 9).

Two out of five teachers are teaching how to use RFB&D, find and order audiobooks, citing valid sources, visual cuing with text to speech, and photo editing.

One out of five teachers teach how to use a Franklin Speller, create a

Table 9. Technology Skills and Strategies Taught by Eighth Grade Teachers

Number of teachers who taught the skill	Technology Skills and Strategies Taught
5	Spell check and dictionary, Computer use to word-process, Organizes digital files in folders by subject, Backs up work on flash drive and computer
4	Text to speech, Multiple drafts of essays, Internet research to answer questions
3	Cornell notes on computer, Uses correct naming conventions, Creates a song/MP3, Uses search engine efficiently, Writes information in own words
2	Joins/uses RFB&D, Uses audiobooks, Uses valid sources, Cites correct source, Visual cuing with text-to-speech, Edits digital photos
1	Uses Franklin Speller, Creates presentation, Touch-typing, Edits using readability index, Takes, edits digital photos, Creates spreadsheets & graphs, Publishes: InDesign or Pages
0	Reading Software, Computer books, Co-writer, Speech-to-Text, Records class lectures, Digital camcorder/edits movie, Burns CD's/DVD's, Animation files in Scratch, Uses electronic calendars

presentation, touch-typing, editing using readability index, taking and editing digital photos, creating spreadsheets & graphs, and publishing using InDesign or Pages.

Teachers are not teaching students to use reading software, computer books, Co-writer, speech-to-text, recording class lectures with an iPod, digital camcorder

use or movie editing, Burning CD's/DVD's. No teachers are teaching animation in Scratch, or Using electronic calendars.

In the Final Teacher Survey (Appendix J), all teachers said that the Individualized Technology Plan guided the technology skills they taught.

Discussion

Most teachers of eighth grade students teach skills that have been around the longest, such as spell check and dictionary, word-processing, organizing digital files, text to speech, and draft-building software such as Inspiration, have all been documented in the literature to improve student performance (Edyburn, 2005; Sitko, Laine, & Sitko, 2005). Fewer teachers are teaching students to use audiobooks in the classroom, use a Franklin Speller, use specialized reading software, or use digital media software. Many of these strategies and tools rely on extra pieces of equipment, such as a Franklin Speller, an audiobook that has been ordered, a player purchased from RFB&D, or specialized software, above and beyond the computer. It appears that when teachers have to purchase extra equipment, or arrange for students to acquire such equipment, it is less likely to be used by classroom teachers.

Question IV

What technology skills and strategies do alumni think are most important for these students who are transitioning to high school?

Table 10. Technology Skills and Strategies Used by Alumni in High School

Student	Grade and School type	Text to Speech	Multiple Draft Building	Spell Check	Thesaurus Or Readability Index	Franklin Speller	Computer	Speech to Text	Software	Computer	Audio books
A	9 Public		✓	✓	✓ Thesaurus	✓	At home		Accelerated Reader	At home	
B	9 Charter		✓ Word	✓		✓ at home		✓ Dictates to tutor who types		At home	✓
C	10 Independent	✓ at home		✓	✓ Thesaurus		✓ At home and school	iDictate and Dragon, no longer		Takes laptop to school	✓

Three alumni of the technology-rich, independent school for students with diagnosed learning differences were interviewed about the technology they use in their mainstream high school. Students A attends a large, rural, public high school, Student B attends a California Distinguished public Charter School in a small city, and Student C attends an independent, Christian school (see Table 10).

Student A attends a large public high school in a rural part of Central California. This student reported that his public high school has one computer lab and computers in the library. The library computers are for students to access Accelerated Reader, a computer program that provides reading comprehension tests

for the most commonly read novels and assists students in choosing appropriately leveled books. He reported that he currently is taking a Drafting Tech class where he is learning to draw three dimensional figures on the computer.

Currently, Student A uses spell check, an electronic dictionary and thesaurus, and a computer at home to complete written assignments. When he writes essays, he no longer uses writing templates found in Inspiration Software. He reported that he has internalized the structure of essays and no longer requires that structure. Furthermore, he does not use technology to support his reading. He is getting straight A's in school.

Student B attends a California Distinguished public Charter School in a small city. This student said that this school does not have much technology for students to use in classrooms. There is a cart of twenty laptops that is wheeled between classes. He said his classes infrequently use them. He said that he uses audiobooks from RFB&D to help him with his reading. When writing at home, he can touch-type, though not quickly, uses Microsoft Word to write and revise essays, uses spell check and an electronic dictionary, and checks his written work with a Franklin Speller when at home. He has a tutor that he works with each week at home. He speaks his essays and his tutor types them. When asked what technology strategy he wished he would have learned at the independent school, he did not report a technology. Instead, he said that he wished he would have learned test-taking skills. He is struggling to get the accommodations that he needs in school. He completes "A" quality work, but fails the tests.

Student C attends an independent, Christian school. He reported that there is a computer lab for student use, but he brings his own laptop to his classes to complete written assignments, record lectures and take notes. He is currently taking a computer programming class where he is learning different programming languages. To help him with reading, he is using text to speech at home only; it would be disruptive at school. He used RFB&D for audiobooks last year, but found it difficult to carry a player and a laptop to school. Audiobooks from RFB&D are in a Daisy format and need a specialized player to play them. He has an account to http:// www.audible.com, and listens to audiobooks.

When writing, he is getting better at touch-typing, but is not yet proficient. He uses spell check, and an electronic dictionary, but finds that his spelling is so bad that the spell check will not recognize his mistakes. He also uses the thesaurus to improve his vocabulary. He said that he used Dragon Dictate when he was younger, and iDictate as a freshman in high school, with little success. iDictate was difficult for him to use because his voice was changing when he began using it in the summer before freshman year, and it did not understand three out of four words he spoke.

Student C reported that his high school uses an online information system, called Moodle, an file transfer protocol (ftp) system that allows students to upload their schoolwork to the school network remotely, and individual teachers use websites such as www.turnitin.com for students to turn in their work. It also maintains a school wide wireless network, and printers where students can print their work. There are not computers in every room. English and language teachers can

sign up to use the computer lab on a routine basis. Student C said he goes to the computer lab to make a PowerPoint presentation once a week for his Japanese class.

Discussion

Students in high school use many technology skills and strategies to help support their reading and writing. Each student is using some type of strategy to help them overcome their learning needs. Students C relied most heavily on his laptop to complete written work, both at school and at home. He worked independently, with the use of the laptop. Student A also used a laptop at home to help him succeed in school. He did not need support in reading and, while he used a computer for writing, he was dependent upon it to structure and organize his writing. Student B uses a person, rather than technology, to assist him with writing essays at home. This reliance on a tutor for writing support is a classic strategy for students with dyslexia. Further research is necessary to indicate if students such as Student B, can use technology as effectively as having a tutor take dictation.

Implications for Further Research

Results from this study indicate that computers allow students to overcome their reading and writing difficulties. Similarly, the Individualized Technology Plan effectively guides students, families, and teachers in teaching the skills students need before they leave this school.

Data from this study suggests that much more research is necessary in the area of technology and special education. All three alumni reported that they did not use speech to text software, such as Dragon Dictate or iDictate. They said that immediately after their eighth grade year, their voice was changing and the programs were too inaccurate to be effective. Further research is necessary to ascertain the effectiveness of speech to text software, such as Dragon Dictate and iDictate.

Furthermore, word prediction software, such CoWriter, could be an effective writing tool for adolescent teens. It can be programmed to catch dyslexic spelling errors which commonly are not recognized by the built in spell check. Word prediction software could correctly help dyslexics select the right word the first time, and avoid the tedious editing tasks associated with Dragon Dictate.

Conclusions

Technology provides important support for students who are dyslexic. Audiobooks, multiple draft building in a word processor, electronic dictionaries, spell check and grammar check are some of the most critical tools for students who struggle with reading and writing. These essential tools appear to provide the necessary support for students with dyslexia to succeed in mainstream learning environments.

Teachers play an important role in helping students acquire technology strategies. If one teacher does not teach technology strategies, there can be a noticeable effect on students' writing performance with a laptop.

CHAPTER V

Summary

The purpose of this study was to help students with dyslexia access the appropriate technologies to help them succeed in mainstream high school classrooms. The problem is that many teachers, students, and families are not aware of which technology skills and strategies are most effective. Through the use of an Individualized Technology Plan, this research answered the question, "What technology skills and strategies on the Individualized Technology Plan do eighth grade students at an independent school for students with diagnosed language-learning disabilities demonstrate in reading and writing? Which skills do experienced teachers at this school teach? What skills do alumni from this site value and use once their transition to high school?

The participants in this study were ten students at an independent, kindergarten through eighth grade school for students with language learning disabilities. As a technology enriched school that is designed to help students with dyslexia succeed, this school provides an effective setting to study which technology makes a difference for students.

The procedure for this research consisted of teacher surveys, student assessments and surveys, and alumni interviews. All teachers were first asked to participate in the research study and sign a consent form. They were then surveyed about which technology skills and strategies that they teach eighth

grade students to help them be successful. Finally, they provided feedback to finalize the Individualized Technology Plan.

Next, students filled out the Assent forms and their parents filled out consent forms. Students then analyzed their own technology use on the Individualized Technology Plan. Later on in the semester, they were assessed with the Test of Written Language, first with a handwritten essay, and then with a word-processed essay in Microsoft Word. Finally, they filled out the Individualized Technology Plan again.

Lastly, ninth and tenth grade alumni were asked if they would participate in this research. After getting consent from their parents, alumni answered the Alumni Interview Questions regarding which technologies they were using in high school.

Results show that ninety percent of eighth grade students currently use at least one technology strategy to help with reading which is most often audiobooks. In writing, students improved an average of two grade levels in punctuation, capitalization, and spelling when they use a laptop. Students improved an average of 2.6 grade levels in grammar, sentence structure, and vocabulary. Computers neither helped, nor hindered the majority of students' ability to construct a story.

Eight grade teachers most often teach students to use spell check and dictionary, a computer use to word-process, organization of digital files in folders by subject, and backing up work on flash drive and computer. They often do not teach skills or strategies that require the use of extraneous devices such as Franklin Spellers, iPods, digital cameras, or software that is not included on school computers.

The findings of this study are that students with dyslexia use technology to improve their reading and writing skills. First, all students with dyslexia at this site are using at least one technology strategy in reading. In writing, students are improving in writing conventions and writing language. First, students improved in their mechanics by two grade levels, which is consistent with the literature. This research also finds that computers help dyslexics improve their language conventions by two and six tenths grade levels, which refutes many claims in the literature that students struggle to use the grammar check effectively in a word processing program. Students were able to use the grammar check and spell check to effectively access their large spoken vocabulary. They are also using many different technologies to help them improve their written work.

Teachers' surveys revealed that they most often teach students how to use spell check and dictionary, word processing skills, organization of digital files, and using a flash drive to save work. They also taught students to use text to speech, and multiple draft building when writing essays.

Alumni revealed that they use many different technology strategies that help them succeed in high school. All three students use a significant number of technology strategies, from Audiobooks, to spell check, to multiple drafts of essay and the thesaurus to improve vocabulary. These strategies are represented on the Individualized Technology Plan. Further research needs to be conducted to find out the efficacy of speech to text software and word prediction software for dyslexics.

In conclusion the Individualized Technology Plan effectively identifies technology skills and strategies that teachers, students, and families can use to help students improve their reading and writing performance. This qualitative research was conducted for a Master's in Education at California State University, Monterey Bay.

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APPENDIX A

Consent Form

Committee for the Protection of Human Subjects, CSUMB
CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: The Role of Technology in Overcoming Disability: A Technology Transition Plan for Students with Dyslexia

---

We would like you to participate in a research study conducted by Kris Hill from Chartwell School to be used for her Master's Thesis at California State University, Monterey Bay.

The purpose of this research is to identify the ways in which technology helps students with learning variations overcome their disability and succeed in school.

You were selected as a participant in this study because you are an eighth grade teacher at Chartwell School who uses technology with students.

The benefits of participating in this project learning the research-based technologies that make a difference for students with language-based learning differences.

If you decide to participate in this research, you will be asked to meet fill out a survey about which technologies you think students need to learn to help them with their literacy. You will be asked to help students acquire new technology skills. At the end of the research, you will be asked to give written feedback about the effectiveness of the Individualized Technology Plan.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will only be disclosed with your written or witnessed verbal permission or as required by law. You will be filling out surveys using an online survey website and your name will be kept confidential. When quoted, you will be assigned a pseudonym.

Taking part in this project is entirely up to you. You can choose whether or not to be in the study. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you do not want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

If you want to know more about this research project or have questions or concerns, please call me at Chartwell School 831-394-3468 or khill@chartwell.org

The project has been reviewed and accepted by California State University, Monterey Bay. You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

If you have questions about CSUMB's rules for research, please call the Committee for Human Subjects Chair, Chip Lenno, CSUMB Technology Support Services, 100 Campus Center, Building. 43, Seaside CA 93955, 831.582.4799.

You will get a copy of this consent form. Thank you for considering participation.

Sincerely,
Kris Hill, Technology Mentor, Chartwell School

Consent Statement

I understand the procedures described. My questions have been answered to my satisfaction and I freely agree to participate in this study. I know what I will have to do and that I can stop at any time.

I have been given a copy of this Consent Form.

_____ _____

Signature Date

Signature of Researcher

In my judgment, the participant is voluntarily and knowingly giving informed consent and possesses the legal capacity to give informed consent to participate in this research study.

_____ _____

Signature of Researcher Date

APPENDIX B

Parental Consent Form

Committee for the Protection of Human Subjects, CSUMB
PARENTAL/LEGAL GUARDIAN CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: The Role of Technology in Overcoming Disability: An Individualized Technology Plan for Students with Dyslexia

---

We would like your child to participate in a research study conducted by Kris Hill from Chartwell School to be used for her Master's Thesis at California State University, Monterey Bay.

The purpose of this research is to identify the ways in which technology helps students with learning variations overcome their disability and succeed in school.

Your child was selected as a participant in this study because s/he is an alumni of Chartwell School.

The benefits of your child's participation in this project include individualized assessment and instruction in research-based technology strategies that help students with learning challenges.

If you decide to allow your child to participate in this research, [he/she] will be asked to identify the technology skills and strategies uses to be successful in high school. This information will be discussed with parents during Chartwell students' yearly conferences.

There are no risks involved in this study. No medical treatment or financial compensation for injury from participation in this project is available.

Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will only be disclosed with your written or witnessed verbal permission or as required by law. Each student will be given a pseudonym when discussed in any way. Similarly, Chartwell School will not be mentioned by name, to protect the identity of all subjects.

Allowing your child to take part in this project is entirely up to you. You can choose whether or not to allow your child to participate. If you consent to your child's participation in this study, you may withdraw that consent at any time without consequences of any kind. Your child may also refuse to answer any questions [he/she] does not want to answer and still remain in the study. The

investigator may withdraw your child from this research if circumstances arise which warrant doing so.

If you want to know more about this research project or have questions or concerns, please call: Kris Hill at 831-394-3468 or khill@chartwell.org.

The project has been reviewed and accepted by California State University, Monterey Bay. You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

If you have questions about CSUMB's rules for research, please call the Committee for Human Subjects Chair, Chip Lenno, CSUMB Technology Support Services, 100 Campus Center, Building. 43, Seaside CA 93955, 831.582.4799.

You will get a copy of this consent form. Thank you for considering participation.

Sincerely,
Kris Hill, Technology Mentor at Chartwell School

Parental Consent Statement

I have read the contents of this Consent Form. My questions have been answered to my satisfaction. I freely give my permission for my child to participate in this study. I know that I can withdraw my consent at any time.

I have been given a copy of this form.

_____ _____

Signature Date

Signature of Researcher

In my judgment, the participant is voluntarily and knowingly giving informed consent and possesses the legal capacity to give informed consent to participate in this research study.

_____ _____

Signature of Researcher Date

APPENDIX C
Assent Form

Committee for the Protection of Human Subjects, CSUMB
ASSENT TO PARTICIPATE IN RESEARCH

Title of Project: The Role of Technology in Overcoming Disability: A Technology Transition Plan for Students with Dyslexia

---

My name is Kris Hill.

I would like you to take part in a research study to learn more about how you use technology to help you in school.
If you agree to be a part of this study, you will participate in a group interview about the academics in high school, and the ways that technology assists you.

By participating in this research, you will learn about the technologies available for reading, writing, multimedia, organization and research.

We will also ask your parents to give their permission for you to take part in this study. I want you to know that although your parents may agree to your participation in this study, you may decide to not participate.

Do you have any questions about this study? You can ask any questions about this study at any time. You can call me or ask me next time at 831-394-3468 or khill@chartwell.org.

You can stop at any time by just telling me to stop.

Signing your name at the bottom of this form means that you agree to be in this study and you agree to be part of an interview. You and your parents will be given a copy of this form.

Assent Statement

Please mark one of the choices below to tell us what you want to do:

_____No, I do not want to be in this project.

Yes, I do want to be in this project.

I understand the procedures described. My questions have been answered to my satisfaction and I freely agree to participate in this study. I know what I will have to do and that I can stop at any time.
I have been given a copy of this Assent Form.

Signature _____ Date _____

Signature of Researcher

I have read this form to the participant and/or the participant has read this form. I have provided (or will provide) the participant with a copy of the form. An explanation of the research was given and questions from the participant were solicited and answered to the participant's satisfaction. In my judgment, the participant has demonstrated comprehension of the information.

Signature of Researcher _____ Date _____

Optional:

Witness Statement

I have witnessed the assent process and believe that the participant listed above has been fully informed, understands the project and his/her role, and has voluntarily agreed to participate.

Witness's Signature _____ Date _____

APPENDIX D

Individualized Technology Plan

Individualized Technology Plan for: _____

Literacy Background

Reading Fluency Grade Level_____ Reading Comprehension Grade Level_____

Handwriting Speed _____wpm Keyboarding Speed _____wpm

Handwritten narrative _____(TOWL) Typed Narrative _____(TOWL)

Reading Vocabulary Grade Level_____(SDRT) Written Vocabulary Level (Readability Index) _____

Spelling Grade Level Grade Level_____

Literacy Area	Student Technology Proficiency- Check off the Skills when they are acquired				
Reading	☐ Text to Speech	☐ Joins and orders books from Reading for the Blind and Dyslexic	☐ Finds & uses audiobooks (Lit2Go library, iTunes, audiobooksforfree)	☐ Uses reading software (Lexia, Simon Sounds it Out, Read Naturally, etc)	☐ Uses computer books to support literacy (Don Johnston, Intellitools, Tom Snyder)
Writing	☐ Keyboarding (touch-typing)	☐ Uses multiple draft-building for essays (templates, Inspiration, DraftBuilder)	☐ Uses spell check and Dictionary effectively	☐ Uses visual cuing w/ text to speech for proof-reading (TexEditPlus, Write-Out-Loud)	☐ Checks written work with Franklin Speller
Writing (cont.)	☐ Uses Co-Writer to predict spelling & aid word finding	☐ Uses the Readability Index in Microsoft Word to improve vocabulary	☐ Uses laptop or AlphaSmart to word-process assignments	☐ Uses speech to text (iDictate, Dragon Naturally Speaking,etc)	☐ Records class discussions with iPod or other recording device
Organization	☐ Organizes digital files in folders by subject	☐ Uses Cornell Notes for note-taking	☐ Uses correct file naming conventions (khill_ipoem.doc)	☐ Backs up work on flash drive & computer	☐ Uses calendar for homework (iCal, Google calendar)
Multi-Media	☐ Takes, Imports & Edits Digital Photos	☐ Uses digital camcorder- imports & edits footage	☐ Burns CD's/DVD's	☐ Creates a presentation using PowerPoint or Keynote	☐ Adjust digital still photos (Photoshop or others)
Multi-Media (cont.)	☐ Creates a song or mp3 in GarageBand	☐ Publishes using InDesign or Pages	☐ Creates animation program using Scratch	☐ Creates Spreadsheet in Excel or Numbers	☐ Graphs data in Excel or Numbers
Research	☐ Use search engine for research efficiently	☐ Cites correct source for research, photos	☐ Chooses valid sources for answers	☐ Uses internet research to find answer to questions	☐ Writes information in own words without plagiarism

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APPENDIX E

TOWL Test Prompts

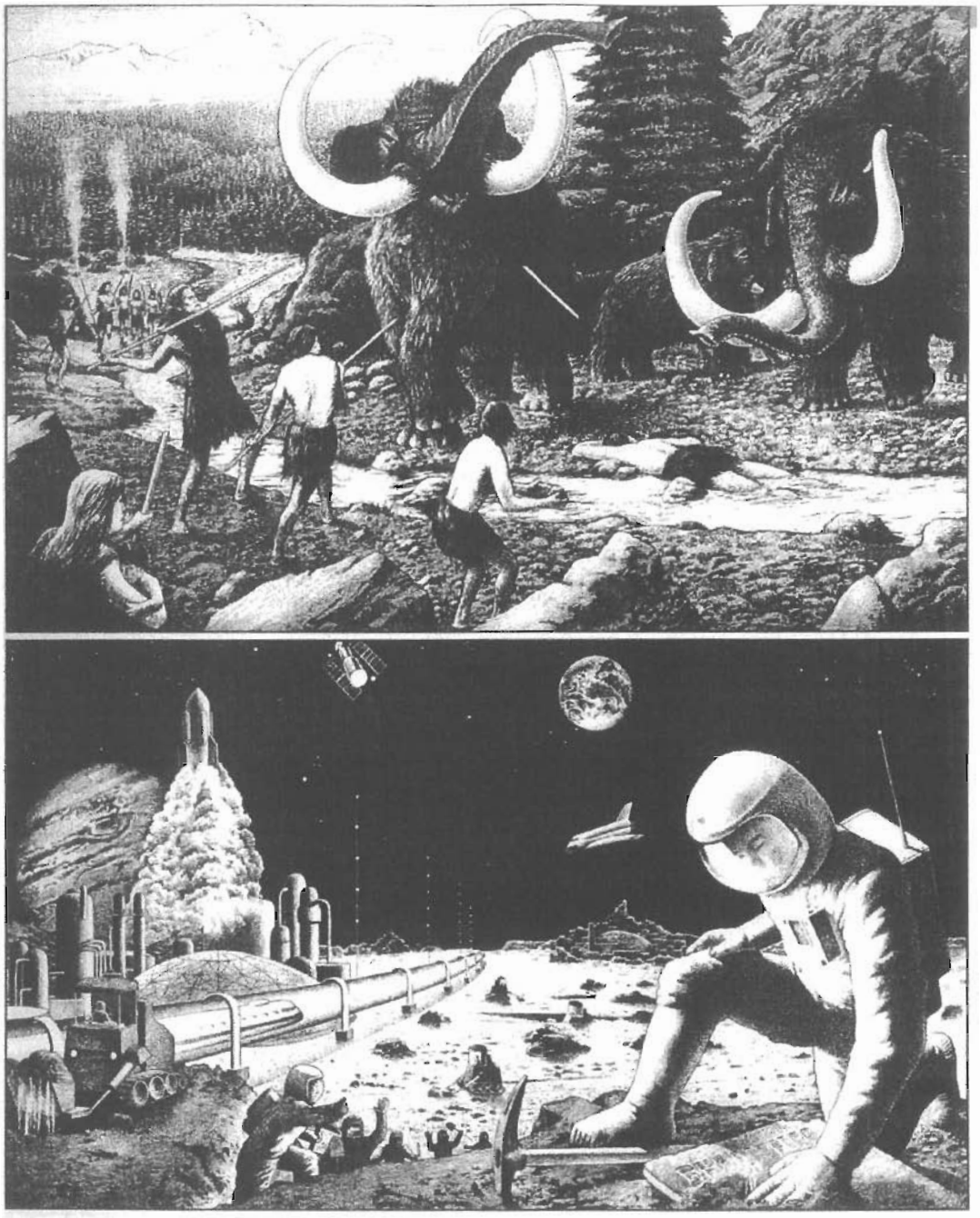

Figure P.2. The TOWL–2 prehistoric picture (Form A) and futuristic picture (Form B) used to elicit written essays from students.

APPENDIX F

Handwriting versus Typing Test

A Rogue Wave

9

Philip Weld lived near Boston with his family. One of his favorite hobbies was sailing, and so he bought an expensive sixty-foot sailboat called a trimaran. This is a boat with three hulls, held together by a deck on top of them. He planned to sail the boat alone in a race across the Atlantic Ocean. But first he had to sail the boat to Europe where the race was to begin.

He hired a young man named Bill Stevens to sail with him on the boat across the three-thousand-mile ocean. They sailed from the island of Bermuda one April. They ran into some stormy weather, but the sailboat was large enough for them not to be too worried. On the night of Tuesday, April 27, Philip Weld took one more look around at the ocean and decided to go to bed. He left Bill to steer the ship through the night, went to his cabin, and opened a book.

Suddenly he heard Bill shout, "Look out, here it comes!" Weld felt the whole boat being picked up, twisted around, and dumped upside down. His head banged against the wall, and when he came to, he was standing on the ceiling of his cabin in two feet of water. Bill poked his head through the door and told him what had happened. A forty-foot rogue wave had suddenly appeared out of the night and capsized them.

Rogue waves are very rare, but every once in a while certain conditions will sweep up tons of water into a column as high as a four-story building. All sailors, especially people in small boats, fear these freak waves, but there is very little they can do about them.

Weld and Stevens crawled up onto the bottom of the boat and tried to figure out what to do. After talking for a while, they decided to get a hacksaw and cut a hole through the main hull. This way they could get at some of the supplies in the bottom (now the top) part of the boat. They saved enough food to last them three weeks and tried to make themselves comfortable. They took turns watching for ships.

One freighter passed nearby, but when they shouted and waved, it didn't see them and passed on. After this they got out lights, mirrors, and flares, and when another ship passed by, four and a half days after the capsizing, it did see them and picked them up. They were glad to be saved, but Philip Weld was heartbroken to have to leave his expensive boat floating upside down in the ocean. When he got home, he joked to his wife that his new hobby was going to be horses.

1. Why was Weld sailing to Europe?

2. What is a trimaran?

3. What happened to Weld's boat?

4. Why are sailors afraid of rogue waves?

5. Why did they cut a hole in Weld's boat?

6. How would you have felt if you were Philip Weld right after the accident?

Why?

7. Why do you think the men on the freighter didn't see them?

8. Why did the next ship see them?

9. After this experience, how do you think Weld felt about sailing by himself across the Atlantic?

Why?

APPENDIX G

Woodcock-Johnson III, Revised Reading Fluency Test

Test Items

1. A bird can fly. ..... Y N
2. Cats have five legs. ..... Y N
3. Some people have long hair. ..... Y N
4. People have teeth. ..... Y N
5. The sky is always brown and yellow. Y N
6. A clock tells time. ..... Y N
7. The color of grass is red. ..... Y N
8. A school bus has a driver. ..... Y N
9. People like to drink gum. ..... Y N
10. A butterfly has ten wings. ..... Y N
11. A train goes on the road. ..... Y N
12. A banana is to eat. ..... Y N
13. Summer is a season of the year. ..... Y N
14. Ants are very big. ..... Y N
15. A fire is cold. ..... Y N
16. A bus has wings. ..... Y N
17. The color of milk is pink. ..... Y N
18. A flower grows in the sky. ..... Y N
19. A dog may bark at a cat. ..... Y N
20. A room in a house has walls. ..... Y N
21. Golf is a game that some people like to play. ..... Y N
22. June is the month after March. ..... Y N
23. Most dogs can fly over the tops of mountains. ..... Y N
24. Some people like to go swimming on hot days. ..... Y N
25. Most windows are made of glass. ..... Y N
26. A pen is for writing. ..... Y N
27. Monkeys live in fish tanks. ..... Y N
28. An insect may live under a rock. ..... Y N
29. A shoe goes on your head. ..... Y N
30. A frog may swim in a pond. ..... Y N
31. A beach by the ocean may have sand. Y N
32. May is the last day of the week. ..... Y N
33. People sit on their hands at the dinner table. ..... Y N
34. You can see only one color in a rainbow. ..... Y N
35. Cars have four wheels. ..... Y N
36. The sun is smaller than an orange. ..... Y N
37. A bird may build a nest. ..... Y N
38. All mountains are very flat on top. ..... Y N
39. You can drink milk through a straw. .... Y N
40. A map is used to help you find phone numbers. ..... Y N

Go to the next page →

APPENDIX H

Alumni Interview Questions

1. Alumni Survey about Technology

100%

Hi Everyone-
Thank you for helping me with my research project! My research involves looking at different types of technology that students use or could use that would help them succeed in school. Please be honest. The purpose of the survey is to identify how technology helps students succeed in school.
Thank you again.
-Kris

1. Reading
How do you use technology to help you with reading? Consider audiobooks, text-to-speech, software...

2. Writing
How do you use technology to help you with writing?

3. Organization
How do you organize your computer files?

4. Multi-media
How do you use digital photography? presentation tools such as Keynote or PowerPoint? Do you make movies? Do these skills help you in class?

5. Research
How do you conduct research on the internet? How do you handle photos or information that you found there?

6. How often do you use computers to help you with your school work?

7. What technologies do you think Chartwell needs to be teaching, but is not?

8. Where did you learn most of your skills that help you in school?

A. Language Arts/Language Training
B. Technology Class
C. From my family
D. From my friends/peers
E. From the internet/book/magazine
F. Other

9. How valuable is technology in helping you succeed in high school? Why?

Thank you for filling out this survey! Your responses will help me with my research.

Done

APPENDIX I

Initial Teacher Survey Questions

1. Initial Teacher Survey about Technology

100%

Hi Everyone-
Thank you for helping me with my research project! My research involves looking at different types of technology that students use or could use that would help them successfully overcoming their "disability." The following survey is meant to elicit your expertise and beliefs about what types of technology skills and strategies really make a difference for students with language learning difficulties. You are the experts! Your thoughts and opinions matter!
Thank you again.
-Kris

1. Reading
In what ways do students use technology to learn to read? What do students need to know before they leave Chartwell about using technology to help them with reading?

2. Writing
How can we use technology to help students improve their writing? In what ways do you currently use technology to help students learn to write? What do Chartwell students need to know before they transition about using technology to improve their writing?

3. Organization
How do you teach students to organize their digital information and files?
What strategies to you teach students to organize their digital information?
How do you teach students to use technology to organize their thinking and their learning?
What do you think students need to know before they leave Chartwell about using technology to help them stay organized?

4. Multi-media
How are students using multimedia to overcome their learning challenges?
How important is multi-media to Chartwell student success? What do you think students need to know before they leave Chartwell about creating multi-media projects, such as digital photography, graphic design, movie-making, or presentation skills (Keynote, PowerPoint)?

5. Research
What types of skills do you see students at Chartwell use to conduct research?
How are students having difficulty with research?
What have you taught students to do regarding research?
What skills are necessary for students to have before they leave Chartwell?

6. What training do you personally need in order to help students with technology? If you were to design a training for yourself, what would it be?

7. What technologies do you think we need to be teaching, but are not?

Thank you for filling out this survey! Your responses will help me with my research.

Done

APPENDIX J

Final Teacher Survey Questions

Post Teacher Survey - Individualized Technology Plan Exit this survey

1. Post Teacher Survey- Individualized Technology Plan

100%

Hi Everyone-
Thank you for helping me with my research project! My research involves looking at different types of technology that students use or could use that would help them succeed in school. Please be honest. The purpose of the survey is to identify how technology helps students succeed in school.
Thank you again.
-Kris

1. What changes do you think we should make to the Individualized Technology Plan?

2. How much growth did students make on their goals for the Individualized Technology Plan?

3. Who do you think should set goals and keep track of students' progress on the Individualized Technology Plan?

4. What changes need to be made to make the Individualized Technology Plan more useful or user-friendly?

5. In which area did you see the most growth?

Reading

Writing

Organization

Multi-Media

Research

Other

6. How often do you use computers in your classroom?

Every period

Every other period

Once per day

Every other day

Once per week

Once per month

Rarely

Never

7. Where do students learn most of their technology skills and strategies?

Home

LT/LA

Math

Science

Technology

Friends

Family

8. Is there anything else you would like to say about including technology in students' education plan at Chartwell?