Spring 2017

The Effect of Electronic Text Reading on Reading Comprehension Scores of Students with Disabilities

Rachel Krieger
Governors State University

EFFECT OF ELECTRONIC TEXT ON READING COMPREHENSION SCORES OF STUDENTS WITH DISABILITIES

By

RACHEL KRIEGER

Prepared in partial fulfillment for the requirements of the Masters of Arts Degree in

Multicategorical Special Education

Approval:

_____
Dr. Philip Boudreau, Ph.D.
Chairperson, Graduate Project
Committee and Graduate Seminar

Date: May, 6 2017

Approval of Graduate Seminar Members:

Member:_____ Member:_____

Member:_____ Member:_____

Governors State University
University Park, Illinois
2017

Acknowledgements

I would like to start off by thanking Governor's State University for offering me the opportunity to expand my education. There are many things that I have learned in this program that will make me a more effective special educator. I would also like to give my thanks to my instructors at GSU, especially Dr. Philip Boudreau. I appreciate your recognition of my passion for education and your insistence that I dig deeper into my data for meaningful analysis. I also would like to thank my colleagues in SPED 8999, all of who helped me tremendously in this journey, as we were all going through the same arduous process together. Lastly, I cannot thank my friends and family enough for dealing with my complaining over the past two years. You will not hear me complain again until I get my Doctorate.

Table of Contents

List of Tables

List of Figures

EFFECT OF ELECTRONIC TEXT ON READING COMPREHENSION SCORES OF STUDENTS WITH DISABILITIES

By

RACHEL KRIEGER

Prepared in Partial Fulfillment for the Requirements of the

Masters of Arts Degree in Multicategorical Special Education

Governors State University

Spring 2017

Abstract

The growing use of technology in the classroom necessitates investigation into the effect technology has on learning. This causal-comparative study examined whether students with disabilities comprehend text better when it is presented electronically or in print. Thirty-one 11th and 12th grade students with varying disabilities read and answered questions on five print and five electronic reading comprehension passages. The results, examined using paired *t*-tests and Cohen's *d* effect sizes, determined that the participants scored significantly better on electronic comprehension passages than print. Similar additional analyses were conducted on mean scores of students with a learning disability, attention-deficit hyperactive disorder, and low and proficient reading scores. Implications, limitations, and suggestions for further research are discussed.

Keywords: causal-comparative, secondary special education, electronic reading comprehension

Chapter I

Introduction

The rights for students with disabilities in American public schools have grown tremendously over the past 50 years (Wright & Wright, 2007). In 2017, more is known about the needs, strengths, and struggles for this population of students than ever before. The impetus behind this expanse of knowledge was a series of legal statutes, regulations, and policies that required public schools to acknowledge and serve the growing number of students in their communities that were identified as having a disability (Wright & Wright, 2007). While the purpose and underlying goal of each mandate over the years may have varied, most aimed to design and expand services that could provide an equal and quality education for students with disabilities.

Branching off from the equal rights agenda of the Civil Rights Movement, education law evolved in the 1960s and 1970s to include the protection and rights of all children, including those with disabilities (Wright & Wright, 2007). In 1975, the Education for All Handicapped Children Act (EAHCA) was passed, with the purpose of (a) providing all handicapped children a "free appropriate public education with the emphasis on special education and related services designed to meet their individual needs," (b) ensuring that "the rights of handicapped children and their parents or guardians are protected," and (c) assisting state and local educational institutes to "provide for the education of all handicapped children." Between 1975 and 2004, the act underwent revisions and name changes, and was ultimately renamed the Individuals with Disabilities Education Act of 2004 (Wright & Wright, 2007). While the name may have changed, its purpose did not, still insisting on providing students with disabilities a quality education (IDEA, 2004).

The Individuals with Disabilities Act identifies a child with a disability as one with "(a) intellectual disability, (b) hearing impairments (including deafness), (c) speech or language impairments, (d) visual impairments (including blindness), (e) serious emotional disturbance, (f) orthopedic impairments, (g) autism, (h) traumatic brain injury, (i) other health impairments, and (j) specific learning disabilities" (IDEA, 2004). Data from 2013-2014 school year identified 12.9% of the total enrollment of public schools from age 3 to 21 as having an IDEA disability, up from 8.3% in its initial year of 1976-1977 (U.S. Department of Education, 2016). Table 1 shows the percentage of students enrolled in a public school during the 2013-2014 school year by IDEA disability category.

Students with disabilities continued to be identified and served in the public school system under IDEA mandates throughout the late 20th century. In the late 1990s, federal lawmakers noticed a significant achievement gap between underserved community schools and their more privileged counterparts (U.S. Department of Education, 2016). The result was the No Child Left Behind (NCLB) Act of 2002, which meant to "close the achievement gap with accountability, flexibility, and choice, so that no child is left behind." The NCLB (2002) Act hoped to standardize national learning goals and hold schools and educators across the country accountable. One way that NCLB held schools accountable for learning was by requiring them to meet benchmarks over the years to achieve 100% student proficiency in math and reading (Yell, 2016). Progress towards proficiency was measured through valid and reliable statewide testing (Yell, 2016). Most students with disabilities, according to NCLB (2002), were required to participate in mandated testing and contribute to the goal of school-wide proficiency. Lawmakers believed that schools should be held accountable for the education of students with disabilities; consequently, the passage of NCLB by Congress in 2002 resulted in a decade-long

push towards standardized, scientifically based assessments for all students, including students with disabilities (Yell, 2016).

Table 1

Prevalence of Children Aged 3-21 Served Under IDEA by Disability Type for the 2013-2014 School Year

IDEA Disability Type	Percentage of children served
Autism	8.3
Deaf-blindness	>1
Developmental delay	6.3
Emotional disturbance	5.5
Hearing impairment	1.2
Intellectual disability	6.6
Multiple disabilities	2.0
Orthopedic impairment	0.9
Other health impairment	12.6
Specific learning disability	35.0
Speech or language impairment	20.6
Traumatic brain injury	0.4
Visual impairment	0.4

Note. From U.S. Department of Education, Office of Special Education Programs, Individuals with Disabilities Education Act (IDEA). Retrieved, from http://www2.ed.gov/programs/osepidea/618-data/state-level-data-files/index.html

The nature of education changed in the legislative and policy sphere, but it also began a shift towards incorporating more technology at the classroom and school-wide level. School-

aged children today have grown up in the digital age. The most recent comprehensive research suggests that teenagers between the ages of 13 and 18 spend, on average, nine hours a day using some electronic media (Tsukayama, 2015). In an effort to engage this tech-savvy demographic, educators have made significant changes in their classrooms (U.S. Department of Education, 2016). Just as policy and procedures evolved in the later half of the 20th century regarding students with disabilities, the 21st century will continue to witness changes relating to technology and what impact it has on students with disabilities and their academic achievement.

Statement of the Problem

Students with disabilities are identified in schools as such because they have challenges that "adversely affect educational performance" (Wright & Wright, 2007, p. 21). Regardless, most students are required by law to participate in mandated statewide testing at their intellectual grade level (Yell, 2016). As education shifts towards technology-based learning, students have begun to see more assessments on computers. For example, with the adoption of the Common Core State Standards, many states, including Illinois, administered a computerized version of the Partnership for Assessment of Readiness for College and Careers (PARCC) assessment (Hefling & Smyth, 2015). However, it is important to consider what effect this technology might have on a student's disability. (I.e., Does it exacerbate the disability? Does it reduce the effect the disability has on learning?)

Since computers and technology began to emerge in classrooms around the world, research has been conducted on how devices affect basic reading. Some studies (Chen, 2009; Putnam, 2004) have indicated that reading electronic text may be more difficult because it requires different strategies than would normally be used for print text, but conclusive data does

not exist yet. When these obstacles are compounded by a disability, the effects might be significant.

Purpose of the Study

Students are being asked to be more computer literate than ever before. This study attempted to determine if there was a difference between students' comprehension of text in print and the comprehension of text in an electronic format. The results from this study will help outline recommendations pertaining to technology and students with disabilities. The goal is to use the study to inform reading instruction and assist students in becoming more proficient readers, both of print and electronic texts. If the limits, obstacles, and effects of reading electronic text can be identified, they can be overcome.

Questions of the Study

This study hoped to answer what, if any, are the differences between reading comprehension scores for students with disabilities when reading text in print versus electronically? Additionally, how do students with a specific learning disability in reading or a lower general reading level perform when compared to students with other disabilities or those with more proficient reading levels?

Assumptions and Limitations

The participants of this study were taken from the researcher's own school, qualifying them as a sample of convenience. However, the students represent a variety of disabilities and information gained from the research can help the researcher's school make informed decisions with regards to technology and its students with special needs. Additionally, this study is under certain time constraints due to the Graduate Seminar course only lasting one semester. The results, therefore, are not sustained over a school year or more.

Significance of the Study

Investigating the impact that e-reading has on students with disabilities will allow teachers, parents, and special education administrators to determine which programs and strategies are most appropriate for students when tasked with reading off of an electronic screen. Additionally, the results of this research will assist these parties in creating strategies to aide students in any deficit areas found to exist when they read electronic text.

Definition of Terms

The terminology of education, and especially special education, can be difficult to comprehend out of context. A definition of terms is provided to ensure complete understanding of various legal and educational terms.

Disability. This term has several different definitions based on the purpose of the agency defining it. For example, Merriam-Webster (2017) defines the term "disabled" as "physically or mentally impaired in a way that substantially limits activity especially in relation to employment or education." Laws like IDEA determine a definition for disability based on who is protected under their purview. In this instance, IDEA identifies a student as having a disability if they are found to have one or more of 13 categories of disability, and that disability negatively affects their education (Yell, 2016). This study will use the IDEA definition of disability.

Free and appropriate public education (FAPE). Wright and Wright (2007) define FAPE as "special education and related services that are provided at public expense, meet state standards, are appropriate, and are provided in conformity with an IEP" (p. 21). According to IDEA (2004), students with disabilities are entitled to a free and appropriate public education during which they receive support in accessing the general education curriculum. Further, IDEA (2004) requires FAPE to meet state educational standards and take place at an appropriate institution in the state involved.

Individualized Education Program (IEP). According to IDEA (2004), an IEP is a "written statement for each child with a disability that is developed, reviewed, and revised" by a team of stakeholders in the child's education. The law requires that an IEP include (a) information about the child's current levels of performance in academics and functioning, (b) a number of goals that can be measured annually and will help the student access the general

education curriculum, and (c) a list of accommodations and modifications required to aide the student in achieving his or her goals and making progress in the general education curriculum (IDEA, 2004). The law requires that an IEP be updated annually at a meeting, during which the team will review and revise the document based on the student's current achievement levels (IDEA, 2004).

Other Health Impairment (OHI). IDEA (2004) defines "other health impairment" to mean "having limited strength, vitality, or alertness, including heightened alertness to environmental stimuli, that results in limited alertness" in an educational environment. The section of IDEA goes on to say that this impairment could be caused by "chronic or acute health problems" like asthma and attention deficit disorder or attention-deficit/hyperactivity disorder. Additionally, like all disabilities under IDEA (2004), this impairment must "adversely affect a child's educational performance" in order for the child to qualify for services.

Specific Learning Disability (SLD). A "specific learning disability", as defined by IDEA (2004) is a disorder "in one or more of the basic psychological processes involved in understanding or in using language, spoken or written" and which may impact an individual's ability to "listen, think, speak, write, spell, or do mathematical calculations." The law explains that disorders like "perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia" are included under this definition, but disorders that are a result of "visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage" are not included. One important distinction is that, according to regulations passed in 2006 by the Office of Special Education and Rehabilitative Services, specific learning disabilities may not be determined by the use "of a severe discrepancy between intellectual ability and achievement," but should use instead

"scientific, research-based intervention" to determine if a specific learning disability exists (IDEA, 2004).

Chapter Summary

Legislative and policy decisions over the past 50 years have resulted in a changing educational system nationwide. At the same time outside the sphere of education, the country was launched into the digital age. As laws evolved to include accountability for the education of students with disabilities, technological advances made their way through businesses and industries and into homes, classrooms, and the hands of almost every student walking the halls of the nation's schools. Well into the 21st century, laws and policies need to evolve again to represent the changing nature of education. In order to understand the large-scale impact technology will have in education, it is first important to determine how technology used in the classroom affects student learning. Additionally, students with disabilities, who represent 13% of the nation's student body, may face additional struggles when engaging in technology and this challenge should not go unstudied.

Chapter II

Review of the Related Literature

Technology has become ingrained in the culture of education. As it becomes more pervasive in classrooms all around the United States, additional research is required to determine how technology affects learning. A common finding from most studies is that the current research is inadequate to make generalized conclusions on this subject (U.S. Department of Education, 2010). While most researchers agree that, when used correctly, technology can provide a myriad of benefits to learners (U.S. Department of Education, 2016), there is no consistent agreement on specific strategies or features of technology that seem to be most effective in improving learning outcomes.

The following will review the existing research related to special education and the impact of technology on learning, particularly on reading achievement and students with disabilities. General information and research on the history of technology in schools will be provided; then research studies and information about the general reading process and the factors that affect reading will be presented; then studies that look into reading comprehension and how it relates to students with disabilities will be examined; and finally, studies that investigate the debate between electronic and print texts will be explored. The chapter will conclude with a synthesis of the literature and the implications it has for this study.

Special Education

History

Individuals with disabilities have a long but troubled history. According to Winzer (1993), one of the largest obstacles to inquiring into the history of disabilities is that, until almost the 19th century, there were no clear ways of identifying, labeling, and differentiating

disabilities. Winzer explained that all people with conceived disabilities were lumped into one category: disabled. It was not until almost the 19th century when the categories of insane, blind, deaf, and dumb emerged, that individuals with disabilities were even identified in broad ranges by the behaviors and symptoms of their conditions (Winzer, 1993). In addition to being severely misidentified as insane or deviant, people with physical and mental disabilities have been sterilized, exterminated, segregated into colonies, forced into asylums, and experimented upon (Minnesota Governor's Council on Developmental Disabilities, 2017).

Prior to the mid-20th century, which saw the largest expanse to special education reform, several movements paved the way. Enlightenment thinkers of the 18th century pushed society to value independence, self-respect, and dignity (Winzer, 1993). The Minnesota Governor's Council on Developmental Disabilities (MNDDC, 2017) compiled a detailed history of the efforts and setbacks in the name of individuals with disabilities. The council explained that industrialization in the 19th century caused social reformers to advocate for those labeled "feeble-minded," and formerly institutionalized to be educated, trained, or cared for in special schools. Later, according to the MNDDC, when laws were enacted that required public school attendance in the early 20th century, teachers began to identify the existence of slow learners and the need for training on how to educate them. The MNDDC explained that by 1925, special education classes expanded with enrollment into the thousands. Beginning in the 1940s, the MNDDC illustrated that a movement spurred by parents of individuals with disabilities (and aided by President John F. Kennedy and his influential family) pushed the treatment of this group into the national spotlight. Finally, the MNDDC concluded, in the 1950s and beyond, international and domestic organizations and associations were formed, public attitudes began to shift, and legislation was passed.

Legislation

The legal backdrop for special education picks up the rest of the history. As Martin, Martin, and Terman (1996) explained, early educational reform legislation did not initially include terms for the education of students with disabilities. According to the authors, eventually legislation was passed that addressed subsidizing special education, requirements for the education of individuals with disabilities, eligibility parameters, and the treatment of students with disabilities in schools. The first major law that granted federal funds to schools with provisions to benefit special education was the Elementary and Secondary Education Act of 1965 and its later versions (Martin, Martin, & Terman, 1996). In 1975, Congress passed the Education for All Handicapped Children Act (EAHCA), and with it came a free, appropriate public education in the least restrictive environment possible for all eligible children with a disability (Russo, 2008).

The Individual with Disabilities Education Act (IDEA) was passed first in 1990 and is the most recent incarnation of the EAHCA (Martin et al., 1996). This legislation stipulates how an individual can become eligible for federally-funded special education services, as well as requires school districts to follow certain steps to ensure each student with a disability has their needs met. Martin et al. (1996) explained that for their part, schools must (a) identify all students who may be eligible for special education in their district; (b) conduct testing and evaluations to determine eligibility for services; (c) create and annually update an IEP; and (d) provide accommodations, modifications, and related services as deemed appropriate by an IEP team.

Under IDEA, in order to receive special education services at primary or secondary educational institutions, a student must be determined to have a physical or mental impairment that “substantially limits one or more major life activities, have a record of such impairments, or

are regarded as having impairments" (Russo, 2008, p. 249). A major life activity includes "caring for oneself, performing manual tasks, walking, seeing, hearing, speaking, breathing, learning, and working" (p. 249). Because learning is considered a major life function according to IDEA (2004), students with learning disabilities are eligible to receive special education and related services.

According to Gonzalez (2014), half of the students who qualify for services under IDEA do so for a learning disability (p. 111). Of those students with a learning disability, 80% have a known reading disability (p. 111). The National Institutes of Health (NIH) explained that reading disabilities are cognitive in nature and have been shown to be genetic in certain studies (2014). According to the NIH, an individual with a reading disability may have trouble decoding, or sounding out, words; may read slowly; and may have poor comprehension of texts. Reading disabilities will be further discussed in a later section.

Students with reading disabilities are not the only ones who are affected by reading comprehension difficulties. An attention deficit/hyperactivity disorder (ADHD) diagnosis can qualify a student under the Other Health Impairment (OHI) IDEA label for special education services because it can significantly impact an individual's impulse control and executive functioning skills (Miller et al., 2013).

Technology in Schools

21st Century Learner

The capacity for technology's use in schools has grown exponentially over the past decade (U.S. Department of Education, 2016). The Kaiser Family Foundation (as cited in Putman, 2014) determined that children in 2010 were using some form of technology for almost eight hours a day. Five years later, a second study suggested that teenagers between the ages of

13 and 18 spent, on average, nine hours a day using electronic media (Tsukayama, 2015). These figures explain why there has been an increase in the amount of technology in schools: because the students in them have embraced the digital age with fervor. Banas and Brown (as cited in Kalmane, 2012) agree and stated, "Twenty-first century learners have increasingly become a generation whose learning experiences require and afford vastly different instructional opportunities than the generation before" (p. 28).

Blair (2012) agreed that the 21st century learner is more adept with technology than preceding generations, but added that they are asked to master more skills as well. She explained that in addition to showing proficiency in reading, writing, and math, students today must be skilled in critical thinking, creativity, communication and collaboration: the four C's. Blair explained that where teachers used to teach material *using* technology in a teacher-centered class, now many teachers are teaching *through* technology, allowing it to foster discovery and exploration amongst students. Using technology to develop these skills, suggested Blair, will help create more independent and successful adults. It seems that technology has a place in education, and the next step is to find out what that place is.

Technology Integration

There are, however, few studies on *how* exactly a digital or electronic environment affects learning in the classroom. According to the U.S. Department of Education (2010), a search for literature conducted between 1996 and 2008 found very few experimental or quasi-experimental studies on the effectiveness of different digital learning environments. Another U.S. Department of Education (2016) publication done six years later supported the earlier claim and recommended additional research be conducted about the effects of technology on learning.

One further problem that has begun to arise with the emergence of new technology is that the digital classroom is very different from the traditional classroom, and therefore, skills and strategies taught when working with print materials may not work for computerized or digital materials (Putman, 2014). Putman (2014) explained that online learning environments require different reading strategies from those used for traditional learning environments. For example, he identified hyperlinks and multimedia as features of an online text that may cause distractions or otherwise make it difficult to process and understand the content. He recommended that a reader have the skills to adapt and navigate these media in order to read in such an unstructured environment as electronic text. This type of insight from research can aid educators and administrators in creating a plan for implementing technology effectively in the classroom.

It is evident there is a need for additional research on how effective technology is in the learning, and specifically the reading, process. However, in order to understand how students read electronic text, it is important to first identify the factors that affect reading achievement in general and draw conclusions about how those factors may affect reading digital text.

Factors that Affect Reading Processes and Comprehension

Reading Basics

Reading is a complex process that requires specialized instruction to master. It is a learned skill, not an inherent one; in order to develop reading skills, a student must be specifically taught them (Bender & Larkin, 2009). According to the National Reading Panel (NRP), the five components of research-based reading programs are (a) phonemic awareness, (b) phonics, (c) fluency, (d) vocabulary, and (e) text comprehension (Jennings, Caldwell, & Lerner, 2014). Figure 1 refers to NRP's components. A brief description of each of the five components is contained below:

- Phonemic awareness refers to the understanding that spoken language is made up of individual sounds (called phonemes; Jennings et al., 2014). Letters consist of phonemes; when blended together, phonemes make words (Jennings et al., 2014). Phonemic awareness, along with phonics, should be the earliest skill introduced in reading instruction in kindergarten and first grade (Shanahan, 2005).
- Phonics instruction teaches students to match letters with their sound equivalents. (E.g., The word *play* is pronounced /plā/ because the long *a* vowel sound is made when followed by a *y.*; Jennings et al., 2014) Phonics connects written and spoken language; it requires students to make the connection between one or more letters and the sounds they make when combined (Shanahan, 2005). This component is at the heart of learning to read, and should be used to develop the three remaining components (Shanahan, 2005).
- Fluency is an essential piece of eventual comprehension of a text and involves word identification accuracy, reading rate, and expression (often called prosody; Jennings et al., 2014). The term "fluency" is frequently used interchangeably with "reading rate"; however, they are not synonymous. The NRP defines fluency as "reading with accuracy, speed, and expression and doing so without conscious or overt attention on the part of the reader" (Jennings et al., 2014, p. 201).
- Vocabulary is similar to fluency in that it is directly related to how well a child understands a text. The term vocabulary refers to the meaning of words (Jennings et al., 2014). Vocabulary is taught directly through instruction, but also indirectly in the environments in which children interact (Jennings et al., 2014). Language instruction should not stop at a certain grade, because the type of vocabulary a student is required to

know changes between grades and content areas (Shanahan, 2005). The more words a child knows, the easier it is to understand what he or she reads (Shanahan, 2005).

- Text comprehension requires students to understand that "(1) the purpose of reading is comprehension, (2) comprehension is an active and accurate process, (3) readers use their background knowledge to comprehend, and (4) comprehension requires higher-level thinking" (Jennings et al., 2014, p.263). Direct instruction in all of the previous components are meant to aid students in the ultimate goal of understanding what they read.

Because reading comprehension is the focus of this study, it is necessary to delve further into the final component specifically.

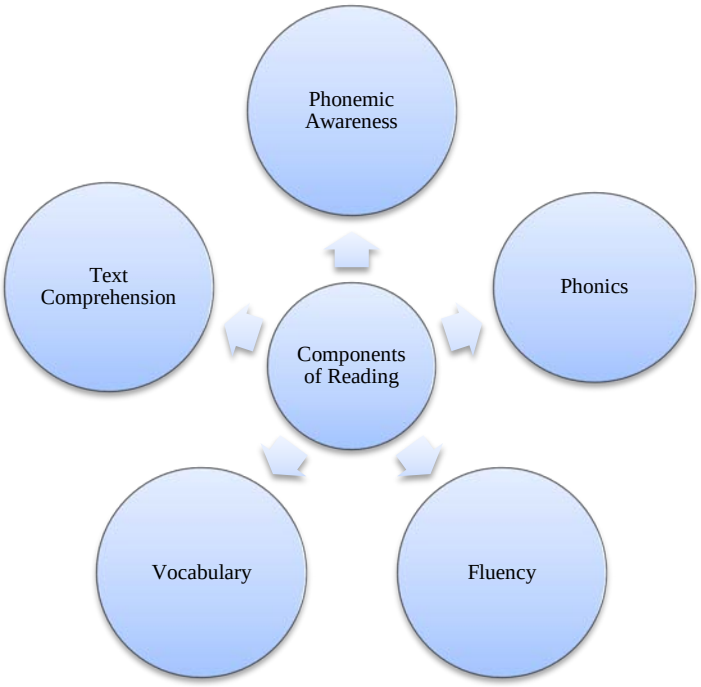

Figure 1. National Reading Panel's five components of reading.

Reading comprehension

Making meaning of a text necessitates that the first four NRP reading components to work together. An example of how this interaction works comes from Shanahan (2005): "If a

student lacks the phonemic awareness and phonics skills to translate written text into oral language, reading comprehension will be blocked no matter how well the student can think about the ideas" (p. 28). Early literacy instruction is paramount to later reading comprehension proficiency.

At the most basic level, Woolley (2011) explained that comprehension requires a reader to process the individual letters, words, and sentences. He explained that this is a complex cognitive process and that there are many factors affecting how successful a reader is. Woolley pointed to several factors influencing readers' comprehension, including the way a text is organized; the metacognitive ability of the reader; the style and spacing of the font; and biological, cognitive, and behavioral variables. However, he argued that the goal of reading should focus more on knowing what the text says overall than what the individual words mean, echoing the NRP's statement that the goal of reading is comprehension. He explained that the last variables (i.e. biological, cognitive, and behavioral factors), what he called "reader variables," are the underlying causes for learning disabilities, not the textual, structural, or organizational variables.

The National Council of Teachers of English (2004) published an informational article on reading and explained that readers use different processes and systems in order to understand text. Woolley (2011) agreed, explaining that reading is a cognitive process that requires readers to bring their experience to the text, allowing them to make a connection to it and ultimately constructing meaning. Kalmane (2012) also concurred, stating that pre-existing and background knowledge are essential for success in reading comprehension.

In general, researchers studying the reading process agree that (a) it requires active building of meaning by the reader, (b) the skills can be built upon, and (c) previous knowledge

affects the ability to comprehend. It is important to note that, while developing reading skills may be a lifelong process, it becomes increasingly difficult to remediate reading struggles after third grade (Vaughn et al., 2015). The NRP identified seven strategies supported by research that should be included in effective reading comprehension instruction: (a) question asking, (b) monitoring, (c) summarization, (d), question answering, (e) story mapping, (f) graphic organizers, (g) and cooperative grouping (Shanahan, 2005). Eventually, learning disabilities related to reading are diagnosed when these strategies and other remediations fail.

Approaches to Reading Instruction

There are multiple theories to explain the nature of learning to read. The theories have shifted and been reevaluated over time, but three general approaches have remained constant: bottom-up and top-down, and eclectic or interactive (Faust & Kandelshine-Waldman, 2011; Liu, 2010). Figure 2 summarizes the three theories to literacy development. The bottom-up approach to learning to read involves beginning with individual units within a word (Faust & Kandelshine-Waldman, 2011). This approach is phonics-based, and the process of reading starts with letters making sounds, then making words, then sentences, and eventually meaning is made (Liu, 2010).

Top-down processes are the exact opposite of bottom-up, and are often associated with the whole language movement (Faust & Kandelshine-Waldman, 2011). In top-down reading instruction, a reader is meant to comprehend text based on context and previous knowledge, and the process follows from whole (or sentence) to part (or letter/sound; Liu, 2010; Faust & Kandelshine-Waldman, 2011). A study conducted by Faust and Kandelshine-Waldman (2011) found that students taught using top-down instruction had more errors on a missing letter test while reading for comprehension, possibly indicating that this particular approach does not focus enough on reading proficiency or letter detail.

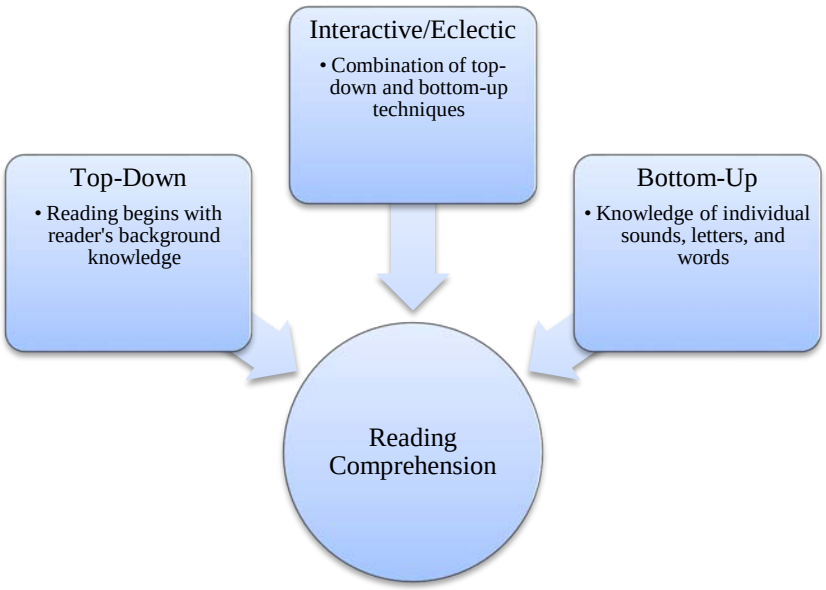

Figure 2. Three approaches to reading comprehension instruction.

The final approach to teaching learning is a hybrid of the previous two. When using the eclectic or interactive approach, readers use phonics and word features (bottom-up) along with their resources and previous knowledge (top-down) to make meaning of a text (Faust & Kandelshine-Waldman, 2011; Liu, 2010). This approach is important for students with reading difficulties because top-down processes may help compensate for bottom-up deficiencies (Faust & Kandelshine-Waldman, 2011). Clearly learning to read is a complex skill that requires time and effort to develop. Students with disabilities have more obstacles to overcome than their nondisabled peers in order to achieve and succeed in the classroom.

Reading Comprehension and Students with Disabilities

Reading Disabilities

As seen in the previous section, the reading process incorporates many variables and prior knowledge. Woolley (2011) explained that reading difficulties are caused by more than just deficiencies within the reader and could be influenced by a mixture of other factors, including social, educational, cultural, and environmental. Bender and Larkin (2009) agreed, but

cautioned stating that even though there is a growing body of research using genetic factors to explain the development of a reading disability, educators should instead focus on developing a literacy-rich curriculum that emphasizes the environmental factors affecting reading development.

Defining a reading disability can be difficult, and "dyslexia" is often used interchangeably to describe such disabilities. A working definition of dyslexia comes from Lyon, Shaywitz, and Shaywitz (2003):

> Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience can impede growth of vocabulary and background knowledge. (p. 2)

As the definition states, dyslexia is a complex disability that results in reading difficulties. While dyslexia is neurobiological in nature, there are other factors that may impede a child's ability to read. The factors most commonly recognized are (1) neurological and cognitive factors, (2) environmental factors, (3) intelligence and intellectual factors, (4) language factors, and (5) physical factors (Jenings, et al., 2014).

Neurological and cognitive factors. Recent research suggests that children who are poor readers have differences in brain function and structure than children who read at a normal level (Jennings et al, 2014). Studies have found that individuals with dyslexia have less grey (information processing) and white (information transfer) matter in their brain compared to

nondyslexic learners (Hudson, High, & Al Otaiba, 2007). Functional brain imaging allows medical professionals to see how the brain functions during a task (i.e., reading). Studies using functional brain imaging have found evidence that certain brain systems do not function properly when an individual with dyslexia engages in reading (Lyon, Shaywitz, & Shaywitz, 2003). Deficits in cognitive processing can account for reading disabilities as well. If an individual struggles with memory, language development, or visual or auditory processing, it is probable that he or she will experience difficulties in learning to read (Jennings, et al., 2014).

Environmental factors. The environment in which a child learns and develops reading skills plays a vital role in ability levels. Jennings, Caldwell, and Lerner (2014) explained that an environment that is unstable or lacks appropriate supports or resources could lead to the development of a reading disability. The authors emphasized that the home environment is where a child's reading instruction should begin; if reading is not emphasized or featured at home in the early years of a child's life, there is an increased risk of reading problems later on. Additionally, they identified issues like poverty, family instability, violence, hunger, homelessness, and health as all contributing to reading disabilities.

The school environment is important because, after a certain age, most of a child's time is spent in school. Jennings et al. (2014) urged that effective, comprehensive research-based reading instruction is vital, as is attention on the teacher's part to identifying and nurturing children who are at-risk for reading problems. Additionally, the social and cultural environments can impact a child's reading skills. Although research is not definitive on whether a correlation exists, children with academic struggles tend to also have trouble connecting with peers, which results in an often unpleasant school experience, resulting in further academic difficulties (Jennings et al., 2014).

Intelligence and intellectual factors. Many different scales and tests exist to determine and identify an individual's intelligence. In general, "intelligence" is "an individuals cognitive or thinking abilities" (Jennings et al., 2014, p. 27). Studies have found that a direct relationship exists between intelligence and academic achievement. For example, Ghabanchi and Rastegar (2014) found that there was a significant correlation between IQ and reading comprehension, confirming previous results.

It is important to note that intelligence tests have been used in the past to determine the existence of reading disabilities through the discrepancy model (Jennings et al., 2014). A discrepancy (and thus a reading disability) exists if there is a significant difference between where a student should or potentially could be reading, and where they actually are reading (Jennings et al., 2014). Concerns with using intelligence tests for eligibility determinations resulted in new practices according to the law. In 2004, IDEA encouraged schools to instead use "scientific, research-based intervention" to determine if a specific learning disability exists (IDEA, 2004).

Language and physical factors. These two features are combined and described briefly because no participants in the present study had a speech, language, visual, or hearing impairment. Due to the fact that language development is a foundation of literacy development, children who have speech problems or language disorders may experience difficulties learning to read (Jennings et al., 2014). For example, Hesketch (2004) determined from her literature review that children with speech disorders tend to have poor phonological awareness, which may impair literacy development. Hearing and visual impairments can also have a significant effect on a child's ability to read (Jennings et al., 2014). If a problem exists with auditory acuity, or the ability to hear sounds, normal language development could be impeded (Jennings et al., 2014).

In contrast with hearing and language impairments, not all individuals with visual impairments have difficulties reading (Jennings et al., 2014). Many of the impairments (e.g., nearsightedness, farsightedness, astigmatism) experienced by children can be corrected with lenses or glasses as long as they are found early (Jennings et al., 2014).

Other Disabilities

Perhaps not surprisingly, students with specific learning disabilities in reading are not the only ones plagued with reading problems. Students with ADHD also often experience struggles academically, including in reading instruction. In fact, ADHD and learning disabilities (LDs) have a higher comoribidity rate than may be expected. Dupaul, Gormley, and Laracy (2012) examined studies indicating that the comorbidity rate of ADHD and LD was 45.1%. Miller et al. (2013) provided support for this statistic, finding that children with ADHD may experience difficulties in reading due to deficits in working memory. However, in their research into existing literature, the authors found that the links between ADHD and reading challenges were inconsistent. Their study attempted to close the gap in research by finding that children with ADHD struggled with reading comprehension due to a centrality deficit, or an inability to recall central informational from a text over peripheral information.

Students with autism may also experience reading troubles as well, in particular related to comprehension. According to Nguyen, Leytham, Whitby, and Gelfer (2015), children with autism spectrum disorder (ASD) are often very capable of decoding text, but may not always effectively understand it. The authors explained that three cognitive characteristics of children with ASD contribute to reading comprehension deficits: theory of mind (ToM), weak central coherence (WCC), and executive functioning (EF). Theory of mind is the “ability to understand others’ point of view or perspective,” weak central coherence is the “inability to bring details

into a central concept or context", and executive functioning is the "process of organizing, planning, and monitoring progress when presented with a situation" (p. 72).

Electronic Versus Print Texts

Different Reading Strategies

Despite being a fairly new topic, a substantial amount of recent research has been dedicated to the features of electronic texts that make them different from print texts. Chen (2009) explained that the three main differences between reading on a screen and reading from a piece of paper are that (a) the text on a computer screen is in a restricted or limited space, (b) print texts are generally arranged sequentially as a reader moves down the page (whereas an electronic text may have hyperlinks or pop-ups), and (c) electronic text requires different and more engaged cognitive activity. Jabr (2013) reported something similar, stating that reading on a screen requires more of our "mental resources" (para. 6) than print text. Some research has found that reading fluency and comprehension are affected by the format of the text, while others have found that no significant difference in reading exists between the two formats.

Some studies focused on tests administered on computers to determine the effects on reading comprehension. Higgins, Russell, and Hoffman (2005) cited two early studies (Haas & Hayes, 1986; Mazzeo & Harvey, 1988) that found that students taking reading assessments on a computer had lower test scores or found the tests more difficult. Other aspects of reading have been examined as well. Kalmane (2012) indicated that people read 10-30% faster from paper than they do from a screen, explaining that reading fluency decreases when reading electronically. Jabr (2013) reviewed many studies and found that before 1992, most research indicated that individuals perform worse on assessments when reading on screens over paper.

However, he explained that things have changed since the 1990s, when the research became more inconsistent and has started to disprove former conclusions.

Universal Design for Learning

One important facet of technology that has benefitted students with disabilities is its compatibility with the Universal Design for Learning (UDL). The UDL is a principal stating that a classroom should be designed to meet the needs of as many students as possible (U.S. Department of Education, 2016). There are three tenants of UDL: (1) multiple means of representation, (2) multiple means of action and expression, and (3) multiple means of engagement (U.S. Department of Education, 2016). Figure 3 summarizes the key concepts within the UDL framework. The United States Department of Education (2016) sponsored the National Education Technology Plan, which explained that many of the tools that make learning accessible for all individuals can come from technology, including pop-up dictionaries, magnifiers, text blocking, and speech-to-text and text-to-speech capabilities.

Very few studies have been done to determine which specific digital tools can assist learners with reading difficulties or whether computerized reading affects their comprehension. In her exploration into existing literature, Gonzalez (2014) stated that she found little to no research on electronic reading comprehension, specifically for students with disabilities. She went on to study a group of third and fourth graders with reading disabilities to determine whether scaffoldeded features of eBooks, such as text-to-speech functions and pop-up dictionaries, had an effect on reading comprehension. She determined that, while there was no significant improvement in multiple-choice quiz scores, students were better able to retell the points from a text when given these eBook scaffolding features. Similarly, Stetter and Hughes (2011) conducted a study of high school students with learning disabilities to determine the

effect computerized reading intervention had on reading comprehension. The researchers found that most students improved their score on a standardized reading comprehension test, regardless of the type of reading intervention they received. As more and more assistive technology becomes available for individuals with and without reading difficulties, it becomes increasingly important to understand how reading is affected by electronic text.

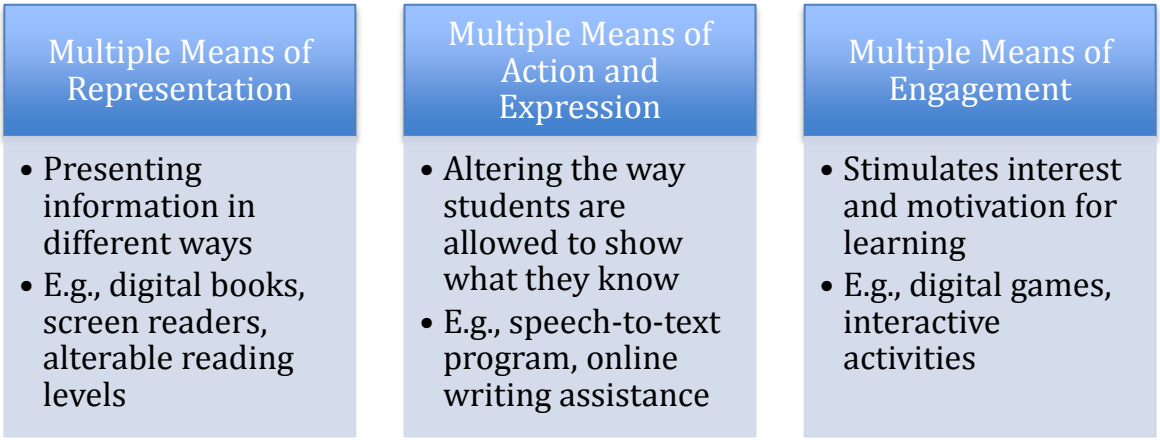

Figure 3. Summary of key concepts and technology of Universal Design for Learning. From U.S. Department of Education (2016), Future Ready Learning. Retrieved from http://tech.ed.gov.

Opthomological Effects

While few studies have been done that investigated the electronic reading comprehension of students with disabilities, some research does exist regarding ailments related to extended electronic use. The American Optometric Association (AOA, 2016) identifies computer vision syndrome (CVS) as a variety of eye and vision problems that are caused by prolonged computer use. According to the AOA, symptoms of CVS may include eye discomfort, eyestrain, headaches, blurred vision, or dry eyes. Additionally, the AOA claims that, when compared to printed material, reading on a digital screen includes letters that "are not as precise or sharply defined, the level of contrast of the letters to the background is reduced, and the presence of glare

and reflections on the screen may make viewing difficult" (para. 10). The AOA identifies anyone who spends two or more hours looking at a computer screen a day as at risk for CVS. In the expanding digital learning environment, it is likely that students are experiencing some of the symptoms of CVS.

A study (Chu, Rosenfield, Portello, Benzoni, & Collier, 2011) investigated and compared various symptoms of CVS after viewing digital and print text. The researchers determined that participants rated most symptoms higher after computer use. One symptom, blurred vision during the task, returned a statistical significance between digital and hardcopy readings, while the remaining symptoms did not. The researchers concluded that some evidence from their study supported the claim that viewing a computer monitor for a prolonged period of time does not produce the same viewing conditions as viewing printed text. The results from this study can help inform educators on the ophthalogical impact digital reading may have on students and hopefully encourage them to find ways to minimize these effects.

Conflicting Results

Research on electronic reading comprehension since the 1990s shows conflicting results. Higgins et al. (2005) studied 219 fourth graders in three groups: (1) those reading a passage in print, (2) those reading a passage on the computer that requires the examinee to scroll, and (3) those reading a passage on the computer that has all text in one spot. No significant difference in reading scores was found across the three modes. Shepperd, Grace, and Koch (2008) studied 400 college students who chose between electronic and traditional textbooks to determine who performed better in their course. The researchers found no significant difference between the final grades of the traditional and electronic textbook users. Grimshaw, Dungworth, McKnight, and Morris (2007) studied a group of 9 to 11 year olds who read a story either (1) in print, (2) on

a CD-ROM, or (3) on a CD-ROM with narration. They determined that, while comprehension test scores were significantly higher in the narration group, no significant difference in reading comprehension scores existed across the other two formats. Gonzalez (2014) cited studies (Greenlee-Moore & Smith, 1994; Matthew, 1997) that found that comprehension scores were even higher with electronic books than print books.

The research that has been done on this topic is conflicting. While numerous studies have been conducted on the effect of print reading versus electronic reading, many of them studied adults or elementary-aged children. Additionally, little research has been done on how reading comprehension of students with disabilities is affected by reading electronic texts. In order to make more informed curricular decisions about reading instruction, more research needs to be conducted.

Chapter Summary

Three conclusions can be drawn after a review of the existing literature. The first is that most researchers agree technology has a place in the learning process, but more empirical evidence is needed to identify (a) what specific role it should play and (b) what strategies and approaches are effective for digital learning (e.g., Putman, 2014). The second conclusion is that the research is inconclusive on whether electronic texts affect basic reading skills, including fluency and comprehension (e.g., Higgins et al., 2005). The third conclusion is that students with disabilities, especially those with reading problems, might benefit from technology to assist them in overcoming obstacles (e.g., Gonzalez, 2014). However, more research needs to be conducted in order to identify technology's place in this support process.

The present research study has provided some additional insight into all of these questions that have been left unanswered. Students with learning disabilities and/or reading

problems are valued members of the educational environment and their ability to engage in the digital community needs to be investigated.

Chapter III

Methodology

The purpose of this study was to determine if a significant difference existed between students' comprehension of a reading passage when reading it in print as opposed to reading it electronically. Specifically, the study sought to investigate whether the reading comprehension scores of students with varying disabilities and reading levels were affected by the medium in which the text is presented. The study took a qualitative approach, and a causal-comparative design was used to investigate the difference (Mills & Gay, 2016).

Participants

School Demographics

The participants of this study were 31 eleventh and twelfth grade students with varying disabilities from Community High School M. This sample was one of convenience, as these students attended the school at which the researcher is employed. The researcher was given permission by her administration to complete this study, and an ethics-training course was completed (see Appendix A). The school district encompasses several counties and includes suburban and rural communities. According to the 2015 Illinois School Report Card (completed by the Illinois State Board of Education) for High School M, 75% of the school's more than 2,500 students are racially white, 5% are black, 17% are Hispanic, 1% are Asian, and 3% identify as two or more races. Less than 1% of the students at this school are considered low income, 1% is enrolled in the English learners program, 10% are identified as having a disability, and 1% is homeless (ISBE, 2015).

English Courses

The students were selected for the study based on their enrollment in either a Response to Intervention (RtI) English course or a self-contained English course. At this high school, students with and without disabilities are placed in the RtI class, called "Applied," as a result of reading scores or English grades considered to be "at-risk" or concerning. There is an Applied English class for each of the four required years. Students in this study were either special education students in the English 3 and English 4 Applied courses, or from one self-contained English 4 class. The Applied classes are co-taught, with one highly qualified English teacher and one Special Education teacher with at least a Learning Behavior Specialist (LBS-1) credential.

These classes are adapted and modified from the general English curriculum to best meet the needs of the learners enrolled. Students with disabilities in the class receive additional accommodations and modifications, per their IEP. All of the students enrolled in the self-contained English class have an identified disability and receive special education services. This class further adapts and modifies the regular English and Applied curriculums in a way that meets the needs of its learners. The majority (n=25) of the students participating in this study were in an Applied English class, while the remainder (n=6) of the students was in the self-contained English class. Two the six students in the self-contained class participate in the school's Life Skills program and are pulled out solely for English instruction.

Students with Disabilities

All students participating in this study were identified as having a disability under the Individuals with Disabilities Act (IDEA). Students in this study qualify for services with six different eligibility labels: (a) four students are eligible for an IEP with autism spectrum disorder

(ASD); (b) one student qualifies with emotional disturbance (ED); (c) eight students qualify for an Other Health Impairment (OHI) label with attention-deficit/hyperactivity disorder (ADHD); (d) 12 students have Specific Learning Disabilities (SLD), all with at least a qualifying deficit area in reading fluency or reading comprehension; (e) one student qualifies with an intellectual disability (ID) and (f) five students qualify with two disabilities (i.e., OHI and SLD, AU and OHI, ED and OHI, SLD and ED).

Scholastic Reading Inventory

At the beginning of the school year, all students enrolled in Applied and self-contained English classes completed a reading assessment called the Scholastic Reading Inventory (SRI). According to MetaMetrics, Inc. (n.d.), the SRI is a "research-based, computer-adaptive assessment for Grades K-12 that measures students' comprehensive, actionable reports to teachers and administration" (p. 2). When students complete the SRI assessment, they receive a Lexile score. Scholastic, Inc. (2014) identifies the Lexile Framework is a common scale to measure text complexity and reading ability. Scholastic, Inc. (2014) explains that the Lexile Framework for Reading is a valid measurement based on results that "show that most attempts to measure reading comprehension . . .measure a common comprehension factor specified by the Lexile Theory" (p. 25). According to MetaMetrics, Inc. (n.d.), students in eleventh and twelfth grade should earn a Lexile score between 1050 and 1300 in order to be a "proficient" reader. Students below 799 Lexiles earn the "below basic" distinction, students earning between 800 and 1049 Lexiles are considered "basic" readers, and students earning above 1300 are identified as "advanced" readers. It is important to note that the SRI test is computerized. This is significant because students' Lexile scores were based on their comprehension of electronic text, and this study investigated that variable.

Instruments

The primary instrument used to collect data in this study was the *Advanced Level Six-Way Paragraphs*, 3rd edition (Pauk, 1999). Six-Way Paragraphs are high-interest reading passages with six essential reading comprehension questions for each passage. On most days during the school year, students have completed Six-Way Paragraphs. Students are aware and comfortable with the strategies needed to go through these assignments. On a Six-Way Paragraph assignment, students read a nonfiction passage and answer six types of questions: (1) determining what the main idea of the passage is, what is too broad to be the main idea, and what is too narrow to be the main idea; (2) identifying what the subject matter of the passage is; (3) determining accurate supporting details; (4) drawing a conclusion or making an inference; (5) clarifying writing devices in the passage; and (6) selecting correct vocabulary in context. Comprehension scores are calculated based on number of correct answers per passage. The book contains 100 reading passages, with every 25 passages increasing in reading level (Pauk, 1999). This allowed participants in the study to read similar, but not identical, appropriate passages over the six week time period. For this study, students read and completed five print Six-Way Paragraphs and five electronic Six-Way Paragraphs. The electronic assignments were completed on Google Forms; the text was displayed and multiple-choice questions followed. Student responses were collected into a spreadsheet for analysis. An example of a Six-Way Paragraph used in this study can be found in Appendix B.

Procedures

Data Collection

The data was collected over six weeks in February and March of 2017. Students were divided into two random groups: one group completed the Six-Way Paragraphs in print on weeks

1, 3, and 5, and electronically the other weeks; the other group completed the Six-Way Paragraphs in print on weeks 2, 4, and 6, and electronically the remaining weeks. Each Six-Way Paragraph was graded daily and entered into an encrypted, password-safe spreadsheet that held all student information and scores. Scores were out of 10 points: 0.5 points for correctly identifying the "too broad" and "too narrow" statements, and 1.5 points for correctly identifying the remaining components.

The school in this study utilizes a block schedule. The involved classes met on alternating days, for one-and-a-half hours. Over the six-week study, participants continued to be assigned Six-Way Paragraphs; however, during the course of the study, they alternated between completing them online and completing them on paper.

Data Analysis

The primary data analysis for this study consisted of comparing the reading comprehension scores the participants attained when completing the Six-Way Paragraph assignments on a computer and when completing them in print. The mean and standard deviation of all print scores were compared to the mean and standard deviation of all electronic scores, and paired dependent *t*-tests were used to determine if there was a significant difference between reading comprehension scores on an electronic reading passage and a print reading passage. Cohen's *d* was used to determine effect size for each analysis group and each individual student. This determined the answer to the first research question: Is there a difference between students' comprehension of a reading passage when reading it in print as opposed to reading it electronically?

To address the second research question regarding the effect electronic reading had on students with specific disabilities, the mean scores and standard deviation of print reading and

electronic reading were compared for students with different disabilities. Additional dependent paired *t*-tests were utilized to determine if there was a significant difference between the two modes the passages were presented in. This assisted in answering the following questions: Do students who have a specific learning disability perform better on a reading comprehension passage when completing it in print or when they are completing it electronically? Are students who are diagnosed with ADHD more successful in reading comprehension when it is presented digitally or on paper? Lastly, final analyses were done (using dependent paired *t*-tests) to determine if students with different reading levels according to their Lexile performed better on print or electronic reading comprehension passages.

Chapter Summary

This study investigated the scores of 31 eleventh and twelfth grade special education students on print and electronic reading comprehension passages. The students in this sample were taken from the researcher's school, and all were enrolled in an RtI or self-contained English class due to previous reading or English challenges. Each class period over six weeks, students completed a Six-Way Paragraph reading passage, which measured the students' ability to identify the main idea, use context to define an unknown word, and draw conclusions from implied text, among other skills. Students alternated between reading and answering these questions on a computer and on paper. The scores were collected and recorded for each student, and then paired dependent *t*-tests and Cohen's *d* were used to determine if a significant difference existed between the print and electronic scores. Further *t*-tests were conducted to determine the significance, if any, that existed between the reading scores for different disability categories and between different reading levels.

Chapter IV

Results

The purpose of this study was to determine if there was a difference between students with disabilities' reading comprehension on electronic passages and their reading comprehension on print passages. The participants were 31 students with varying disabilities, and each student completed 10 reading comprehension passages – five passages in print and five electronically. The means and standard deviations of various combinations were compared using a paired two-sample *t*-test, and Cohen's *d* was used to calculate effect size. The results of these tests determined whether a significant difference existed between multiple variables on the two types of reading comprehension passages.

Demographics

There were 31 junior and senior students, all with an identified disability, who participated in this study. Each of the students was enrolled in a special education English class, either co-taught or self-contained. Six disability categories were represented in this study: (1) specific learning disability, (2) attention-deficit/hyperactivity disorder, (3) autism spectrum disorder, (4) emotional disability, (5) intellectual disability, and (6) multiple disabilities. Each student identified with a specific learning disability (n=12) had at least a general reading eligibility area. Figure 4 summarizes the percent breakdown of disabilities represented in this study.

One student was removed prior to conducting the study because she has a hearing impairment that requires a cochlear implant and FM system. It was determined by the researcher to remove her from the study due to the impact the hearing impairment may have had on her early literacy instruction. Additionally, two students were identified as English Language

Learners in addition having specific learning disabilities. They were removed from the study because the students' primary language is not English and the linguistic effect on their literacy had not be thoroughly investigated.

The majority (*n*=22) of the participants were boys, with the remaining nine students being girls. Ethnically and racially, the participants were not diverse: 23 students were white, one student was black, five students were Hispanic, and two students were multiracial. One important data point about these students was their reading level, or SRI score. Most (*n*=15) students scored in the "basic" range for their grade level, while three students were identified as "below basic," 11 students were "proficient," and one student scored in the "advanced" level.

In this study, the general electronic and print mean scores were compared using a paired two-sample *t*-test for all students. Additionally, because of the high incidence of learning disabilities and ADHD in these classes, the scores for those two disability categories were compared to determine if students with ADHD or SLD performed significantly better on one of the two modes. Finally, the SRI score can help determine a student's reading level, and an analysis was done to determine if students in the various reading levels performed significantly better or worse on either mode of presentation. Table 2 summarizes the demographic characteristics for the participants of this study.

Results

This study sought to determine if there was a significant difference between how well students with disabilities comprehended reading passages when they were completed electronically or in print. All 31 of the students previously identified as participants completed the study to its entirety. Scores were collected for each student for five reading comprehension passages in print and five reading comprehension passages electronically.

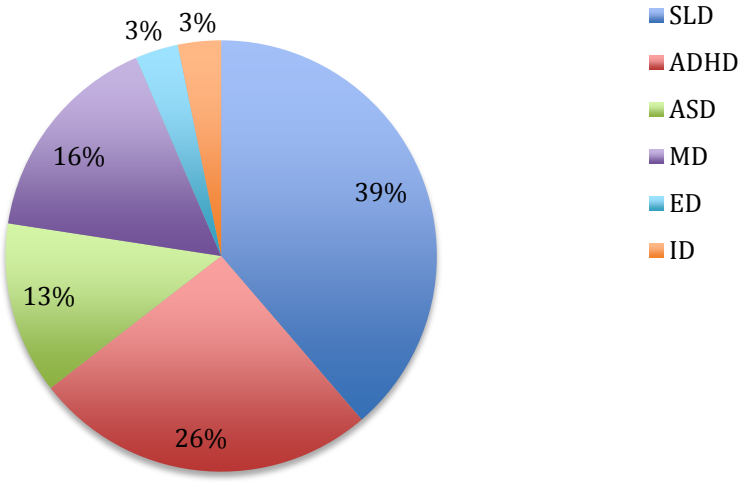

Figure 4. Graphical summary of percentage of disabilities represented in present study. SLD=specific learning disability, ADHD=attention-deficit hyperactive disorder, ASD=autism spectrum disorder, MD=multiple disabilities, ID=intellectual disability, ED=emotional disturbance.

Print Versus Electronic

The primary purpose of this study was to determine whether a significant difference existed between the reading comprehension scores of students with disabilities when asked to read passages in print and electronically. Means (with standard deviations in parentheses) for the population's reading comprehension scores in print and electronically were 7.13(1.65) and 7.44(1.36), respectively. A statistically significant difference was found between these two means, $t(30)=2.90$, $p \leq .01$. Cohen's $d=0.21$ indicates a small effect size. Table 3 and Figure 5 display these results.

In addition to calculating mean, standard deviation, Cohen's *d*, and *t*-tests for the whole population, the effect size for each individual student was calculated. The individual effect size for all students is located in Table 4. Negative effect size values indicate that the student performed better, on average, on print reading comprehension passages, while positive values indicate better performance on electronic passages. Any value below -0.40 signifies a small

effect size, while values above 0.40 indicate a larger effect size. In other words, a value above or below 0.40 indicates that the student responded better to either electronic or print passages, respectively.

Table 2

Demographic Characteristics for Eleventh- and Twelfth- Grade Participants

Class	English 3 (*n*=12)	English 4 (*n*=13)	SC English 4 (*n*=6)
Disability Status			
SLD	5	5	2
ADHD	4	3	1
ASD	1	2	1
ED	0	1	0
MD	2	2	1
ID	0	0	1
Gender			
Male	9	11	2
Female	3	2	4
Race/Ethnicity			
White	10	9	4
Black	1	0	0
Hispanic	1	3	1
Other/Multiracial	0	1	1
Lexile Range [a]			
Below Basic	2	1	0
Basic	7	3	5
Proficient	3	8	0
Advanced	0	1	0

Note. There was one student for whom Lexile data could not be retrieved.
[a] Lexile ranges are as follows: Below Basic= <799, Basic=800-1049, Proficient=1050-1300, and Advanced=1300+ (MetaMetrics, Inc., n.d.).

Table 3

T-Test Results of Electronic and Print Reading Comprehension Scores for All Participants

	n	$\bar{x}$	*sd*	*t*	*df*	*p*	*t*	*d*
Print	31	7.13	1.65	-2.90	30	.01*	.21	.21
Electronic	31	7.44	1.36					

*$p \leq .05$, two-tailed
Note. $d = M_e - M_p / SD_{pooled}$

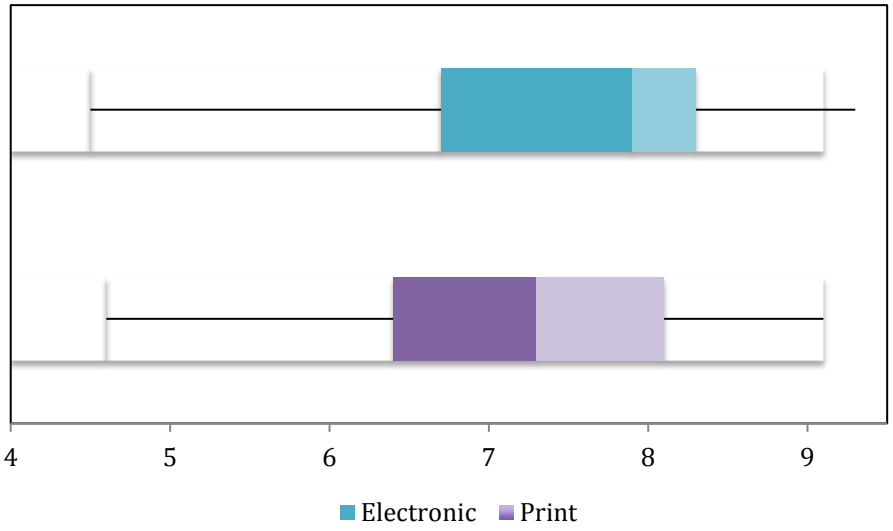

Figure 5. Box plot representation of population mean print and electronic reading comprehension scores.

Disability

For students with a learning disability in reading, the means (with standard deviation in parentheses) for print and electronic comprehension score were 6.90(1.76) and 7.24(2.24), respectively. A paired two-tailed *t*-test was run and no significant difference existed between the print and electronic scores of students with a specific reading disability, t(11)=2.00, $p \leq .07$. Cohen's *d* =.17, again indicating a small effect size. Similar results were found for students

Table 4

Effect Size Test for Differences Between Mean Electronic and Print Passage Scores

Student	Disability	$M_{electronic}$	M_{print}	difference	*d*
1	SLD	6.10	8.60	-2.50	-1.70
2	SLD	7.70	5.60	2.10	1.40
3	SLD	7.80	6.10	1.70	1.10
4	SLD	5.50	7.20	-1.70	-1.10
5	SLD	6.20	7.10	-0.90	-0.60
6	SLD	6.40	6.70	-0.30	-0.20
7	SLD	8.40	8.10	0.30	0.20
8	SLD	9.50	8.60	0.90	0.60
9	SLD	4.60	7.60	-3.00	-2.00
10	SLD	8.00	4.70	3.30	2.20
11	SLD	5.20	6.90	-1.70	-1.10
12	SLD	8.20	5.60	2.60	1.70
13	ADHD	7.60	7.60	0.00	0.00
14	ADHD	5.00	6.90	-1.90	-1.30
15	ADHD	6.90	5.50	1.40	0.90
16	ADHD	9.40	7.30	2.10	1.40
17	ADHD	8.60	7.30	1.30	0.90
18	ADHD	6.00	5.70	0.30	0.20
19	ADHD	7.80	7.10	0.70	0.50
20	ADHD	9.80	7.90	1.90	1.30
21	ASD	8.30	8.80	-0.50	-0.30
22	ASD	9.20	8.10	1.10	0.70
23	ASD	8.20	8.80	-0.60	-0.40
24	ASD	7.70	8.70	-1.0	-0.70
25	MD	6.60	4.80	1.80	1.20
26	MD	7.10	8.30	-1.20	-0.80
27	MD	6.80	7.60	-0.80	-0.50
28	MD	8.30	7.40	0.90	0.60
29	MD	7.90	6.70	1.20	0.80
30	ID	5.50	4.60	0.90	0.60
31	ED	9.70	9.10	0.60	0.40

Note. SLD=specific learning disability, ADHD=attention-deficit/hyperactivity disorder ASD=autism spectrum disorder, MD=multiple disabilities, ID=intellectual disability, ED=emotional disturbance.

$d = M_e - M_p / SD_{pooled}$

with ADHD, with no significant difference existing between the two types of reading passages, $t(8)=1.97$, $p \leq .09$. Cohen's $d=.26$, indicated a small effect size. Table 5 shows the results.

Table 5

T-test results of electronic and print reading comprehension scores for SLD and ADHD students

	n	$\bar{x}$	*sd*	*t*	*df*	*p*	*d*
SLD							
Print	12	6.90	1.76	-2.00	11	.07*	.17
Electronic	12	7.24	2.24		11		
ADHD							
Print	8	6.91	1.94	-1.97	7	.09*	.26
Electronic	8	7.43	2.12		7		

*$p \leq .05$, two-tailed
Note. $d = M_e - M_p / SD_{pooled}$

Reading Level

One last analytical question was investigated relating to a student's standard reading level and his or her performance on a print or electronic reading comprehension passage. There were very few ($n=3$) students in the "below basic" level, and only one student in the "advanced" level; consequently, an analysis was done on the majority of students, or those in the "basic" and "proficient" levels. The mean comprehension scores (with standard deviations in parentheses) for "basic" level students on print and electronic passages were 7.01(2.03) and 7.45(2.22), respectively. Again, no significant difference was found for basic readers, $t(14)=1.05$, $p \leq .31$. Cohen's $d = .11$ determined a small effect size.

Proficient readers scored, on average, higher than their classmates at the basic level. This is unsurprising since the proficient students performed well enough on the online reading assessment to place them in this level in the first place. In this group, a significant difference between the print and reading scores existed, $t(12)=2.46$, $p \leq .04$. Cohen's $d=.17$ indicated a small effect size. Table 6 summarizes the results.

Table 6

T-Test Results of Electronic and Print Reading Comprehension Scores for Basic and Proficient Readers

	n	$\bar{x}$	*sd*	*t*	*df*	*p*	*d*
"Basic" SRI							
Print	14	7.01	2.03	-1.05	13	.31*	.11
Electronic	14	7.45	2.22		13		
"Proficient" SRI							
Print	12	7.67	1.82	-2.46	11	.04*	.17
Electronic	12	7.99	1.91		11		

*$p \leq .05$, two-tailed
Note. $d=M_e - M_p / SD_{pooled}$

Chapter Summary

The goal of this study was determine if a significant difference existed between the reading comprehension scores of students with disabilities on print and electronic reading passages. The results of this study found that, overall, students performed significantly better on electronic reading passages. Only one other analysis, that of proficient readers, yielded a significant difference between the two formats of passage. The remaining significance tests determined that students reading at the basic level, students with ADHD, and students with SLD

did not perform significantly better on either of the tests. While no statistical significance existed, it is interesting to note that the mean electronic reading score was higher than the print score for every group compared in this study. Additionally, Cohen's *d* effect size calculations point to a large disparity between which format of text students responded better to.

Chapter V

Discussion and Conclusion

The results of this study indicate that students with disabilities, on average, perform better on a structured reading comprehension passage when it is presented electronically than when it is presented in print. For each category analyzed (ADHD, SLD, basic reading level, and proficient reading level), the electronic reading comprehension average score exceeded the print comprehension score. Additionally, a significant difference was found to exist between print and electronic scores for all participants, as well as specifically for those students whose reading level was identified as "proficient."

Discussion

Electronic Text Features

This study required students to utilize electronic reading skills in order to score well on the computerized reading comprehension passages. Several authors (Chen, 2009; Jabr, 2013: Kalmane, 2012) have pointed to the fact that, to read electronic text fluently and with comprehension, students need to be able to acknowledge that electronic reading is different than print reading and adjust accordingly. In the present study, students had to scroll through a reading passage on a laptop computer and use radial buttons and drop down menus to select the correct answer.

Print Versus Electronic Reading Comprehension

Existing research is conflicted on whether electronic reading scores are higher than print scores. In the present study, it was determined that the average electronic comprehension score was significantly higher than the average print comprehension score for the population. These results directly conflict with some studies (e.g., Shepard et al., 2008; Stetter & Hughes, 2011)

that reported no significant difference between the reading outcomes on electronic learning and print learning. However, the results of the present study do affirm some early research (as cited by Gonzalez, 2014) that found that children performed better on electronic reading tests than print reading tests.

Effect sizes. According to Hattie (2012), an individual effect size greater than 0.40 indicates that a student responded to a certain intervention or experienced more growth than was expected as a result of the normal learning process. Hattie conducted over 900 meta-analyses to determine which variables had the largest positive effect on student achievement and learning. In an analysis of 150 influences or interventions on student learning, computer-assisted instruction ranked 77th (with an effect size of 0.37) and web-based learning ranked 124th (with an effect size of 0.18). This finding is interesting in that it conflicts with research (e.g., U.S. Department of Education, 2016) that identifies technology as an important learning tool. Hattie's conclusion is that computer-assisted instruction and web-based learning are not necessarily the most effective strategies to improve student achievement.

Disabilities and Reading Comprehension

Specific learning disability. It is logical to expect that the students participating in this study with reading disabilities have lower mean scores on reading comprehension passages than some of the other groups studied. Students with LD returned the lowest mean print and electronic scores, supporting previous research indicating reading comprehension difficulties relating this IDEA category (Bender & Larker, 2009; Kalmane, 2012; Lyon et. al, 2003; Shanahan, 2005; Woolley, 2011). The more telling data come from effect size analysis. Half of the students with SLD performed better on electronic passages, and all but two students had individual effects higher than 0.40. When looking at the largest effect sizes compared to the

population, it was the students with learning disabilities who responded the most to one format or the other. For instance, the two students with the largest negative effect sizes on electronic passages and the two students with the largest positive effect sizes on print passages were all students with SLD. This leads to the conclusion that students with reading disabilities overwhelmingly responded to one format or the other, and it is up to the classroom teacher to determine which format works best for which student.

Attention-deficit/hyperactivity disorder. Students with reading disabilities are not the only students who may experience reading difficulties. Martin et al. (1996) found that many children with ADHD have centrality deficits that make the reading process more difficult. In the present study, both students with learning disabilities and those with ADHD on average scored higher on electronic reading passages than in print, but no significant difference existed between the two formats. While students with learning disabilities performed below the average population score on both print and electronic passages, students with ADHD only performed below the average population on print passages. A majority of the students in the middle of the effect size calculations, with relatively small effect sizes, were the children with autism, multiple disabilities, and, to some extent, children with ADHD.

Autism spectrum disorder. Some research exists (Nguyen et al., 2015) that suggests that children with autism may have trouble comprehending text due to a variety of factors. The evidence found in the present study did not support this claim. The four participants with ASD in this study were among the highest scorers. Interestingly, the data indicates that the children with ASD in this study responded better to print text than electronic text. Of the top average print scores, the children with autism accounted for four of the top 10. In contrast, of the top average electronic scores, children with autism accounted for only three of the top 10.

Conclusion

The results of this study indicate that this population of students with special needs performed significantly better on electronic reading comprehension passages than print passages. No significant difference existed between the print and electronic scores of "basic" readers, children with learning disabilities, or children with ADHD, but significance did exist for students reading at the "proficient" level. Some of these results could be attributed to the familiarity that this population of students had with technology. The school that they attend is eager to launch a one-to-one initiative, with each student having an electronic device. As such, teachers are utilizing more technology (as discussed by Blair, 2012) in the classroom, and students are becoming more adept at learning electronically.

Educational Implications

With the data collected in this study, some generalized conclusions can be made. The data supports a recommendation for increased digital learning environments. Students in this study are clearly comfortable with completing reading assignments electronically, and this area should be explored and fostered. As these students move on to colleges and universities, it is likely that a significant portion of their instruction will be digital in some way.

Additionally, the effect size data was beneficial in identifying how students responded to print or electronic formats. Data analysis of this type is important because it provides information about individual students, including what works well for them and what may not. This invaluable information should be used to drive classroom instruction and help inform policy and curriculum decisions. Multicategorical special education programs should be determining the needs of each individual student, regardless of eligibility category, and providing empirical data for IEP teams to use for the benefit of the student.

Lastly, it can be concluded that some students evidently feel significantly more comfortable completing reading assignments in print, while others are more proficient electronically. This should lead a classroom teacher to acknowledge that accommodations and modifications should be made to assignments and assessments based on a student's strength and comfortability level. Further, the classroom teacher should be using the tenants of UDL and providing students with multiple ways to access the curriculum, engage in the material, and demonstrate their knowledge.

Recommendations for Further Research

This study included a relatively small sample size of 31 participants, and many of the disability categories were not well represented. Repeated or similar studies should be conducted to explore the differences between reading comprehension on print and electronic passages. Further studies should be done to determine whether electronic reading passages significantly impact reading scores for children with ASD, emotional disturbance, and intellectual disabilities. Additionally, the scores for children with multiple disabilities were not closely investigated in this study. Some of the children with multiple disabilities qualified for a specific learning disability in reading, but their scores were not fully analyzed due to comorbid factors with other qualifying disability. Investigations into this would be beneficial as well.

Finally, electronic features that help or hinder students with special needs in understanding digital text should be explored. Technology is not likely to disappear, and if children struggle to make sense of electronic text, they may encounter significant difficulties in the future. Universal Design features (e.g., text-to-speech, magnifiers, etc.) should be analyzed and studied to determine what works best for students with varying disabilities. These tools will help minimize the potential affect digital text may have on children with disabilities.

Summary

The changing nature of education has necessitated an increased focus on digital literacy. Students with disabilities are increasingly being required to engage in material electronically in order to be successful in their classes. In an effort to understand the affect technology has on reading comprehension for students with disabilities, a causal-comparative investigation was conducted. Students with varying disabilities, backgrounds, and reading levels read comprehension passages in print and electronically, and the differences were calculated using *t*-tests and Cohen's *d* effect size. The results from this study indicate that students with disabilities comprehend electronic text better than printed text, a positive sign for educators who use technology in the classroom. Moving forward, it is imperative that the relationship between technology and learning continue to be explored, especially for students with disabilities.

References

American Optometric Association. (2016). Computer vision syndrome. Retrieved from www.aoa.org

Anderson, N.J., & Nunan, D. (2008). Reading horizons in practical English-language teaching. Retrieved from http://www.readinghorizons.com/research/

Bender, W.N., & Larkin, M.J. (2009). *Reading strategies for elementary students with learning disabilities: Strategies for RTI* (2nd ed.). Thousand Oaks, CA: Corwin.

Blair, N. (2012, Jan/Feb). Technology integration for the 21st century learner. *Principal*, 8-13.

Chen, H. (2009). Online reading comprehension strategies among fifth- and sixth-grade general and special education students. *Educational Research and Perspectives, 37*(2), 79-109.

Chu, C., Rosenfield, M., Portello, J.K., Benzoni, J.A., & Collier, J.D. (2011). A comparison of symptoms after viewing text on a computer screen and hardcopy. *Ophthalmic Physical Optics*, *31*, 29-32.

Disabled. 2017. In *Merriam-Webster.com.* Retrieved from https://www.merriam-webster.com/dictionary/disability

DuPaul, G.J., Gormley, M.J., & Laracy, S.D. (2012). Comorbidity of LD and ADHD. *Journal of Learning Disabilities*, *46*(1), 43-51.

Education for All Handicapped Children Act of 1975, Pub. L. No. 94-142, § 20 U.S.C. 1401 (1975).

Faust, M., & Kandelshine-Waldman, O. (2011). The effects of different approaches to reading instruction on letter detection tasks in normally achieving and low achieving readers. *Reading and Writing*, *24*, 545-566.

Ghabanchi, Z. & Rastegar, R. (2014). The correlation of IQ and emotional intelligence with reading comprehension. *Reading Matrix: An International Online Journal*, *14*(2), 135-144.

Gonzalez, M. (2014). The effect of embedded text-to-speech and vocabulary eBook scaffolds on the comprehension of students with reading disabilities. *International Journal of Special Education, 29*(3), 111-125.

Grimshaw, S., Dungworth, N., McKnight, C. & Morris, A. (2007). Electronic books: Children's reading and comprehension. *British Journal of Educational Technology*, *38*(4), 583-599.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning.* New York: Routledge.

Hefling, K, & Smyth, J.C. (2015, February 15). Testing based on Common Core standards starts this week. *The San Diego Union-Tribune.* Retrieved from http://www.sandiegouniontribune.com/

Hesketch, A. (2004). Early literacy achievement of children with a history of speech problems. *International Journal of Language and Communication Disorders*, *39*(4), 453-468.

Higgins, J., Russell, M., & Hoffmann, T. (2005). Examining the effect of computer-based passage presentation on reading test performance. *Journal of Technology, Learning, and Assessment*, *3*(4), 1-36.

Hudson, R.F., High, L., & Al Otaiba, S. (2007). Dyslexia and the brain: What does current research tell us? *Reading Teacher*, *60*(6), 506-515.

Illinois Interactive School Report Card. (2016). *Interactive Illinois report card*. Retrieved from https://www.illinoisreportcard.com/

Individuals with Disabilities Education Act, 20 U.S.C. § 1400 (2004).

Jabr, F. (2013, April 11). The reading brain in the digital age: The science of paper versus screens. *Scientific American*. Retrieved from http://www.scientificamerican.com/

Jennings, J.H., Caldwell, J.S., Lerner, J.W. (2014). *Reading Problems: Assessment and Teaching Strategies*. Boston: Pearson Education, Inc.

Kalmane, R. (2012). *Improving reading comprehension with online text visualization tools*. Riga, Latvia: Lulu Press.

Liu, F. (2010). A short analysis of the nature of reading. *English Language Teaching*, *3*(3), 152-157.

Lyon, G.R., Shaywitz, S.E., & Shaywitz, B.A. (2003). *Defining dyslexia, comorbidity, teachers' knowledge of language and reading.* Annals of Dyslexia, 53, 1-14.

Martin, E. W., Martin, R., & Terman, D. L. (1996). The legislative and litigation history of special education. *The Future of Children, 6*, 25–39.

MetaMetrics, Inc. (n.d.). The Lexile framework for reading: A system for measuring reader ability and text complexity. Houghton Mifflin Harcourt. Retrieved from http://www.hmhco.com/products/assessment-solutions/assets/pdfs/sri/RITheLexileFramework.pdf

Martin, A.C., Keenan, J.M., Betjemann, R.S., Willcutt, E.G., Pennington, B.F., & Olson, R.K. (2013). Reading comprehension in children with ADHD: Cognitive underpinnings of the centrality deficit. *Journal of Abnormal Child Psychology, 41*, 473-483. doi: 10.1007/s1080201296868

Mills, G.E., & Gay, L.R. (2016). *Educational Research: Competencies for Analysis and Applications* (11th ed.). Boston: Pearson.

Minnesota Governor's Council on Developmental Disabilities. (2017). Parallels in time. Retrieved from http://mn.gov/mnddc/parallels/index.html

National Council of Teachers of English. (2004, May 1). "On reading, learning to read, and effective reading instruction: An overview of what we know and how we know it." Retrieved from http://www.ncte.org/positions/statements/onreading

Nguyen, N.N., Leytham, P. Whitby, P.S., & Gelfer, J.I. (2015). Reading comprehension and autism in the primary general education classroom. *Reading Teacher, 69*(1), 71-76.

No Child Left Behind (NCLB) Act of 2001, 20 U.S.C.A. § 6301, *et seq*. (West 2003).

Pauk, W. (1999). *Six-Way Paragraphs: Advanced* (3rd ed.). Lincolnwood, IL: Jamestown Publishers.

Putman, S.M. (2014). Exploring dispositions toward online reading: Analyzing the survey of online reading attitudes and behaviors. *Reading Psychology, 35,* 1-31.

Russo, C.J. (ed.) (2008). Individualized Education Program (IEP). In *Encyclopedia of Education Law*. Thousand Oaks, CA:Sage Publications.

Scholastic, Inc. (2014). SRI College and Career technical guide. Retrieved from http://www.hmhco.com/products/assessmentsolutions/assets/pdfs/sri/SRI_TechGuide.pdf.

Shanahan, T. (2005). *The National Reading Panel peport: Practical advice for teachers*. Naperville, IL: Learning Point Associates.

Shepperd, J.A., Grace, J.L., & Koch, E.J. (2008). Evaluating the electronic textbook: Is it time to dispense with the paper text? *Teaching of Psychology, 35*, 2-5.

Stetter, M.E., & Hughes, M.T. (2011). Computer assisted instruction to promote comprehension in students with learning disabilities. *International Journal of Special Education, 26*(1), 88-100.

Tsukayama, H. (2015, November 3). Teens spend nearly nine hours per day consuming media. *The Washington Post*. Retrieved from http://www.washingtonpost.com

U.S. Department of Education. (2010). "Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies." http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf.

U.S. Department of Education, Office of Special Education Programs. (2014) Individuals with Disabilities Education Act. Retrieved, from http://www2.ed.gov/programs/osepidea/618-data/state-level-data-files/index.html

U.S. Department of Education. (2016). "Future ready learning: Reimagining the role of technology in education." National Education Technology Plan. Retrieved from http://tech.ed.gov/files/2015/12/NETP16.pdf

U.S. Department of Health and Human Services, National Institutes of Health. (2014). "What are reading disorders?" Retrieved from https://www.nichd.nih.gov/health/topics/reading/conditioninfo/pages/disorders.aspx

Vaughn, S., Roberts, G., Schnakenberg, J.B., Fall, A., Vaughn, M.G., Wexler, J. (2015). Improving reading comprehension for high school students with disabilities: Effects for comprehension and school retention. *Exceptional Children, 82*(1), 117-131.

Winzer, M. (1993). *The History of special education: From isolation to integration*. Washington, D.C.,: Gallaudet University Press.

Woolley, G. (2011). *Reading comprehension: Assisting children with learning difficulties*. London: Springer.

Wright, P.W.D., & Wright, P.D.W. (2007). *Special education law* (2nd ed.). Hartfield, VA: Harbor House Law Press.

Yell, M. (2016). *The law and special education* (3rd ed.). Boston: Pearson.

APPENDIX B: Example Six-Way Paragraph

80 - The World's Longest Rivers

At some 2,300 miles in length, the Mississippi is the longest river in the United States; at some 1,000 miles, the Mackenzie is the longest river in Canada. But these waterways seem miniscule in comparison to the world's two lengthiest rivers, the Nile and the Amazon.

The Nile, which begins in central Africa and flows over 4,100 miles north into the Mediterranean, hosted one of the world's great ancient civilizations along its shores. Placid for most of the year, the Nile used to flood annually, thereby creating, irrigating, and carrying new topsoil to the nearby farmland on which ancient Egypt depended for sustenance. A transportation and food source as well, the river carried various vessels up and down its length, from modest fishing and cargo boats to the magnificent barges of the ruling pharaohs. A journey through the unobstructed part of this waterway today would pass by the splendid Valley of the Kings, where the tombs of many of these ancient monarchs have stood for over 3,000 years.

Great civilizations and intensive settlement are hardly associated with the Amazon, yet this 4,000-mile-long South American River carries about 20 percent of the world's fresh water - more than the Mississippi, Nile, and Yangtze combined. Other statistics are equally astounding. Of its 15,000 tributaries, 17 are over 1,000 miles long, and the river itself is so wide at some points that from its center neither shore can be seen. Each second, the Amazon pours some 55 million gallons of water into the Atlantic; there, at its mouth, stands one island larger than Switzerland. Most important of all, the Amazon irrigates the largest tropical rainforest on earth.

1. Mark the *main idea* with the letter "M"
   Mark the statement that is *too broad* with the letter "B"
   Mark the statement that is *too narrow* with the letter "N"

   A. The world's longest rivers, the Amazon and the Nile, have little more than length in common. _____

   B. Many countries have very long rivers. _____

   C. The Nile is about 4,100 miles long, and the Amazon is about 4,000 miles long. _____

2. This passage mostly deals with
   A. interesting facts about the Amazon and the Nile.
   B. a history of life along the Amazon and the Nile.
   C. rivers as important natural resources.
   D. the longest rivers in several large countries.

   _____

3. The Amazon is **not** known for
   A. its many tributaries.
   B. its amazing width.
   C. the amount of water it carries.
   D. the large cities along its banks.

_____

4. The writer suggests that a tour along the Nile today would reveal
   A. modern irrigation methods.
   B. monuments from ancient times.
   C. the poverty of present-day Egyptians.
   D. many houseboats along its shores.

_____

5. The writer talks about the two rivers by
   A. explaining the history of each.
   B. telling what makes each unique.
   C. discussing their importance as trade routes.
   D. describing the specific land that each passes through.

_____

6. Miniscule means
   A. very large.
   B. very small.
   C. medicine.
   D. destroy.

_____