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# How High School Students With Dyslexia Use Assistive Technology; A Teacher's Perspective

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College of Education  
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How High School Students With Dyslexia Use Assistive Technology: A Teacher's Perspective

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Dissertation submitted to the Faculty of the College of Education  
in partial fulfillment of the requirements for the degree of Doctor of Education in  
Higher Education

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Concordia University-Portland

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## **Abstract**

High school teachers of students with dyslexia face unique instructional challenges. Students with dyslexia experience levels of difficulty in reading and writing tasks that have now transmigrated into the digital realm. These teachers are working to collaborate with and teach students that are dyslexic, using technology tools. The purpose of this qualitative case study was to gain an understanding of how these teachers are using technology to support the learning of students with dyslexia. Two research questions guided this study: How do the teachers of high school students with dyslexia perceive the use of digital technology to assist in the learning process? What are the experiences of teachers who use digital technology to teach high school students with dyslexia? The sample was a purposeful sample consisting of eight high school teacher participants. Participants taught a variety of subjects including English, mathematics, history, and science at a charter school in western North Carolina. The data collection instruments were face-to-face interviews, observations, and member checking sessions. The typological analysis model was used to analyze data collected from interviews and observations. The constant comparative strategy was used during analysis to effectively determine commonalities among these data. The key findings of this study were that participants view digital classroom technology favorably and are using technology frequently as a teaching tool for all students. The teachers expressed the need for professional development and training sessions to more fully develop technology skills as a way to specifically engage with students with dyslexia and their learning needs.

*Keywords:* dyslexia, assistive technology

## **Dedication**

I would like to dedicate this dissertation to Barack and Michelle Obama. Without their express enthusiasm in support of educators and their consistent message concerning greater access to college and graduate school for all this journey would most likely never have been a possibility for me. I will always be grateful for the warm support and enthusiasm the President and First Lady exuded to the students of our nation. Graduate school became a reality for me because of the Obamas. Their vision of college and success resonated with me and I am hopeful that many more students will be able to achieve their dreams as I have.

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## **Chapter 1: Introduction**

Teachers of high school students with dyslexia face unique instructional challenges. Students' difficulties with reading and writing tasks can have a profound impact on their academic capabilities (Forgrave, 2010), particularly in terms of critical understanding of texts and performance mastery. An estimated 5% to 17% of all readers will experience reading impairments because of the inherited neurological effects of dyslexia (Schneps, Thomson, & Chen, 2013). This percentage of the reading population indicates a notable group of struggling readers in the classroom, suggesting their teachers need specific training and experience to meet their needs.

The reading and writing difficulties high school students with dyslexia experience have now transmigrated into the digital realm. Many classroom teachers have begun to adopt technology tools into their own instructional practice, which can help their engagement with students with dyslexia in new and improved ways (Passe, 2006). However, how teachers employ technology as a teaching tool to support students that are dyslexic is not clearly understood. Using assistive technology to support readers with dyslexia is a relatively new adaptive modification, and little is known about how these new technologies help a learner decode and understand written text (Schneps et al., 2013). Increasing numbers of students with dyslexia are enrolling in postsecondary education, signaling a need for greater understanding of how these students are preparing for the adjustment of college (Passe, 2006). There is a need to understand the role and influence of assistive technologies as they are employed in the classroom.

Twenty-first century postsecondary education requires a high level of learner autonomy (Mortimore, 2013; Tops et al., 2013). College students with dyslexia must have traits of self-efficacy and resourcefulness to succeed. As Anderson and Knox-Quinn (2007) argued, to perform well, students with dyslexia must learn how to learn (Anderson-Inman & Knox-Quinn,

2007) to adapt and do well in college settings. This level of expected performance poses a great challenge for high school students with dyslexia, who consistently struggle with language deficiencies. Preparing for college reading and writing requires even greater autonomy.

While the trend in developing good study skills and habits continues to be important in today's schools (Anderson-Inman & Knox-Quinn, 2007), the focal point must reflect the digital learner. By using assistive technology, students with dyslexia may need to spend less time learning course content, constructing meaning, and articulating course objectives in postsecondary instruction. Digital access to this literacy content requires students to construct knowledge through adaptive and interactive learning methods.

Dyslexia continues to be a challenging disability to understand and accommodate in education (Callens et al., 2012; Roach et al., 2004; Sparks & Lovett, 2009; Williams, 2006). The core deficit in dyslexic phonological processing is thought to disrupt important language receptors in the brain (Lishman, 2016). This deficit is present in childhood, adolescence, and adulthood for an individual with dyslexia, and inhibits phonemic processes that tend to be critical in the accessibility of higher level content and text interpretation. Within this perspective, the impact of digital literacy on secondary students with dyslexia remains under researched (Jackson, 2013). The level to which the teachers of these students with dyslexia have used assistive technology tools is also underreported. Little is known about how high school teachers construct knowledge concerning their own perceptions of students with dyslexia and their understanding of assistive technology; these experiences are revealed as a gap in educational practice.

### **Conceptual Framework: Constructivism**

The historical origin of constructivism is that the learner, through an active process, creates working systems of knowledge and frames of reference. Constructivist theory

emphasizes learners' active participatory role and the heightened recognition given to the social nature of learning (Liu & Matthews, 2005). The Greek philosopher Socrates guided students through developmental thinking and learning as one way to reject the indoctrination of autocratic order (Liu & Matthews, 2005). In the 18th century, Kant discovered that the method and means through which learners perceive external stimuli greatly influenced and shaped personal understanding and recognition (Liu & Matthews, 2005). The progression of constructivist thought has been adapted in the current system of educational design. Students are now expected to take an active role in their own learning and create and apply meaning to this learning process.

Constructivism encompasses the idea that learners build knowledge from within an individual perspective (Qiong, 2010) and that the meaning of this knowledge is derived from the process of personal attempts in learning. In Dewey's view, the learner must be considered at the thought-process level since this is where the construction of knowledge occurs (Liu & Matthews, 1991). To construct a frame of reference, the learner undergoes a series of process-oriented steps to retrieve, sort, organize, and build information systems. These information systems are vital to integrated learning that later supports complex operations and abstract thinking.

How a person learns and the nature of the knowledge that is built are integral to constructivist theory (Liu & Matthews, 2005; Qiong, 2010). Each learner builds knowledge for himself or herself (Liu & Matthews, 2005) and then later through social operations associated with the learning process. This approach to understanding the manner and means in which knowledge becomes purposeful learning may explain the intricacy of how elements such as motivation and experience factor into actual learning (Qiong, 2010). The experience of learning is a dynamic and active process, requiring the student to engage in sensory input and formal operations to contextualize information into schema that may be recalled or used later (Qiong, 2010).

A high school student with dyslexia at the developmental level of Piaget's (as cited in Qiong, 2010) formal operational stage must be able to engage in systematic and abstract reasoning and critical thought. Students should build learning as both a synchronous and personalized experience; their active learning dynamic should encompass new knowledge acquisition through a fluid, organized and systematic process. In Dewey's view, this learner must be able to construct knowledge at the thought-process level, as this is where the formation of new knowledge takes place (Qiong, 2010). However, learners with dyslexia require precise orthographic skill to code, map, and make meaning from phonological information; this process is not automatic or synchronous to the introduction of new content (Taub, 2011).

Instead, the introduction of new textual information presents a backlog of mismatched and often disorganized content that confounds students with dyslexia. The time spent attempting to use mismanaged, self-appropriated coping skills can prevent students with dyslexia from accessing new content and constructing new meaning of information (Callens & Tops, 2012). High school students with dyslexia should be able to use assistive technology to achieve more efficient text access and greater autonomy.

### **Statement of the Problem**

The literature has inadequately addressed how high school teachers perceive the experiences of their students with dyslexia as they attempt to use digital technology and prepare for postsecondary education (Madeira et al., 2016; Nguyen et al., 2013; Papadima-Sophocleous et al., 2014; Schneps et al., 2013). The transitional time frame, in which high school students with dyslexia work with their teachers to complete high school courses, may not provide support a sufficient amount of time for teachers to fully prepare these students for postsecondary education. Dyslexia does not simply vanish with age; high school students with dyslexia must manage and cope with decoding and struggle with orthographic and phonological processing,



which slows down reading productivity (Schneps & Chen, 2013). In light of the enormous pressure to read well in society, students with dyslexia will need to have mastered mature decoding skills and compensatory strategies to handle the expected workload.

Students with dyslexia have difficulty coping with the rigorous coursework and reading requirements in high school, creating barriers and frustration toward learning (Callens & Tops, 2012). They need more time and alternate strategies to engage with the text on their own. Little research exists on how adaptive and assistive technology programs such as Texthelp, Kurzweil 3000, Firefly, and Dragon are being used to address these challenges in the classroom (Barden, 2014).

### **Purpose of the Study**

The purpose of this study was to investigate how high school teachers perceive students with dyslexia and work with these students, using digital technology tools, to prepare these students to handle complex challenges. The perceptions of these high school teachers and their personal use of technology in the classroom illustrate the two main focal areas. This study uncovered more about these teachers' own perceptions, assumptions, and insights.

Participating teachers learned more about their own perceptions, thoughts, and assumptions as they take part in this study. The information collected from this study was designed to provide insight to educators about how students with dyslexia in high school courses use assistive digital technology in the classroom.

### **Research Questions**

The study is guided by two research questions:

1. How do the teachers of high school students with dyslexia perceive the use of digital technology to assist in the learning process?

2. What are the experiences of teachers who use digital technology to teach high school students with dyslexia?

### **Rationale for the Study**

The results of this study may benefit the population of high school teachers who work with students with dyslexia and use digital technology tools to support these students. This study is designed to illuminate the perceptions of a group of high school teachers, whose experiences may resemble those of others teaching students with dyslexia.

The lack of literature (Taylor et al., 2009; Tops et al., 2013) concerning high school teachers' perceptions of students with dyslexia and their use of digital technology suggests this group of teachers may not be well represented in the larger body of educational research. There is a need to uncover high school teachers' perceptions, specifically, in relation to their working relationship with students that have dyslexia and their attitude toward the use of digital technology in the classroom. The elements reflect two areas in education that are becoming more visible in the 21st century as the visibility of students with dyslexia has increased and more teachers are beginning to incorporate technology into their teaching repertoire.

### **Definition of Terms**

**Dyslexia:** 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 (Mortimore & Crozier, 2007).

**Assistive technology:** Any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a learner with a disability (Barden, 2014).

## **Limitations and Delimitations**

### **Limitations**

The study was limited to perceptions of a small sample of high school teachers. This small sample is not representational of all high school teachers and therefore is limited to only the information and experiences participants within the study sample may provide and my own observations. The accuracy of each participants' contributions to this study will vary, dependent on the overall willingness of each participant to respond honestly and fully. The study was also limited to one specified school, which is not representational of all school sites. The study design of qualitative case study yielded unique data unique via observation and interview sessions. The information generated from the participants during these sessions reflected each participants' life experiences but not those of other high school teachers.

### **Delimitations**

The study is delimited to eight high school teachers in one North Carolina school who currently teach using digital technology and also work with students who have dyslexia. Data collection consisted of observations, interviews and member checking. Data analysis aligned to the typological method and was subject to triangulation of the data set.

### **Summary**

In this chapter I presented the research questions within the frame of constructivism. The study problem is the lack of research examining how high school teachers perceive the experiences of their students with dyslexia as teachers attempt to use digital technology and prepare for postsecondary education. The study addresses the perceptions of teachers of students with dyslexia who use assistive technology. Dyslexia was explained as a specific reading disorder; assistive technology includes any device that may be customized and used to increase, maintain, or improve the functional capabilities of a learning-disabled student. How high school

teachers train and work with students with dyslexia is introduced; the perceptions of these specific teachers is the main area of focus of this study. Limitations and delimitations of the study are also explained.

## Chapter 2: Literature Review

This chapter is a review of the literature on high school age dyslexic students, a specific subgroup of the greater digital population. I accessed the following databases through the Ed.D. Concordia University online library: ERIC, ProQuest, and ProQuest Central. Key terms of the literature search included; *dyslexia*, *dyslexia in high school*, *dyslexic reading deficiencies*, *dyslexia and assistive technology*, *dyslexia*, and *adaptive technology*. These terms set the search parameters of the literature review. A review of theory, research, and methods suggested emergent knowledge concerning adult dyslexic education is currently lacking; this deficit of research has put adult dyslexic students at a distinct disadvantage in reading capabilities (Kennedy & Deshler, 2010; Silvestri, 2011).

This review of the literature examines the conceptualization of dyslexia, a dyslexic profile, history of dyslexia, and the impact of assistive technology use on dyslexic literacy. To focus this review on the latest dyslexic research content and methodology, included sources are those that have been published over the last 5 to 10 years. A few older sources are incorporated in the literature review because of the dearth of more recent research on specific gaps concerning the trends and transition periods of high school students with dyslexia and freshmen college students with dyslexia. This lack of literature has resulted in an opportunity to investigate how these students adapt to the rigor of upper high school coursework and approach the transition to college settings. The technology specifically designed for use by students with dyslexia has also not been studied on a broad enough scale to support any significant claims about the usefulness of such tools for students with dyslexia.

The topics covered in this literature review include; definitions of dyslexia, the dyslexic high school student profile, multiple viewpoints, dyslexic theory, assistive technology for dyslexic learners, guiding questions in dyslexic research, and general conclusions from the

literature. The significance of this topic is supported through this investigation of the available research.

## **Review of Research and Theoretical Literature**

### **Definitions of Dyslexia**

The selected literature indicates some commonality in the definitions of dyslexia. The term *dyslexia* is derived from Greek and expresses “difficulty with words; dys, difficulty, and lexis, language and words” (Woodfine, Baptista Nunes, & Wright, 2008). Dyslexia is a specific learning disability with a neurobiological context (Ramus, Rosen, & Dakin, 2003; Williams, 2006) and is typically marked in terms of significant difficulties with literacy (Barden, 2014; Silvestri, 2011) in which the traits become evident through the process of language acquisition. Accepted definitions of dyslexia exhibit a range of defining characteristics that have been revised considerably due to emergent research

This term is used to describe learning difficulties involving both written and spoken language (Madeira, Silva, & Marcelino, 2015). Dyslexia is characterized by trouble in the learning and acquisition letters and speech sounds and of difficulty in reading and writing practice (Madeira, Catarina, Marcelino, & Ferreira, 2015). Dyslexia is also primarily characterized by problems with the effective progression of word decoding strategies and underdeveloped fluency in reading (Warmington, Stothard, & Snowling, 2012). Such difficulties in these areas of linguistic development and usage display the inherit level of adversity that dyslexic students experience. Essentially, students with dyslexia attempt to acquire necessary language skills while experiencing the effects of limited speech and text automaticity related to the processing difficulties associated with this learning disorder.

Dyslexia, as a specific reading disorder, is heavily influenced by language processing errors in the area of the brain that deals with language reception and processing (Wright, 2008).

Dyslexia affects automatic skills that are necessary for the progression of learning to effectively read, write, and spell (Hazan, Messaoud-Galusi, & Rosen, 2009; White et al., 2006).

Individuals with dyslexia struggle to adapt and use the language cues, nuances, and expressions that are part of an opaque, intricate language such as English. The rules, expectations, and complexities of learning how to understand and use language challenge dyslexic learners. The condition is described as a combination of abilities and difficulties that affect the learning process in one or more areas of reading, writing, and spelling (Wright, 2008). These difficulties are evident in dyslexic learners via short-term memory usage, processing speed, organization of information, auditory, and visual perceptual difficulty, and sequencing skills.

The International Dyslexia Association and existing state education codes throughout the United States (2006) all consider dyslexia a specific learning disability; one that affects reading comprehension and vocabulary development (Hazan et al., 2009; White et al., 2006). Barden (2014) examined the 115-year history of dyslexia in greater detail and found it to have been characterized by the psycho-medical language of, “deficits, weaknesses, and difficulties,” as indicated in the broad reference publication, *Annals of Dyslexia*, psychology and educational textbooks, and teacher-training literature (Barden, 2014).

The limited understanding and prior perception of dyslexia have undergone transformation, in turn leading to a greater body of information from which to construct a more significant meaning of the condition. Reading, as experienced by a dyslexic student, is not a linear process in which silent, sustained reading constructs textual meaning through practice (Roach, Edwards, & Hogben, 2004). Instead, dyslexic reading is an experience in which a range of discursive activities are compensated through strategies (Jackson, 2013) and often creative means as the reader attempts to make meaning from the text. The difficulties experienced by

learners with dyslexia is linked to phonological language deficits (Elliot & Gibbs, 2008; Williams, 2006) resulting in numerous problems.

Dyslexia refers to difficulty in reading in children and adults (Lishman, 2003; Marshall, Snowling, & Bailey, 2001). This range of difficulty is not indicative of the intelligence, motivation, or instructional practice associated with fluent and accurate reading of the dyslexic student (Warmington et al., 2012). Dyslexia is a combination of abilities and it is also a combination of difficulties that affect the learning process in one or more areas of reading, writing, and spelling (Draffan, 2007). These definitions of dyslexia present a complex disorder that is characterized by a perceived difficulty with the activities associated with the reading process. What remains unclear is the exact manner to which the reading profile of individuals with dyslexia may be more fully understood.

An evident range of interpretation of the developmental degree of dyslexia as a learning disorder is present in the literature. As I will discuss in detail below, the three leading theories in dyslexia—phonological, magnocellular, and cerebellar (Ramus et al., 2003; Wilson & Lesaux, 2001)—do not account for each individual dyslexic profile. A biological underpinning to dyslexia (Roach & Edwards, 2004) is indicative of variability in the level of reading difficulty experienced by each dyslexic person. These theories seek to account for the biological implications of the disorder from a biological, medical, and psychological context.

The academic community has highlighted problems with phonological processing as a core deficit of dyslexia (Lishman, 2003). This difficulty with reading, writing, and processing affects individual learners (Hazan et al., 2009; Maccini, Gagnon, & Hughes, 2002). Dyslexia is typically marked in terms of significant difficulties with literacy (Barden, 2014) in which the traits become evident through the process of language acquisition. As students with dyslexia attempt to read, recognize vocabulary, and practice language expectations, the full range of



deficits may or may not become obvious or apparent (Birch & Chase, 2004) because of its manifestation can hide behind a range of compensatory behaviors and tools (Passe, 2006). The standing definition and acknowledgement of dyslexia indicates this brain-based disorder is unassociated with intelligence (Kennedy & Deshler, 2010). Children and adults may have reading, writing, and spelling problems because of dyslexia (Hazan et al., 2009; Lishman, 2003; Warmington et al., 2012; Wilson & Lesaux, 2001). The disorder does not look identical in each individual, no matter what age he or she is.

### **Types of Dyslexia**

Madeira et al. (2015) discussed the different types of dyslexic classification and division, including acquired dyslexia and developmental dyslexia. Acquired dyslexia results from injury to the brain in which the individual loses language ability over time. Acquired dyslexia is not a lifelong condition as it is dependent upon the experience of trauma or injury. Developmental dyslexia describes an individual who has difficulty in initial reading acquisition, typically in early in life when learning to read. The person will have difficulty associating graphic symbols and letters to corresponding sounds, which Madeira et al. noted is critical to foundational reading skill development. Individuals with dyslexia also experience great difficulty with phonological processing skills (Warmington et al., 2012) that are typically associated with reading performance.

Dyslexia may also be a developmental impairment. Developmental dyslexia refers to an unexpected difficulty in reading in children and adults who otherwise possess the intelligence, motivation, and schooling considered necessary for accurate and fluent reading (Lishman, 2003). Developmental dyslexia is a neurologically based learning disability in which the individual experiences difficulty decoding, spelling, and recognizing words. Currently, there is no single working consensus to explain the learning profile of dyslexia.

## **Profile of High School Students With Dyslexia**

The 21st-century young adult with dyslexia (Birch & Chase, 2004) is not presented in the literature as a clear, recognizable profile. The cognitive profile of students with dyslexia, in both compensated and uncompensated individuals, is not well understood (Birch & Chase, 2004; Warmington et al., 2012) because of the relative lack of existing information (Tops, Callens, Lammertyn, Van Hees, & Brysbaert, 2012; Tops, Callens, Van Cauwenberghe, Adriaens, & Brysbaert, 2013) concerning these learners. Current literature (Callens, Maaïke, Tops, & Brysbaert, 2012; Cameron & Billington, 2015; Mortimore, 2013; Svensson, 2015) suggests that it simply is not sufficient to highlight only reading delays in those with dyslexia without the presence of consistent frameworks to promote clear interpretation and understanding of the dyslexic young adult profile. A substantial number of dyslexic performance traits and indicators display a significant disparity from the norm (Hazan et al., 2009; Ramus et al., 2003; Wilson et al., 2001). These performance indicators may work to establish a more credible young adult dyslexic profile, one that is specific and relevant to learners with dyslexia.

Students with dyslexia represent a marginalized group of learners who struggle to cope due in part to difficulty in text comprehension (Anderson-Inman & Horney, 2007; Taub, 2011). The high school student with dyslexia is expected to access, interpret, comprehend, and analyze higher level text, within several academic domains in a typical school day. The level of preparedness and experience these students must demonstrate only intensifies in college. Digital learning has not made it easier for students with dyslexia to learn (Passe, 2006). To the contrary, the expectations of digital literacy have placed considerable challenges upon the dyslexic high school student. In order to understand these expectations and experiences, the profile of the high school student with dyslexia prompts further investigation.

When students with dyslexia enter high school, they encounter a world in which their own abilities and strengths are markedly different from those of their peers (Marshall, Snowling, & Bailey, 2001; Passe, 2006). These students have more than likely been exposed to intervention and tutoring at some point in their past educational careers (Warmington et al., 2012) and have likely developed a diverse range of compensatory strategies to attempt to combat known reading and writing deficits, thus changing the characteristics of older dyslexic students. This prior skill set, typically acquired during formative elementary school instruction, may or may not be supported in the content laden classroom designs of middle and high school courses. Is it typically here that the student with dyslexia is forced to acquire coping and adaptive skills to read, synthesize and perform at these levels of academic rigor.

A learner diagnosed with dyslexia exhibits a subset of signs and symptoms that are specific and unique (Woodfine et al., 2008). The diverse, characteristically individual profile of dyslexia is very personal to each learner. The Dyslexia Association (Woodfine et al., 2008) has categorized these as reading problems, writing problems, speaking, memory, and general difficulty. Reading and writing problems of students with dyslexia illustrate organizational and structural issues in which the student is unable to read and write without substantial preparation (Price, 2006; Woodfine et al., 2008). There are notable discrepancies within the verbal and written performances of a young adult with dyslexia. This individual tends to have trouble with note taking, spelling, writing structure and organization of tasks and ideas that are necessary to assignment completion (Woodfine et al., 2008). These difficulties create hesitation and a marked inability or anxiety in students with dyslexia as high school courses require active participation and numerous reading and writing tasks within the curricular scope.

Speaking and memory problems for young adults with dyslexia also feature a discrepancy within the verbal and written samples of these learners as well as difficulty with pronunciation,

fact, and information retrieval from memory, and difficulty with name retrieval and sequencing (Woodfine et al., 2008). These benchmark features create indicators within the dyslexic profile that do apply specifically to dyslexic learners. However, the experience linked with these problems do not remain stagnant or even consistent within each profile of dyslexia from childhood through adulthood. Instead, many older students with dyslexia develop and implement new coping skills as a result of the negative and often arduous experiences they have had to deal with in the classroom. This is observed in the specific perceptions students with dyslexia have of their own classroom experiences and academic difficulties (Mortimer & Crozier, 2006).

High school students with dyslexia may feel insufficient, unrecognized, and devalued at school (Mortimer & Crozier, 2006) if they fail to keep up with the assignments and tasks that are required. They may feel unsuccessful, and they may demonstrate negative coping behaviors as a result of these specific experiences. Conversely, dyslexic students who have managed to experience academic success may display greater confidence and may be more likely to exhibit positive coping behaviors. This converse relationship with academic experience signifies and emotional investment on behalf of high school student with dyslexia (Forgrave, 2010). Those student with dyslexia who encounter some measure of success, tend to adapt well to the rigor and challenge they are required to engage with. Those high school students with dyslexia who experience negative encounters in the classroom, or find a lack of successful interactions with their own academic efforts tend to cope via detachment and disengagement as they adversely struggle. Mortimer and Crozier (2006) suggested students with dyslexia may cope at the high school level of their educational careers in order to deal with these negative experiences through task, emotional, and avoidance coping strategies (Barden, 2014). These traits may be observable in the classroom and may also provide an opportunity to determine the specific pattern or routine of coping a student with dyslexia attempts to engage.

Mortimer and Crozier (2006) discussed different types of coping at greater length as present in students with dyslexia. Task coping enables a dyslexic learner to practice proactive strategies through persistence and determination. Emotional coping may manifest through a lack of confidence, self-doubt, and negative self-perception and is a trait found in dyslexic students who have struggled with the expectations and requirements of classes and course objectives. Avoidance coping is evident through extreme, nonparticipatory behavior and is present in students who experience withdrawal from social and academic situations (Passe, 2006). These students may also have had difficulty in these settings. In recognition and greater understanding of the coping tools of dyslexic students, it is likely these individuals may be better understood, with greater accuracy (Mortimer & Crozier, 2006). This may alleviate some of the challenges faced by both compensated and noncompensated students with dyslexia in comparison with their peers (Cameron & Billington, 2015). It is essential that more attention be given to the individual dyslexic learner's identity (Roach et al., 2004; Skottun & Skoyles, 2007) and their performance in order for perceptual understanding of students with dyslexia to continually improve.

Learner profiles are critically important as more discrepancies become apparent within the population of individuals with dyslexia through collection, consumption, and analysis of strong data (Erickson, 2013). These profiles help account for the types of struggles that characterize dyslexic learners as parallels, and discrepancies can be illuminated to account for the range and representation of the specific problems that dyslexics experience. Going forward, the literature suggests (Elliot & Gibbs, 2008; Erickson, 2013; Tanner, 2009) that profiles should reflect a combined effort to provide inventories that clearly identify students' strengths, weaknesses, and abilities in relation to identified areas of dyslexic deficit in language skills. The determined effort to support student with dyslexia in high school, with respect to their own

strengths and weaknesses is indicative of a commitment to 21<sup>st</sup> century learning and a holistic, student centered commitment to education.

### **Self-Advocacy**

An additional variant of the dyslexic high student profile is the push for self-advocacy (Tanner, 2009; Passe, 2006) in the identification and conceptualization of dyslexia for the individual learners who experience this condition. The implicit construction of the condition of dyslexia to those who experience the learning disorder is often fraught with negative self-perceptions that impact the emotional state of being (Tanner, 2009). Self-advocacy may provide a suitable context in which the dyslexic student may learn to adapt in a positive and constructive manner that may better serve across academic settings and expectations. Dyslexia does not inhibit one's ability to achieve educational success (Elliot & Gibbs, 2008; Phayer, 2007). The challenges and struggles associated with low comprehension typically experienced by students with dyslexia indicate that there is difficulty in assessing what the student with dyslexia does and does not comprehend (Draffan & Evans, 2007; Forgrave, 2010.) To further understand how the mind of an individual with dyslexia may learn, despite the difficulties this complex learning disorder presents, existing theories of dyslexia must be further examined.

### **Theories of Dyslexia**

Theories within the dyslexic spectrum define, characterize, and symptomatically distinguish the learning disorder from a basis of diagnostic reading information, performance, and brain science. Central within this framework are phonological, magnocellular, and cerebellar theory (Birch & Chase, 2004; Hazan et al., 2009; Marshall et al., 2001; Poulsen, 2011; Ramus et al., 2003, Wilson & Lesaux, 2001). The most recent and prominent versions of dyslexic theory associated within these three main frameworks will be discussed systematically.

**Phonological theory.** Phonological theory asserts that a dyslexic individual has a specific impairment in the storage, retrieval, and representation of speech sounds with language (Ramus et al., 2003). This theory explains why teachers and parents notice how dyslexic individuals have trouble learning sequences of alphabetic systems that involve grapheme and phoneme correspondence and recognition (Ramus et al., 2003); essentially, the learner associates alphabetic letters with the appropriate sounds of speech. As many students with dyslexia struggle with this aspect of language acquisition, phonological theory proponents posit that phonology plays a central, causal role in the profile of a dyslexic individual (Birch & Chase, 2004; Ramus et al., 2003). The logical string of this theory suggests that if the speech sounds and letter recognition of an individual with dyslexia is poorly represented, improperly stored, or unable to be retrieved, then it is likely the phoneme and grapheme correspondence (Birch & Chase, 2004) is phonologically compromised.

Some additional evidence suggests learners with dyslexia often do display phonological deficiencies (Poulsen et al., 2011; Birch & Chase, 2004). However, what remains unclear is how pervasive these phonological deficiencies are within each dyslexic profile. Though phonological theory tends to be the prevailing theory of dyslexia (Birch & Chase, 2004), this theory has not been able to determine to what extent other affective language processing deficits are impacted within the dyslexic brain. As these core language processing deficits are central to the definition of dyslexia, as previously analyzed in this review of the literature, the phonological theory of dyslexia lacks the confirmation of these specified language processing deficits.

Some researchers (Birch & Chase, 2004; Hazan et al., 2009; Marshall et al., 2001; Poulsen et al., 2011; Ramus et al., 2003, Wilson & Lesaux, 2001) have suggested individuals with dyslexia struggle with phonemic awareness; the marked distinction within this recognition is that the disorder features many more aspects that transcend the phonological neural pathway

and impact more of a general profile of dyslexia beyond what this theory has substantiated. Adults with dyslexia have difficulty processing language at the level of speech sound, phonological coding, and phonological awareness (Birch & Chase, 2004). Thus, these seasoned individuals with dyslexia tend to struggle with phonological processing, just as children with dyslexia also do.

In critical context of phonological theory, the evidence used to support this particular theory structure is dependent on the correspondence of phoneme and grapheme representation. Yet, the theory does not articulate the sensory and motor disorder conditions that many individuals with dyslexia happen to experience (Ramus et al., 2003; Hazan et al., 2009). What proportion of dyslexics are affected by phonological disorder is unknown (Ramus et al., 2003; Hazan et al., 2009). In sum, the range of variability within the profile of individuals with dyslexia falls outside of the conceptualization of phonological theory, as no singular explanation has yet been accepted.

**Cerebellar theory.** Cerebellar theory is also distinguished as automaticity theory (Poulsen, 2011; Ramus et al., 2003) and its advocates have attempted to categorize dyslexia as a mild cognitive dysfunction (Poulsen, 2011; Wilson et al., 2001). From a biological standpoint, according to this theory, the cerebellum within a brain with dyslexia is said to feature mild dysfunction (Ramus et al., 2003). The cerebellum is understood to play a vital role in human motor control, speech, and language articulation (Ramus et al., 2003). Within the dyslexic cerebellum, the process of automatization is compromised according to this theory and evidence suggests that students with dyslexia exhibit poor motor function, time estimation, and phonemic correspondence (Marshall et al., 2001; Ramus et al., 2003). It has also been established through brain imaging (Ramus et al., 2003) that there are anatomical, metabolic, and activation differences in the cerebellum of dyslexics. As the push for understanding brain science has



become a pivotal additional to classroom experiences for teachers and students, the understanding of the brain in these conditions provides a meaningful resource for those who are or who work with students with dyslexia.

Of notable interest is the idea that cerebellar theorists have been unable to articulate what these specific impairments alter within the brain function of individuals with dyslexia. The cerebellar theory is unable to account for the full range of sensory disorders experienced by learners with dyslexia (Ramus et al., 2003), and much of the evidence that is provided to support the brain science of this theory is still heavily dependent upon outdated theories of motor and speech therapy. These techniques are not in line with current educational practice, in which the development of phonological representation works in tandem with current speech and language therapy. The whole language approach, as is taught in many school settings, does not isolate the language processes that students with dyslexia struggle with in independent learning modalities. Rather, language instruction is immersive as a blended, structured approach to access text through whole language exploration. Cerebellar theorists would posit that this approach has not been able to account for the sensory experiences, students with dyslexia versus students that do not have dyslexia, that have been adopted to teach core reading instruction. Students with dyslexia may not experience speech or text automaticity through whole language instruction as their peers that do not have dyslexia do.

**Magnocellular theory.** To combine the perceived strengths and limitations of phonological and cerebellar theory, magnocellular theory (Ramus et al., 2003) unifies these integrated theories into one school of thought. The intention of magnocellular theory is to combine findings of both phonological and cerebellar theory to strengthen the found weaknesses of prior theories surrounding dyslexia, and also to lift some of the restrictions from those prior theories such as the inability of either phonological or cerebellar theory to account for the

modalities in visual and tactile deficits (Ramus et al., 2003) that are found in learners with dyslexia. Magnocellular theory reasons that specific dysfunctions and deficits associated with dyslexic modalities are not restricted to only visual or phonological factors; rather, the learner's brain with dyslexia is biologically different from that of other learners (Ramus et al., 2003). This theory is able to account for visual, auditory, tactile, motor, and phonological manifestations (Birch & Chase, 2004; Ramus et al., 2003). Although there is consensus in the literature (Birch & Chase, 2004; Ramus et al., 2003) that the visual and auditory accounts are found within the magnocellular theory, this theory is still unable to entirely account for the spectrum of all individuals with dyslexia.

Although magnocellular theory does have the ability to account for the principal manifestations of dyslexia, there are key problems within this theory. Most conclusions presented within the literature (Ramus et al., 2003; Edhardt, 2008) are indicative of small groups that do not reflect a wider margin of individual profiles with dyslexia in a larger, credible manner. Data collected from these small groups suggest that some learners with dyslexia represent intact processing skills on test batteries while other students with dyslexia may present slow conceptualization of phonemic tasks or motor skills. The large margin within the magnocellular theory description does not account fully for the data that have been collected. This theory has not been able to account for the absence of sensory and motor disorder, which afflicts a significant number of learners with dyslexia (Ramus et al., 2003).

In regard to the postulations of these three theories, students with dyslexia truly are individual in their experience, perception, and deficit range. These three major theories may, through further evidence and investigation, be fully able to account for each case of dyslexia as the inventories and characteristics of each theory progresses. Further investigation is warranted to establish future relevance and progression of these theories of dyslexia as a brain disorder, as a

means of credible and resource-driven information. The profile of dyslexia continues to evolve. This current analysis of dyslexic theories suggests that the deficits and presence of dysfunction in the dyslexic brain may be linked to phonological, motor, visual, and auditory processing difficulties. The literature suggests the use of assistive technology for disabled learners, such as individuals with dyslexia as a strategy to access text-driven information.

### **Assistive Technology for Dyslexic Students**

The use of technology is a vital and integral part of our society (Barden, 2015; Engstrom, 2005; Maccini et al., 2002). Technology continues to improve and promote wider accessibility to diverse learners; it may be used as a valuable tool with which to activate student involvement in the learning process and to assist students in accessing and organizing information (Barden, 2015; Maccini et al., 2002). Technology has excellent potential for students with dyslexia, as the use of these software programs and tools provides a pathway to the curriculum that these students struggle to access and comprehend (Passe, 2006). In order to learn this content, students with dyslexia have to be able to interact with the content through a rich learning environment that features authentic activities, social interaction (Woodfine et al., 2008), and varying levels of text complexity.

Increasingly, educational technology tools focus on reading and the learning process required of language acquisition (Kennedy & Deshler, 2010; King-Sears et al., 2011; Maccini et al., 2002; Passe, 2006; Pedrotty Bryant et al., 1998). Incorporation of these tech tools into a student with dyslexia's skill inventory may alleviate the gap in which students with learning disabilities, such as dyslexia, perform at a lower level than their non-learning-disabled peers (Kennedy & Deshler, 2010). These students may learn through the use of assistive technology platforms in which they may acquire comprehensive understanding of text with greater autonomy.

Assistive technologies for use by learners with dyslexia include; text-to-speech software, word-processing programs, voice-recognition software, and organization software (Engstrom, 2005; Okolo & Bouck, 2006; Tops et al., 2013). These technology developments are relatively new, although they may be able to hold the promise of matching a student with dyslexia's needs to their actual, authentic abilities (Engstrom, 2005). As explored through theory and the cognitive profile of dyslexia, it is known that dyslexia does not impact an individual's level of intelligence. Dyslexia causes blockages to receptors and learning pathways vital to the acquisition and processing of information. These technology devices may be able to alleviate blockages to enable dyslexic learners to demonstrate their intelligence and knowledge.

The literature (Kennedy & Deshler, 2010; King-Sears et al., 2011; Maccini et al., 2002; Okolo & Bouck, 2007; Woodfine et al., 2008) has suggested that the impact of assistive technology software, programs, and devices on high school students with dyslexia has not been comprehensively reviewed. This assertion may be affected by the very newness of assistive technology as a tool for the learning disabled. The assertion may also be impacted by the accessibility of assistive technology in all school settings. Not every school environment is able to provide clear and consistent access to assistive technology. The idea that assistive technology usage and impact has not been extensively reviewed may also indicate an emergent field within education that has yet to be significantly explored; there simply have not been many reviews concerning the effects of assistive technology use by high school students with learning disabilities. Technology-driven programs and applications are developing at a fast rate. The implications of assistive technology and its effect on students with dyslexia is constantly evolving (Okolo & Bouck, 2006).

Students with dyslexia must navigate active, critical reading at high levels across broad ranging content areas each and every day of their educational experience. Students with learning

disabilities do not employ necessary study strategies, nor do they take an active approach to academic tasks that must be accomplished in order to progress (Anderson-Inman, Knox-Quinn, & Horney, 1996; Maccini et al., 2002). These students experience difficulties in reading comprehension ability, organization, and retention and linkage of information to existing knowledge (Maccini et al., 2002). Students with dyslexia feature individual strengths, weaknesses, experiences, and personal interests (Predrotty Bryant et al., 1998). For this reason, each student with dyslexia's perception, experience, and conceptualization of education and the academic tasks they must complete, presents a complex and personalized challenge.

Technology is commonplace in the lives of high school students (King-Sears et al., 2011), and many devices and programs are intrinsic to the daily academic and social interactions of this age group. Increasingly sophisticated applications for phones, computers, and tablets provide automatic speech-to-text functioning that enables any user to command programs orally without any required keystroke (King-Sears et al., 2011). These trends in availability of adaptive technology illustrate some important considerations for high school student with dyslexia. These students have used technology since early childhood. These so-called digital natives often thrive through the use of digital technology, as a means to interact with their world and learn information. However, for technology to serve as a purpose-driven and academically oriented platform, it must support the authentic learning deficit as it is experienced by the student.

In order for assistive technology to suit the needs of a learner with dyslexia, the program, software, or device must align closely with the learner's identified deficits. Essentially, these technology concepts must undergo extensive assessment to ensure that the tool matches the learner profile and functional capabilities. Functional capabilities refer to sensory, motor, cognition, language, and memory areas in relation to language domains; listening, speaking, reading, writing, memory, motor, and organization (Okolo & Bouck, 2006; Pedrotty Bryant et

al., 1998). Students with dyslexia require a variety of adaptations in order to succeed at school (Okolo & Bouck, 2006; Pedrotty Bryant et al., 1998); assistive technology may help the students meet the rigorous requirements of classroom instruction and the learning of each content area.

Technology may create pathways in which to empower learning in autonomous practice, and yet the conclusiveness of this idea is not fully decipherable. Assistive technology may indeed be recognized as a catalyst for change (Barden, 2014; Gerrard, 2001; Price, 2006). However, this change itself is not clearly recognizable. As computer-based technology made its debut as an instructional learning tool, the use of assistive technology looked promising (Raskind & Higgins, 1998). Over the last 20 years of educational progression, assistive technology has made considerable improvement (Evetts & Brown, 2005). The level of assistance and personalization for the user of such tools and software has transformed considerably. These attributes appeal to learners with dyslexia, as each individual with dyslexia experiences the disorder with some level of variability. A means to personalize, customize, and convert assistive technology to suite each individual with dyslexia and work to support their own needs would certainly support the unique profile of learners with dyslexia.

The use of assistive technology as an intervention tool for students with dyslexia does appear in the literature (Goldfus & Gotesman, 2010; Hazan et al., 2009; Mortimore & Crozier, 2007), with the considerable point that there are present opportunities to differentiate and moderate assistive technology for maximum usefulness to these students. There is also an articulated need supported in the literature (Goldfus & Gotesman, 2010; Hazan et al., 2009; Mortimore & Crozier, 2007; Okolo et al., 2000) to consistently investigate emergent technology trends as they become available for student use. The use of such devices and software programs should reflect current educational standards and best practice as well.

Goldfus and Gotesman (2010) recognized potential benefits of the use of assistive technology for students with dyslexia: increased independence, greater self-esteem, enhanced motivation to participate, and improved academic knowledge and understanding. At the high school and the university level, assistive technology is viewed through the literature as a modal pathway in which students may compensate learning deficits effectively (Goldfus & Gotesman, 2010). High school students with dyslexia benefit from read-aloud and repeated readings in which assistive technology may integrate into the student's work habits and provide greater access to the required text. Teens with dyslexia already have problems with oral language, vocabulary acquisition, reading comprehension, and writing (King-Sears et al., 2011) and can benefit from responsive instruction via technological programs that can be universally accessible across academic content. Though there appear to be many positive benefits that support the use of assistive technology for teens with dyslexia, a consensus has not been reached, as not all teens with dyslexia have access to or are able to engage with these software programs. Multiple views exist concerning how students with dyslexia should learn, another key component of the discussion concerning dyslexia.

### **Multiple Viewpoints**

The manner in which learners with dyslexia are perceived presents a complex view in which the personal experience of these individuals and the impact of the educational institutions they attend, have struggled to achieve a semblance of interconnectedness. It is not sufficient to show that significant group differences happen at some level of processing; rather, it must be indicated that substantial numbers of dyslexic individuals perform at significantly different levels than the norm (Hazan et al., 2009; Ramus et al.; 2003). Dyslexia has been examined, albeit insufficiently, through an educational, social, and medical context for more than a century (Passe, 2006). These areas of examination have led to a wide lens in the general perception of

the term and conceptualization of dyslexia. Evidence of clear individual differences in adults with dyslexia (Hazan et al., 2009; Mortimore & Crozier, 2006; Ramus et al., 2003) has led to a greater acceptance of the complexities that dyslexia presents to each individual who experiences life with this reading disability. There has been an emergent shift in perceptions of the diverse characteristics and traits of dyslexic students in the educational perception of dyslexia. In the educational setting, this may suggest that more support toward the support of dyslexia through assistive technology and specific language training may continue to gain momentum.

Persons with dyslexia have been perceived as individuals afflicted by phonological processing difficulties (Ramus et al., 2003; White et al., 2006) thought to comprise the learning disability. Through studies that reflect the emergent theory of dyslexia (Birch & Chase, 2004; Hazan et al., 2009; Marshall et al., 2001; Poulsen, 2011; Ramus, 2003; Wilson et al., 2001) conclusions have led to a revised perception more indicative of the personal characteristics across a wide spectrum of established and emergent traits.

### **Guiding Questions in Research on Dyslexia**

The emergent nature of dyslexic research (Draffan & Evans, 2007; Ehardt, 2008; Forgrave, 2010; Roach et al., 2004) illuminates the driving need for existing empirical groundwork to serve as a launching point (Kennedy & Deshler, 2010) in which to open opportunities for new and useful information to evolve. How dyslexia is perceived from an educational, social and societal context, requires more research. The complete brain science of the condition also remains somewhat elusive, and the impacts and future usage of technological supports remain to be seen.

One question embedded in the literature is the extent to which assistive technology may benefit students with dyslexia, over time (Gerrard, 2007; Lishman, 2016; Skottun & Skoyles, 2007; Sparks & Lovett, 2009). Tracking and examination of assistive technology is relatively



unpublished, it has yet to be determined how the students who incorporate assistive technology into their own work and study habits perform over extended time in their educational careers (Price, 2006; Tanner, 2009; Taylor & Duffy, 2009). This vital knowledge is of great interest as how the students who utilize assistive technology over time perform would provide key information as to the capability and quality of these educational resources in the digital age.

Another guiding question presented in the literature (Edyburn, 2004; Marshall et al., 2001; Phayer, 2007) is the purpose and implementation of assistive technology as a consumable tool for dyslexic students. These technology tools will not serve dyslexic students well if only introduced as a supplement in which to play games or promote isolated reading or language tasks that do not reflect the coursework these students must complete. Essentially, the platform of technology in the classroom should reflect purposeful and instructionally motivated decisions. The future literature may provide evidence to establish a clear manner of usage for assistive technology as a useful, intentional, and functional learning tool. In this manner, the use of assistive technology may become more mainstream, and this level of experience in educational settings serves a greater likelihood of meeting the needs of many more learners with dyslexia.

Furthermore, as there already are supports in place for learning disabled students in high school and postsecondary settings, an evident question arises here as to what extent these supports and programs may evolve to better accommodate assistive technology use for students with dyslexia (Cameron & Billington, 2015; Mortimore & Crozier, 2006; Taylor & Duffy, 2009; Tops et al., 2013). The programs and supports put in place to assist dyslexic student in both high school and postsecondary settings may undergo a shift in practice to better meet the needs of these students and their coursework. As more software and initiative programs become available, these tools likely will become consumptive aids for learners with dyslexia who wish to pursue higher education. Indeed, the dearth of research itself suggests that assistive technology

will undergo further transformation as educational support tools in the years to come. As to how this behavior will impact higher education in the future, remains to be seen.

## **General Conclusions**

More students with dyslexia are choosing to participate in higher education than ever before (Maccini et al., 2002; Taylor & Duffy, 2009). If more students with dyslexia are moving into college than previously reported, the transition period between high school and college becomes a much more visible human experience. There is a need to better understand these students, based upon their language learning deficiencies and cognitive and academic profiles. If students with dyslexia struggle to complete this transition period within their educational careers, from high school into college, the burdens that become present in this experience must also be better understood in order to support and understand these students much more clearly. There is an obligation to current and future learners with dyslexia, to examine this transitional timeline and to search for clues as to what works specifically to support autonomy for each student with dyslexia to succeed in college or university settings. There is growing recognition for the acknowledgement and support of students with dyslexia (Mortimore & Crozier, 2006; Papadima-Sophocleous, Charalambous, & Mallouris, 2013; Taylor & Duffy, 2009). Therefore, the viability and exploration of assistive technology as an acceptable consumptive and compensatory strategy for dyslexic learners becomes more clear. There is an emergent opportunity, to present the benefits of supporting learners with dyslexia, in a mainstream and encouraging manner. Educators, parents, and stakeholders may soon realize that dyslexia is no longer an outlying learning disability. With this realization comes a vested interest in ensuring these students meet with success as they continue to work toward college and career pathways.

However, some students with dyslexia in college and university settings do manage to compensate and perform adequately (Passe, 2006). It would seem likely that if some learners

with dyslexia are able to succeed at this level, that all learners with dyslexia could follow suit. This assumption is grossly inaccurate. The variability of each student with dyslexia factors directly into how these individuals cope and perform in education. Not every student with dyslexia has been taught or learned to employ successful coping skills. Also reflective in the literature (Roach & Edwards, 2004; Elliot & Gibbs, 2008) is the standing involvement of high school education settings in supportive measures for learning disabled students, as required by law and facility. The justifiable efforts to propel these support measures into new levels of involvement, namely, with assistive technology and programs in place, comes into question. Are these motivations sound and driven by the desire to see students succeed, or are these calls to action pushed by tech and publishing companies instead?

The support of students with dyslexia should be driven by a vested interest in their academic welfare. The level and expectations of involvement of the academic setting in the successful accommodation of students with dyslexia is also in need of further examination. Individualized instruction is already encouraged and supported for learning disabled students in high school and higher education settings as well. The use of computers is widely in practice for all students. Therefore, the use of assistive technology must be clearly examined and implemented as a tool intended to provide students with dyslexia a level playing field and open access to text to consume and produce work products that indicate their true performance capability. The introduction and use of assistive technology has created a catalyst in which the way students with dyslexia interact with text will continue to evolve (Passe, 2006; Price, 2006). The voice of the student with dyslexia is key in shaping the creative application of assistive technology as a useful platform for these learners.

Although transforming electronic text in ways that might promote text comprehension by struggling readers has generated interest in the research community for more than two decades,

scholars have not determined how to do this well (Anderson-Inman & Horney, 2007; Madeira et al., 2016). Most of what is known about the impact of assistive technology is limited due to the short amount of time in which these tools have been available for student use. Little is also known or understood about how to present and use assistive technology in consistent ways that address the specific learning deficits of each student with dyslexia, according to their cognitive profile (Anderson-Inman & Horney, 2007; Papadima- Sophocleous et a., 2014).

Generally, findings in the literature have presented a nominal gap among students with dyslexia, as they tend to underperform in academic setting. However, this nominal gap in underperformance has not been singularly explained, or attributed to any one specific indicator in the literature. The rigor at which students with dyslexia must perform to advance in coursework through high school and beyond requires a precision of skills and text accessibility that is somewhat disparaging, and beyond attainment for many learners with dyslexia. The distance from the level at which students with learning disabilities perform and the mastery of skills within the curriculum they are expected to meet is often wide (Kennedy & Deshler, 2010), especially so with students in secondary and postsecondary courses. These obstacles highlight the areas of high need for students with dyslexia. Though the incorporation of some assistive technology has attempted to explore this area of disparity for students with dyslexia, no standing, definitive conclusion has been discovered as to how students with dyslexia may better excel as twenty first century learners.

There is evidence from sustained research (Deshler & Schumaker, 2006; Graham & Harris, 2005) of learning disabled students to distinguish learning and development of strong literacy skills with the purpose-driven usage of assistive technology. These contributory works focus on building the capacity for proficiency to occur across content areas in literary tasks that demand higher order thinking and reasoning. This scholarly pathway has created a way forward,

in which the field of dyslexic research, namely the influence and impact of assistive technology on these learners, may build a larger body of contributory information from which to learn and incorporate in higher education.

### **Review of Methodological Issues**

Though a researcher is free to choose a method, design, procedure, and ethical practice within a study framework, this freedom imparts great responsibility. In consultation with the literature of this study, an advocacy worldview (Creswell, 2014) from a qualitative lens is substantially present. There are many quantitative studies, and a limited scope of mixed method research studies, referenced in this literature review. Each study addresses specific elements of both my research questions, from a wider perspective. I was mainly concerned with locating qualitative research, as the nature of the research question I am exploring complements a qualitative framework. However, I made certain to incorporate appropriate studies from the quantitative spectrum as well, in order to consult a wider range of information still relative to the nature of the question of my study.

The strength within a selected methodology demonstrates a plan that includes observations, measurement, programs and treatment, as well as potential groupings (Gibbs, Clarke, Taylor, Silver, & Lewins, 2011). A well-aligned research model portrays internal validity as an inferential destination with respect to the cause-and-effect relationships of the study. This is necessary as the experiment and conclusions should promote a new knowledge base within the selected field of study. Qualitative research, the study of words, promotes a means in which to explore and understand individuals and groups associated within a social, humanistic context (Creswell, 2014; Maxwell, 2013). The qualitative researcher makes interpretations of collected data through a final written report that is flexible in structure and features a focused, inductive style (Creswell, 2014) to make meaning. The qualitative research

design may develop a case study as a method to enact inductive reasoning of a complex event or concept. The case study provides a suitable context to analyze at a specialized level to indicate different or conflicting perspectives within a social structure; this methodology is present in many of the research designs included in this literature review.

Quantitative research objectively examines theories and research topics in alignment within areas of social science. This objective design measures relationships relative to the research question. Variables in quantitative design are measured by specific instruments; instrumentation produces numbered data which may then be analyzed via statistical procedure (Creswell, 2014). The final report is consistent of an introduction, literary review, theory, methodology, results, and discussion. This design model reflects a quantitative model as suitable for examination of experimental design. In this literature review, quantitative studies focused upon testing protocol with both dyslexic and non-dyslexic students in which variables measured items such as reading competency using digital software and programs.

Nguyen et al. (2013) aligned a descriptive comparative study in which interviews were analyzed and questionnaires examined to determine how the experiences of readers with dyslexia could be influenced via the introduction of a digital reading program. This method allowed the authors to examine the impact of specialized treatment for students with dyslexia and academic achievement from the perspective of the population's willingness and comfort level with the treatment technology. The investigation, procedure, and conclusions drawn suggest that previous perceptions suggested quite a few areas of treatment options to produce greater quality assessment data concerning learners with dyslexia. The structure of Nguyen's et al. (2013) study indicated close attention to careful and consistent alignment to the research method, which was indicated throughout the body of the author's study. This structured approach created a much clearer understanding for the reader to absorb and process the salient points of the

investigation. This particular study was of great interest as an initial source of literature early in my process of gathering research publications for this particular literature review, mainly due to the high readability and interest of the work.

### **Synthesis of Research Findings**

The primary focus of this literature review began with the area of dyslexia in education and the use of assistive technology by learners with reading disabilities. The studies that have been integrated into this literature review reflect this shared relationship of a shared understanding of dyslexia and the emergent patterns of assistive technology use by learners with disabilities. To present dyslexia as a complex learning condition to the reader (Draffan & Evans, 2007; Edyburn, 2004; Lishman, 2016; Marshall et al., 2001; Mortimore & Crozier, 2007; Nguyen et al., 2013; Okolo et al., 2000; Williams, 2006) these authors worked to present dyslexia as a complex learning disability, one that does not adhere strictly to one sort of learning profile. These studies reflect mainly qualitative inquiries in which the significance of human experiences and perceptions of dyslexia shaped the conditions, patterns, and findings associated with dyslexia. A singular focus was also present in these studies, as they featured teen and young adult participant groups.

A second central finding among the literature featured topics of inquiry related to assistive technology and students with dyslexia (Barden, 2014; Brown, 2005; Erickson, 2015; Evett & Roach et al., 2004; Madeira et al., 2015; Schneps et al., 2013; Svensson, 2015; White et al., 2006). These authors included a mix of both qualitative and quantitative design to pursue research questions related to how students with dyslexia use assistive technology in educational settings. Educational settings within these authors' studies included both secondary and postsecondary environments and assistive technology included devices, applications, and software options, all of which appeared to be of significant interest in each study.

Evident within the larger framework of these studies is a shared commitment to report a greater understanding of dyslexia as a complex learning disability and the potential and plausible merits of assistive technology as an integrated and purposeful learning tool for student with dyslexia. Areas of counterargument were not apparent among this series of literature. The wider, projected interpretation of reality remained consistent among these studies; dyslexia is a complex learning disability and is not fully understood in context of its implicit role in education. There was an intrinsic, balanced impression of both positive and cautionary rhetoric in the conclusions of each study in which assistive technology was examined as a learning tool for students with dyslexia.

### **Critique of Previous Research**

A main conceptual framework within the literature (Barden, 2014; Lishman, 2016; Taub, 2011; Williams, 2006) presents dyslexia as a developmental reading disorder in which phonological core processing issues represent a major disruptive impairment in children with dyslexia. This thread is present within these authors' claims and conceptual frames. There is a consensus in this characteristic impression of dyslexia. However, the degree to which phonological processing continues to affect secondary and postsecondary students with dyslexia remains underrepresented within the literature (Jackson, 2013; Nguyen et al., 2013; Papadima-Sophocleous, 2014). These claims describe a common view of dyslexia, in older student groups, as a more elusive and less widely understood reading impairment.

Assistive technology is generally characterized within the literature (Forgrave, 2010; Gerard, 2007; Goldfus & Gotesman, 2010; Phayer, 2007) as a digital tool or program that may build independence in reading, and improve reading performance for students with dyslexia. The claims of these authors indicate a generally positive impact concerning students with dyslexia, who may use assistive technology to support their personal reading methods. However,



unclear within the literature (Callens et al., 2012; Poulsen, 2011; Price, 2006) is the semblance of how students with dyslexia are introduced to and taught to work with assistive technology tools in secondary and postsecondary education settings. It may be inferred at this moment, that these students are essentially figuring out how to use these digital assistive tools. If assistive technology training from educators is lacking, as reported from the literature, to what degree are students with dyslexia missing opportunities to interact fully with these technologies?

## **Chapter 2 Summary**

The initial section of this literature review focused on the current definitions of dyslexia to present a framework in which to understand and interpret the learning disorder in context of high school learners. The perceptions of dyslexia from social, educational, and societal context was also investigated to highlight the complexities and development of dyslexia as a spectrum disorder that impacts many aspects of the individual's life. The cognitive profile of dyslexia was presented as well to demonstrate the characteristics and traits of high school students in the context of education.

Dyslexic theory also comprises a section of the literature review as theorists have attempted to explain the disorder through substantiated evidence. The three prevalent theories in dyslexia were also explored to examine their strengths and areas of weakness. Guiding questions in the field of dyslexia were introduced to establish a future context of the information that is currently lacking. Finally, a general discussion was featured to establish a review of the chapter sub-topics.

### **Chapter 3: Methodology**

A descriptive qualitative case study was selected as the planned research method. The study was intended to explore the phenomenon of the perceptions of teachers who use classroom digital technology to teach high school students with dyslexia. Because the phenomenon is unique to specific human experience, a case study design has been used. The purpose of a case study is to uncover how to better understand a relevant phenomenon in which the situation is not clearly defined (Hatch 2002; Yin, 2003; Zucker, 2006). These conditions support the use of a qualitative case study. How high school teachers use assistive technology to work with students who have dyslexia represented the unclear condition of this study.

Researchers conduct case studies to examine a small number of cases in a natural setting (Harding, 2013; Hatch, 2002; Stake, 2010; Zucker, 2006). I collected and examined data from a small group of teachers that were the driving force of the case study (McMillan, 2012). Data was collected through observations and interview sessions with the participants (Harding, 2013; Hatch, 2002). This design methodology is best supported by a case study, as observations and participant interviews, in their natural setting, comprise the primary sources of data collection (Creswell 2013; Stake, 2010).

In Chapter 3 I explain the purpose of the study, justify the research design as supported with current literature and relevant descriptive detail, and introduce the population and sampling methods, instrumentation, data collection, identification of attributes, data analysis, limitations of design, and validation. Chapter 3 concludes with a discussion of the expected findings and ethical issues, followed by a chapter summary. These chapter sections will present a logical, sound design that aligns with the research question and problem.

#### **Research Questions**

The study was guided by two research questions:

1. How do the teachers of high school students with dyslexia perceive the use of digital technology to assist in the learning process?
2. What are the experiences of teachers who use digital technology to teach high school students with dyslexia?

### **Purpose and Design of the Study**

#### **Purpose**

The purpose of the study was to investigate how high school teachers perceive students with dyslexia and use digital technology to prepare these students to handle complex challenges. The perceptions of these high school teachers and their personal use of technology in the classroom illustrated the two main focal areas. This study has attempted to uncover more about these teachers own perceptions, assumptions, and insights.

Students with dyslexia face complex challenges in attempting to meet the rigor of high school. These individual challenges have not been adequately observed during the transitional period, 12th grade, between high school and postsecondary education. This transition time is important to students with dyslexia, who must learn how to cope with academic and environmental challenges (Barden, 2014; Gotesman, 2009; Passe, 2006; Svensson, 2015). The purpose of this study was to explore how the teacher participants construct knowledge concerning their own perceptions of students who have dyslexia and use digital technology as instructional support.

#### **Design of the Study**

A descriptive qualitative case study design was selected to reflect a focus on human experiences (Yin, 2014). The conceptual framework reflected constructivism. Qualitative research begins with a framework, derived from theory, to inform the research problem and address human experiences (Creswell, 2013; Stake, 2010). As people make meaning from the

knowledge that they build and use, the constructivist theory suggests that individuals participate actively in the process (Liu & Matthews, 2005). Constructivist theory also emphasizes learners' heightened recognition of what is unclear, given the social nature of learning (2005). This case study design was based upon a constructive paradigm (Stake, 2010; Yin, 2003), in which truth is relative to one's perspective, and meaning shapes and affect one's knowledge.

Specifically, I undertook a structured qualitative case study design to learn more about the experiences of teachers who teach high school students with dyslexia. This design has provided information about how these students, through the perspective of their teachers, handle complex challenges using technology. This information was intended to contribute to the emergent body of knowledge concerning dyslexia and assistive technology. Because a case study provides an opportunity to examine and understand issues, objects, experiences, and illuminate relationships (Hatch, 2002; Stake, 2010), this study has added to the existing literature. Through observations and interviews, a qualitative study can produce thick and rich descriptive data over time (Ponterotto, 2006; Wolcott, 2009). This framework ensures that the collection of meaningful data occurs (Creswell, 2013; Stake, 2010). The final report offers a richly detailed presentation of emergent patterns and themes.

### **Site Description, Research Population and Sampling Method**

#### **Site Description**

The site consisted of a charter school in western North Carolina. The teachers and students represented middle class socioeconomic status. The school population encompassed students in kindergarten through grade 12. The site featured a combined, middle-high school building containing over 20 classrooms. The high school students and teachers complete their academic day on the ground floor at this site. The site includes core academic classroom settings of regular and honors level courses for high school students. Two teachers work in each core

class at each instructional level. Some upper grade high students also complete hybrid and online coursework through a local community college as part of a cooperative learning experience. The site supports this individual learning commitment with the use of a one-to-one technology program. Each high school student is issued a personal laptop to use during the school day and at home. The teachers at this site are minimally trained to use laptops, Aquos boards, Smart boards, and educational apps to support instruction, suggesting that technology is an integral feature of this site.

### **Research Population**

#### **Teachers**

The research population for this case study consisted of high school teachers who teach students with dyslexia in western North Carolina. This population of teachers included both genders and varied levels of professional experience. All participating teachers have used technology to drive and facilitate instruction.

#### **Sampling**

The sample, referred to as participants in case study (Stake, 2010; Yin 2003), consisted of eight teachers who taught high school students with dyslexia. These participants served as the core subjects of this single case study. Homogenous purposeful sampling is an appropriate method for the identification and selection of cases that are rich in descriptive information and in close alignment to the study topic (Hatch, 2002; Harding, 2013; Palinkas et al., 2015; Turner, 2010). The participants shared common, homogenous characteristics related to the study (Baxter & Jack, 2008; Hatch, 2002; McMillan, 2012; Palinkas et al., 2015; Turner, 2010; Yazan, 2015). Purposeful sampling ensured that participants represented a narrow range of variation and met the context of the study research questions, literature, and methodological design (Hatch, 2002; Yazan, 2015). All participants indicated beforehand that they were willing and able to

participate, and that they were also able to articulate their reflective thoughts and ideas (Creswell, 2013; Hatch, 2002) about teaching students with dyslexia.

### **Instrumentation**

Instrumentation provides valid means in which to collect data for later analysis, interpretation, and discussion. Observations and interviews (Hatch, 2002; Harding, 2013; McMillan, 2012; Wolcott, 2009; Zucker, 2006) provided the instrumentation avenues for this research study. Observations provide a means in which to produce a collection of notes describing the participants in the natural setting (Harding, 2013; Hatch, 2010). Interviews provide a means to conduct structured, open-ended sessions in which to collect rich and descriptive data (Creswell, 2013).

Observation protocol is a suitable instrumentation method to obtain a deeper understanding of the study phenomenon (Creswell, 2013; Stake, 2010). Through observation over extended time, I compiled brief notes taken in the study setting into expansive field notes (McMillan, 2012) and then provided a detailed descriptive series of prose of the observation information, as well as my own interpretations. I used an observation checklist (Appendix A) as a note taking instrument to record information about the participants in context of their natural, everyday classroom environment.

### **Data Collection**

#### **Overview**

As discussed below, the data collected from this study from interviews and observations provides a detailed and meaningful portrait of the experiences of the teachers.

#### **Interviews**

During interviews, researchers must be flexible and adaptable (Harding, 2013; Hatch 2002) as they work with participants. The purpose of interview in this study was to divulge

meaningful data that represented a construct of the participants lived experiences, instead of my own notions. A conversational interview format was used to produce a greater opportunity for me to listen to the views and perceptions of the participants. Interview questions (see Appendix B) provided the participants with open-ended opportunities to provide meaningful, purpose driven responses. The interview questions were worded to encourage open ended responses that provided participants with the opportunity to share their knowledge and experiences with me. Interview yielded thick and rich descriptive data, reflective of the study participant's individual and specific human experience in context of the interview questions.

Interview sessions occurred in each participant's natural setting, their classroom. The first interview session consisted of a 45-minute face-to-face session, in which each participant and I discussed the set of interview questions (see Appendix B). The first four interview questions focused on the teachers' perceptions of students with dyslexia and the last three questions focused on the teacher's perceptions of technology and instructional tools that support their classroom instruction. The first interview sessions were recorded with each participant's prior agreement obtained via informed consent (see Appendix C).

### **Observations**

Observation data consisted of checklist criteria (see Appendix A). The instructional styles, techniques, and procedures of each teacher served as components of the observation checklist. By observing teachers in their own classrooms, I better understood their perceptions and experiences in their own classroom setting. The checklist guided my observations of each teacher as I systematically collected structured data related only to my research questions and study context. Specifically, I observed how teachers use digital assistive technology and engage with students with dyslexia.

## **Member Checking**

The second series of interviews accomplished member checking (see Appendix I), to clarify, review, and ensure greater understanding of the teachers' perceptions of the students with dyslexia and how these teachers use technology in the classrooms. During the second interview, the member check strategy ensured greater validation of the descriptive data provided by the participants, as they commented on the accuracy of the information I previously obtained during the first interview (Koelsch, 2013). I asked each participant to review and check over the content information collected during their first interview session with me. I recorded changes and corrections that were posed by the participants during the second interview.

## **Data Analysis Procedures**

### **Introduction**

Data analysis requires a methodical approach to extract meaning from information (Hatch, 2002). These procedures must be intentional and clearly communicable. Data were primarily organized and analyzed using both summarizing and constant comparative strategies (Harding, 2013). Summarizing the data is a beginning step in analysis as the information is assessed for vital information related to the focus of the study. The constant comparative strategy enables effective recognition of similarities and difference among the data as they are collected. These two strategies ensured data were analyzed beyond the surface level. Data were coded (see Appendix E) to highlight their commonalities (Harding, 2013).

### **Coding**

Coding is a strategy that enables a deeper connection to potential insights and conclusions that may otherwise remain obscure, due to the high volume of data that qualitative projects tend to generate. Specifically, I used a typological framework (Hatch, 2002) in which I divided data into categorical groups based on preset typologies linked to the research objective



and theory (see Appendix D). After a review of Hatch (2002) and Harding (2013) concerning typological framework and coding techniques, I developed a code bank (Appendix E) directly related to the typological categories of technology usage and perception related to assistive technology and dyslexia. The code bank I created and used to analyze interview and observation data was in direct alignment to both central research questions.

### **Analysis: Interview Data**

Interview data was first read thoroughly to promote a clearer understanding of the information. Next, the data from each interview was synthesized in a concise narrative story format to illustrate my own interpretation of the data set. After the narrative was constructed carefully from the interview data, the information was coded according to typologies (Hatch, 2002) that were identified as specifically relative to the research questions and literature review topics of my study. The interview questions were each directly linked to my research questions to promote a close alignment during this process of data analysis. Each participant's set of summarized interview data was marked relative to the typology categories that were identified. On each narrative summary sheet, the main ideas surmised from the data set were recorded. The narrative summary sheet was then coded again, relative to the typological categories that align to the research questions. At this stage, I determined patterns present in the data set that aligned to the ascribed typologies. Patterns were articulated in one-sentence generalizations to communicate each point of discovery presented from the data set. Upon completing these steps for each participant's data set, I extracted data that support the generalizations that have been articulated from the data analysis procedure. At the end of each series of data analysis of interview content, I took time to reflect in my researcher's journal.

## **Analysis: Observation Data**

Observation data recorded in the observation checklist (see Appendix A) was first read over and reviewed carefully to interpret a clear picture of what went on during the observation session. Next, the data were summarized into concise narrative format, to provide a cohesive, written context of the observation session. The summarized narrative was read carefully and coded based upon the selected codes (see Appendix E) that applied. Coding serves as a solid platform for analysis (Harding, 2013) and to develop the qualitative story line. The coding stage also provided an opportunity to synthesize the data and consider relative themes, and concepts that supported the analysis of this qualitative data. After the observation data were coded, I extracted the themes and concepts that emerged from the prior coding step, and reflected upon these findings in my researcher's journal. Coding that is done well at this stage will help to illuminate the complexity of the data set, and potentially highlights areas of contradiction that may inspire further review. Observation data collected from each participant followed this same series of steps.

## **Limitations and Delimitations of the Research Design**

### **Limitations**

The following design, sampling method, and time constraints limited the study's outcome. The sample consisted of only 8-10 participants, who did not represent all individuals within the population. Data were collected and analyzed in a manner which presented areas of limitation, as this case study was conducted at a novice level. The scope of this qualitative study did not generate any type of large-scale findings as the participant group only consisted of eight individuals. This marked an additional limitation of the research design.

## **Validation**

Credibility and dependability characterized the reliability standards of the data and contributed to further validation of the study (Stake, 2010). To promote trustworthiness and confidence I chose participants who represented the subject phenomenon from a constructivist perspective. These participants shared knowledge and information that was derived from their own lived experiences (Hatch, 2002). The participant group was presumed to be trustworthy, as individuals were selected based upon affability, and willingness to participate in both observation and interview. The participants were informed of the subject matter of the study to ensure a clear, upfront understanding that was free from deception (Creswell, 2013). The participants were treated with respect at all times. The information the participants provided was collected and analyzed, confidentially. Each participant was assigned a pseudonym to further the commitment to confidentiality.

Concerning dependability standards, the data was subject to triangulation (Stake, 2010). Data were collected from observations, primary face-to-face interview sessions, and member checks that addressed the two focal areas of this study; participant perceptions of students with dyslexia and their perceptions about the use of technology in the classroom. This multiple method approach to collecting data presented layers of information that related to the research questions and provided a deeper insight into the subject matter. With the use of rich and thick description in this study, and dedication to reflection and reflexivity practice, the level of dependability of data also improved. These aspects required a consistent and active engagement in which I experienced working with data numerous times while exploring and taking account of my own sense of bias and expectation of the findings.

## **Expected Findings**

Findings and results of this study are expected to show that participants each have unique and valuable insights about the nature and relevance of their educational practice in regard to students with dyslexia. The expected findings may reside within the greater educational community in which educators, students, educational researchers, parents, and other significant stakeholders may gain important insights concerning how teachers of students with dyslexia make meaning of their shared experiences. This information may also contribute to a greater sense of understanding and shared responsibility among educators and students with dyslexia.

## **Ethical Issues of the Study**

### **Researcher's Position**

My own position within the context of this study was that of an active educator. I am a teacher at the research site, as described earlier in this chapter. I had no personal gains to be made in conducting this study. Motivation was strictly that of a scholarly interest. I worked to observe and interview the participant group exactly as described in this chapter.

I actively engaged with the data collection and analysis procedures with the aid of a researcher's journal. To confront and address my own perchance for bias, I wrote constructively in this researcher's journal and by my own thoughts throughout the data collection and data analysis procedures. Through practice with reflexivity, I made effort to gain insights related to my own bias through recording; impressions, thoughts, insights, reactions, and ideas (Hatch, 2002) within this journal. This practice assisted me in addressing bias tendency and provided a further opportunity to explore and better addresses my own bias.

### **Potential Conflicts of Interest**

Potential conflicts of interest in relation to this study related to situations and interactions that could cause or increase bias. Conflicts of interest may arise if participants are misled or

misinformed about their active role (Creswell, 2013). Participants were informed of the research topic and issued informed consent to prevent potential conflicts of interest. Data were not shared or distributed for any type of personal gain, other than for the sake of scholarship. The findings were shared in Chapter 4 and interpreted in Chapter 5 and contributed to an expanding body of knowledge concerning dyslexia and the use of assistive technology.

### **Other Ethical Issues**

Ethical issues can arise in the context of the site and the participants involved within the research design (Stake, 2010). The host site of this study represented only a microcosm of the phenomenon of interest. The site did not reflect every aspect or member of the population of interest, and findings only illustrate information obtained from this singular research study. The information was not generalized. The participants were informed of their specific role prior to any steps of data collection. IRB approval was granted before any steps of data collection occurred. Participants in the group I have identified were informed through informed consent documentation (see Appendix C) to prepare participants, prior to conducting data collection and analysis. Per standard reporting practice with Health and Human Services of the Belmont Report (United States, 1978) data will be kept strictly confidential for 7 years upon completion of the study. Data will be kept confidential to minimize risk and maintain ethical viability.

### **Chapter 3 Summary**

In summary, Chapter 3 presented the study's research design. The conceptual framework of constructivism was justified. The purpose of the study was examined through the design methodology to generate a stronger, effective, and ethical practice. Descriptive qualitative case study design was defined and reported as appropriate for answering the research question and purpose of the study. Qualitative data are interpretive and derived from human experience (Baxter & Jack, 2008; Stake, 2010). This study is entirely derivative of human experience as it

relates to both research questions. The explanation and description of the research study site and the participant group indicated a field setting. Elements of potential bias were articulated and addressed. Homogenous purposeful sampling, an appropriate method for to generate rich, descriptive information (Hatch, 2002; Harding, 2013), was selected as the appropriate sampling method for purposes of this study.

The rationale of the research design was articulated to better inform the reader about the process of data collection and analysis. The research instruments were examined in detail, as was the method of data analysis. How potential ethical issues were addressed was also reported in this chapter.

## **Chapter 4: Data Analysis and Results**

This descriptive qualitative case study was designed to explore the perceptions of high school teachers who use assistive technology in their classrooms to teach their students with dyslexia. A case study provides an opportunity to examine and understand issues, objects, experiences, and illuminate relationships (Hatch, 2002; Stake, 2010). Through observations and interviews, a qualitative study can produce thick and rich descriptive data over time (Ponterotto, 2006; Wolcott, 2009). This framework ensures meaningful data are collected (Creswell, 2013; Stake, 2010).

I worked with eight high school teacher participants who were currently teaching students with dyslexia and had access to assistive technology in their classrooms. I investigated two research questions: (a) How do the teachers of high school students with dyslexia perceive the use of digital technology to assist in the learning process? (b) What are the experiences of teachers who use assistive technology to teach high school students with dyslexia?

Throughout my career as a high school teacher, I had had many questions concerning assistive technology and the success and welfare of students with dyslexia. I wanted to better understand the interactions of other high school teachers who also teach students with dyslexia and how the prevalence of technology in our classrooms impacts these students. To address the research questions, I designed and conducted a series of face-to-face interviews. I created an observation checklist and observed each participant and then completed member checking with each participant. Once completed, this series of data collection led to the process of data analysis, as presented in this chapter.

### **Description of the Sample**

The purposeful sample for this case study consisted of eight male and female high school teachers who teach students with dyslexia at a school in western North Carolina. Teachers had

varying experiences using technology to facilitate instruction in their classrooms. These eight participants served as the core subjects of this single case study. The participant sample shared several characteristics related to the case study (Baxter & Jack, 2008; Hatch, 2002; McMillan, 2012; Palinkas et al., 2015; Turner, 2010; Yazan, 2015). All were currently teaching high school students, had taught high school students with dyslexia, and used classroom technology. Still, the participants represented a variety of educational experience, and each participant had an individual story. (Pseudonyms are used throughout.)

Irene was a female educator with 10 years of classroom teaching experience including 3 years at the study site. Irene was born and raised outside of the United States but had lived in this country now for more than 30 years. Irene had taught in classrooms with and without access to technology for both teachers and students. She had worked with learning disabled students in general education language classes, including students with dyslexia. Irene currently taught students enrolled in honors and advanced placement Spanish courses. She stated, “Students with dyslexia are capable and intelligent but in greater need of resourceful approaches to learning, and lots of repetition when practicing language skills.” Irene saw many positive benefits to the inclusion of technology in her classroom, including access to applications, such as Spanish Dict, in which students with dyslexia can break down vocabulary at the syllable level and practice multiple exposures to words. Irene said she teaches using technology as an integrated platform that was part of her own planning and instructional delivery. She saw using programs such as the language assistive tool Google Read & Write as especially advantageous to students with dyslexia because this program allows students to highlight and create vocabulary lists from texts that she teaches. Students can then have the text read aloud to them while they practice using this technology tool. According to Irene, this method of study helps students with dyslexia complete language tasks in class with greater accuracy. Irene was cognizant of the difficulties



that students with dyslexia experience in her classroom. She was receptive to teaching in ways that support her students, including those with dyslexia.

Martha had 12 years of classroom teaching experience. Martha immigrated to the United States 13 years ago to begin her teaching career. Martha was invested in her teaching career. She stated, “I am aware of the diverse cultures and students’ learning needs that I teach.” Martha had taught mixed ability, general education science courses at the study site for 10 years and currently taught students in both standard and honors courses. She had noticed both positive benefits and some areas of concern with the presence of technology in her classroom. Martha was concerned that her students are heavily dependent upon the use of technology and may be easily distracted during online learning. However, she was glad that technology can bring real world, large ideas such as genetic simulations, to her students in a highly visual manner. Martha thought that using technology in her classroom supports visual and auditory learning for her students as the technology tools that she plans and facilitates enable her students to experience the course content in a more personalized manner. Martha noted that her students can use spell check features, Google Read & Write, and a PDF reader to access the course content in which they can study and review with greater support on their own. Martha thought that read-aloud support is critical for students with dyslexia in her class. She said she takes time to check in with her students who are dyslexic verbally. She also worked online with the students to assist them with the labs and assignments they must complete. Martha saw the relevance of technology use in education as practical experience that will benefit students with dyslexia, and she had worked to cultivate a teaching style that is adaptable to all of her students. Martha expressed an overall positive mindset considering using technology in her classroom. She acknowledged the relevance of technology use for her science students and saw it as a useful tool, as long as the technology is relevant to her teaching standards.

Javier had taught high school courses for 3 years. Javier was an accomplished visual artist with a wealth of animation experience. He was enthusiastic about his career shift into education. He had also taught college arts courses at a visual arts academy. Javier currently taught a wide range of students in standard and advanced art courses. Javier saw the importance in considering how to teach and interact with the students with dyslexia in his classes. Javier explained, “I have noticed that students with dyslexia benefit most from a step by step, highly visual guide to an art assignment in which I work with them, using modeling and vocal cues to coach them.”

Javier thought students with dyslexia engage with blank canvasses and open concept arts assignments; they are encouraged to express creativity. He has noticed that the students he teaches in art with dyslexia thrive in completing artistic projects that involve both hands-on and digital online practice. Javier said he works to break down the concepts and the objectives he teaches in his art classes to give students with dyslexia greater support in processing the main ideas they need to learn. Javier said he recognizes the creativity and the willingness students with dyslexia in his classes demonstrate when they are given opportunities to create art using online software, apps, and programs. He had integrated explore time into his curriculum because of the high levels of interest he had observed when students with dyslexia are given time to interact with new technology in art class. Javier had a positive frame of mind concerning the presence of technology in his classroom. He was mindful of the support technology can provide for his art students who have dyslexia, and he was willing to include technology tools that assist in their learning experience.

Jane had taught high school English courses for 3 years. She had more than 10 years of experience in education, spanning middle and high school classes. Jane had a great interest in learning new topics and strategies in teaching and currently taught student enrolled in both

standard and honors courses. She saw the language processing difficulties experienced by students with dyslexia in her classes, and she notices key benefits in using technology in her classroom to support these students' learning. Jane was concerned that several students in her classes had unreported or undiagnosed dyslexia. She thought that the few students she teaches who had dyslexia did not represent the student population in high school.

Jane stated, "I recognize that technology use had become a life skill for my students in both college and career settings. That's why I integrate technology into my instructional planning and daily lesson planning." She was comfortable experimenting and learning about technology for use in her classroom and interacting with her students through technology.

Tina had 20 years of experience teaching high school mathematics. Tina was born and raised in the same county in which she currently taught. She was heavily invested in the math courses she taught and her after-school coaching responsibilities. Tina had taught general education math courses in several schools in the same county as the approved site, including 2 years at the approved site. She currently taught students in standard-level courses and had worked with several high school students with dyslexia in her most recent math classes. Tina said she understood that students with dyslexia tend to switch around steps and parts of math problems. She had observed that student with dyslexia struggle with accuracy in practicing the steps they must follow to solve math problems. She had seen that students with dyslexia tend to volunteer and participate less frequently in her classes. Tina was receptive to the inclusion of technology in her classroom for her own use and for her students' use. She stated, "I would like to have more deliberate training to engage with meaningful technology to pass along to my students." Tina was patient and willing to learn, but she expressed some hesitation in terms of her lack of overall experience in learning technology tools for her classroom. She acknowledged that it takes her quite a while to become comfortable with any new form of technology.

Trisha had 7 years of teaching experience in high school English courses. She had taught English classes at the approved site location for more than 5 years. Trisha was highly involved in teaching and supervising student-led clubs. She taught students in both standard and honors level courses. Trisha was well aware of which of her students with dyslexia. She was mindful of their needs in how she went about planning and facilitating lessons for her classes. Technology use was fully integrated in Trisha's class and part of her daily lessons. She explained, "Using technology in my classroom had created a more open-ended, digital interaction with my students in which more of their voices are clearly represented." Trisha was confident that digital participation on behalf of her students with dyslexia had led to a greater emphasis on their contributions in her classroom. She had taken time to learn how to incorporate applications and software into her lessons for her students' benefit. Trisha had a positive, open mind and was willing to continue learning about the changing role of technology in education. Trisha said she values technology that is deliberate, student friendly, and in close alignment to her content area.

Karen had 4 years of classroom teaching experience. She was involved with a student support committee and works diligently to provide teaching and learning support for struggling students in high school at the approved site. Karen had taught a variety of subjects in both middle and high school. Karen had taught world history courses at the approved site for 3 years in both standard and honors courses. She explained, "I understand that students with dyslexia mix up letters and syllables while reading and writing. Dyslexia is mainly a processing issue that is present in the brain." Karen had not taught many students formally diagnosed with dyslexia in her high school classes, although other such students might have lacked the diagnosis. She saw value in planning with technology, and she was currently integrating technology use into her daily lessons. Karen was highly organized and had been pleased with the digital management system she had created that helped her to plan, teach, and analyze data showing students'

progress. She appreciated that technology had enabled her to interact with her students in many new ways. Karen enjoyed learning with her students as opposed to simply giving students work to do; she also participated in learning online alongside her students. Karen had a vested interest in learning more about useful technology for her students. She was open-minded and willing to incorporate technology into her lessons.

Rick had taught a wide level of high school history classes for 8 years at the site. He currently taught advanced placement, standard, and honors-level history courses. Rick expresses overall satisfaction in switching his career from criminal justice and distribution work to education. He had little understanding of what the students he currently taught with dyslexia needed in context of instructional support and practice. Rick knew that dyslexia involves some confusion of letters and words, but he said he did not have much knowledge about teaching strategies that assist students with dyslexia. Rick explained, “I have interest in learning how to support students with dyslexia. I am willing to learn what works.”

Rick had integrated technology into his daily lessons, and he was more than willing to learn more about technology for his classroom. With a great sense of respect, he viewed his students as digital natives. He was intrigued by their natural ease with interacting with the digital world. He said he struggles sometimes to keep up and locate interesting technology inspired lessons and ideas for his students. Rick was always on the lookout for new, creative technology tools and ideas to reach his students. He had noticed that in using technology his planning efforts and instructional habits have changed over time. Rick was open minded and interested in classroom technology.

### **Research Methodology and Analysis**

The case study methodology of this project included data collected via interview, observation, and subsequent member-checking sessions with the eight participants. The focus of

this case study was how high school teachers viewed students with dyslexia in their classrooms and used technology in their classrooms.

In the following section I explain the coding steps I followed and how I collected interview and observation data in the field in detail. What was done with these data once collected was slightly different than what I proposed. In this section I explain how data were analyzed using the typological framework (Hatch, 2002) for all data collected.

### **Coding**

After a review of Hatch (2002) and Harding (2013) concerning typological framework and coding techniques, I developed a code bank (Appendix E) directly related to the typological categories of technology usage and perception related to assistive technology and dyslexia. The code bank I created and used to analyze interview and observation data aligns to both central research questions.

### **Data Collection**

I collected data in three ways. First, I conducted face-to-face interviews with the teacher participants. Second, I completed observation sessions of the teacher participants in their classrooms. Third, I completed member-check sessions with the teacher participants during their instructional planning times to review their interview and observation data with me and to check for accuracy in how I interpreted the information.

### **Interview Data**

I collected interview data from the teacher participants during prearranged, 45-minute interview sessions. During these sessions, I recorded audio files of each interview using Quicktime media player. I also took notes in my researcher's journal as I listened to each participant's interview responses. I wrote clarifying statements in which I summarized what the participant said during the interviews to help me process meaning from each response. For

example, when Martha went into greater detail about online simulations she used with her students, I wrote in my journal that simulations appeared to be important to Martha. Her detailed answer suggested, in essence, Martha thought the visual features of the simulations she used for her students helped them to see and experience the concept much more fully. I used interview questions (Appendix B) directly related to both research questions to facilitate each interview session in the same order. I provide greater detail and explanation of interview data collection in Appendix J.

### **Observation Data**

I collected observation data from the teacher participants during prearranged 45-minute observation sessions in their respective classrooms. During an observation session, I sat at each participant's desk and used my researcher's journal to record descriptive notes into the comments section that I included on the Observation Checklist template I created (Appendix A). For example, during an interview I noticed the teacher consistently modeled the assignment expectations the students were completing in a style I had not observed. I wrote out my reaction to her collaborative method of teaching with her students on the observation checklist copy I used during her session and wrote my immediate reaction in a couple of sentences in the comments section to help me process and later recall what I observed. I used this observation checklist featuring content related to both research questions and specified topics from the literature in Chapter 2 related to assistive technology and dyslexia. I used digital copies of the observation checklist template on my laptop and filled in the checklist template and typed notes while I observed each teacher in their classroom. I provide greater detail of these steps in Appendix J.

## **Member Checking**

I later shared my observation and interview notes with the teacher participants during brief conference sessions in which I met with the teachers during their planning times and also after class. During each member-checking session, I took time to discuss the information taken from both the interview and observation session with each teacher. My purpose was to check for accuracy of my interpretations of their responses and to verify that my observations aligned with each teacher's experience. These member-checking sessions were completed to triangulate the set of data and provide greater validity to the study. The format of each member-checking session was conversational between myself and each teacher participant. I used a brief series of questions to help clarify what was discussed during each member check session (Appendix I).

## **Data Analysis**

I used typological analysis steps (Appendix D) to analyze the data I collected (Hatch, 2002). In following typological analysis steps, I focus on identifying patterns within the interview and observation data I analyzed. I used the constant comparative strategy while I analyzed the interview and observation data and identified patterns of information (Harding, 2013). The patterns I found within these data will be presented after I briefly explain how I completed the typological data analysis steps.

## **Interview Data**

To analyze the interview and observation data I collected, I first transcribed each interview audio-file by typing up each interview session I recorded it. I then reread each interview transcription document and typed a one-page narrative summary in which I simplified each participant's full data set into a concise, cohesive story. For example, I compiled the pages of Javier's detailed responses to the set of interview questions I asked him into a short narrative that highlighted his specific views and experiences with technology and the students he teaches



with dyslexia. I intended to tell each participant's story in context of both their perceptions and their experiences as related to both of my study research questions. As I worked through the narrative summary sheets, I compared my findings within the entire data set of the interview transcriptions. I continued to look for patterns within each participant's narrative summary and then compared the set of participant summary sheets to examine commonalities within the entire interview data set. I provide greater detail and explanation of this analysis of interview data in Appendix J.

### **Observation Data**

To analyze the set of collected observation data, I first carefully read and reviewed each participant's observation checklist (Appendix A). I typed one-page narrative summary sheets of each participant's observation checklist data to interpret a brief story of what I observed in each participant's classroom. I coded each observation narrative summary sheet using the same code bank I created (Appendix E) to view and process the summary sheets in context of typological analysis (Appendix D). Next, I continued to compare my findings within the complete observation data set, just as I had done with the interview data I collected. I organized this information by explaining the emergent themes and patterns that were identified during the analysis process. These themes became the framework for presenting the findings of my study, in answer to both central research questions. I provide greater detail and explanation of this analysis of observation data in Appendix J.

### **Summary of the Findings**

The findings suggested the teacher participants perceived the use of technology in their classrooms as a supportive method for instructional planning and teaching. The teachers tended to rely on technology to plan and to deliver content to their students. Though the teachers expressed similar views about using technology to facilitate instruction, the method in which

each participant engaged with technology varied. The teachers also expressed interest in learning how to use new and viable technology in their classrooms in support of their students. Several of the teachers discussed professional development opportunities as an option for learning how to use technology in their classrooms.

The teacher participants used visual and audio technology features in their classrooms to assist in the learning process of students with dyslexia. PDFs were most commonly present in the text content discussed by each of the teachers. They relied on video clips and audio files to support student learning; these resources were explained by the teachers as available to students to access on their personal laptops through each participant's course websites. Several of the teachers routinely supported student learning through the modeling and use of assistive technology software support: Texthelp for PDF reading support and Google Read & Write for the reading and visual support of any online document. The teacher participants viewed technology as a way to engage and connect with their students. I noticed a pattern in how the participant group viewed technology as a suitable and preferred method of interacting with their students.

Overall, six themes emerged that supported both research questions: technology as an asset, technology as an instructional priority, technology as a support tool, traits of students with dyslexia, technology as a transformative tool, and interaction with technology.

### **Presentation of Data and Results**

I analyzed these data I collected by applying typological analysis steps (Hatch, 2002). These data and the results of my analysis are presented next. My analysis information is organized by both research questions in which the themes emerged, supported by the codes I used during data analysis (see Table 1). I explain each theme in support of answering both research questions and how each theme was identified from these data. The themes presented in

the data and results include technology as an asset, technology as an instructional priority, technology as a support tool, traits of students with dyslexia, technology as a transformative tool, and interaction with technology.

Table 1

*Developed Themes and Codes*

| RQ 1 Theme                              | Code Abbreviation | RQ2 Theme                            | Code Abbreviation |
|---|-------------------|--------------------------------------|-------------------|
| Technology as an asset                  | SN, T, TP, TA     | Traits of students with dyslexia     | D, SN, TE         |
| Technology as an instructional priority | TP, T             | Technology as a transformative tool  | T, SN             |
| Technology as a support tool            | T, AT,            | Frequent interaction with technology | T, TE             |

*Note.* SN = Special needs of students; T = Technology; TP = Teacher perception; TA = Teacher assumption; AT = Assistive technology; D = Dyslexia

*Research Question 1. How do teachers of high school students with dyslexia perceive the use of technology to assist in the learning process?*

Three themes emerged to support the answer to Research Question 1: (a) technology as an asset, (b) technology as an instructional priority, and (c) technology as a support tool. Each of the three themes is explained in detail below.

**Technology as an Asset**

The teachers explained that technology is an important teaching tool. The teachers stated that classroom technology has played an important, central role in daily planning and instructional methods. The teachers explained that they are mindful of the benefit of using technology to support student learning. The following codes reveal the underlying meaning of this theme.

**Code SN: Special needs of students.** The following strategies were observed in Trisha's and Irene's classrooms and documented on the observation checklist I created (Appendix A) in support of student learning. I observed Irene and Trisha using language application software to support student learning and to help students practice vocabulary skills. Both teachers were observed supporting the needs of students as the software helped students learn new vocabulary content through repetition and independent practice. These teachers were observed using technology to give students instructional support. To check for student understanding, Irene prompted students with auditory repetition sequences; she asked the students to repeat with her and after her to help the students learn vocabulary words. I saw that Irene used both visual and auditory cues to engage her students and keep them on task. Irene also used music during her lesson to stimulate student engagement and memory retention, in support of their learning during independent practice time. Trisha was observed syncing audio files of the main portion of her lesson, online so her students would have access to the information during and after class for additional practice.

I observed Trisha working online and collaboratively with her students. She also focused on reaching out to her students beyond the structured class time through email, which she mentioned during the ending minutes of the class period. Trisha was observed providing her students with dyslexia the required course texts, online. She used the integrated software platform Canvas to sync PDFs and additional resource documents.

During her interview, Trisha explained,

Technology is meant to help students use the content I teach them. I post audio and text support online for my students to use. I post links of PDF versions of the texts that we read to also help students access the content from anywhere. That way if they miss class

or need to review, they are covered. Audio support is very important in helping students reread and review the content we cover in class.

Rick and Javier were also observed supporting student learning. The students accessed the lesson content through an online interface, Canvas, in both teachers' classrooms. Rick used Canvas to provide online resource support and organization for his students. Rick's students used Canvas to access all course content he teaches. The students worked online in collaborative groups during the class period to read articles and post responses that Rick created. Each group discussed the assignment after Rick presented the material and lesson objective through discussion, to reinforce what the students had learned. The groups of students in Javier's classroom used Google documents to create their own responses to the lesson questions, based on a PDF Javier had included in the lesson. The PDF included 10 visual examples, with written captions, to support the students' visual learning of the concept. The inclusion of PDFs to support student learning was a classroom asset that was mentioned in detail during Jane's interview. Jane commented,

I link PDFs of text and resource documents we study in all my classes to give students access to the content from their laptops. I also link documents I create to guide instruction for my students. I create these types of digital learning supports through Google documents and Canvas, for the most part. I post all of my instructional assignments and resources on Canvas. The students can access my post content from anywhere. I feel that this is very beneficial to my students. They can revisit the lessons and content I teach as much as they need to really get it.

These strategies, in support of student learning, were documented on the observation checklist I implemented (Appendix A) and indicated that technology functioned as an

instructional asset for the teachers. The teachers used online learning resources to support the needs of their students.

**Code T: Technology.** The teachers were observed using technology during observation sessions. Specifically, Karen was observed engaging her students in learning online with her close guidance. Her class was structured around the organized and deliberate presence of technology tools including laptops and a Smartboard. Karen was observed implementing technology as a routine part of her classroom to learn with her students and to keep them organized.

During her interview, Karen shared the following:

I use a visual, digital calendar to support students with staying organized and on track in class. I use Canvas to post text versions of all course content and assignments and audio files of our course work for students to access to revisit the texts we study, as needed. I make sure to update online class pages very consistently so that students can access the course content from seemingly anywhere. I often publish varied versions of the core text we study to promote greater student engagement with the reading assignments.

During observation, I saw that Karen prioritized reinforcing strong connections with her students through digital learning. She spent time during the lesson reviewing concepts she had taught through an online game that the students were excited to play. Karen was observed modeling instructions and examples for her students; she used technology as a course platform in which her students interact with every bit of information she teaches.

**Code TP: Teacher perception.** The teachers viewed the use of technology as a 21st-century method of both teaching and learning. The teachers emphasized that their roles had shifted to that of facilitators and coaches due to the inclusion of technology in their classrooms.

The teachers viewed this shift as giving more personalization to their students own learning. The teachers discussed the role of technology in their classrooms in mainly positive personal views.

Rick perceived the use of technology in his classroom as a support tool driven mainly by student learning. He said he has noticed his students engage with learning at a much higher level when he uses technology, presentation options and resources, to get their interest and attention. Rick has found technology's role as a support tool that has enabled his students with dyslexia to work at higher proficiency levels with the advanced texts that make up the cornerstone of his history courses. The text levels tend to be rigorous, and Rick believes it is his responsibility to fully consider the needs of his students when he plans course lessons. Rick explained in more detail,

Technology such as word processing is very helpful to students with dyslexia, they can see the text they are reading or writing and they can use spell and grammar check to help them communicate their work more clearly and more in line with the conventions of language. When students research, they can use technology to help them alleviate the process of taking notes, learning new terms, staying organized, and writing out their research reports.

To assist students with dyslexia in a positive and efficient manner, Trisha and Javier perceived technology use in their classrooms as a method to achieve this goal. During her interview, Trisha remarked, "The use of student laptops in my class allows my students with dyslexia to produce more coherent, detailed work." She also commented that students with dyslexia participate and ask questions more in class when she provides online assignments and coaches students through the work, as opposed to only using direct instruction.

During his interview, Javier mentioned:

I give extra attention to detail through verbal and visual instructions, I use bullet points and diagrams, and I check for understanding constantly with my students. My students with dyslexia tend to be more successful in class when I put in this time and effort to make sure they are getting help. When we work online together, I encourage the students to draw and map out what they are thinking and learning so that when I meet with them I can better understand how they are progressing.

During observation, I noticed that all students in Trisha's class work online with her on the same model student laptops. Trisha noticed that students with dyslexia do not feel singled out, since everyone in class works on the same laptops; she notices that they are more likely to engage in daily lessons as this sense of inclusion is part of her classroom culture in which everyone works together to learn. Trisha views technology as a way to level the playing field for the students with dyslexia in her classes.

**Code TA: Teacher assumption.** The teachers expressed that the role of technology is key for preparing their students' futures in college and career settings. The teachers explained that modeling with technology and encouraging students to use technology is important in their classrooms and to the students' quality of life and success. The teachers supported the role of technology as a way to assess student learning and show that students are making growth.

Irene assumed that her students require many opportunities to break down key points from her lessons to practice and learn. During her interview Irene mentioned:

I use digital tools and apps to interact with students. I know that they are on their computers often and I like to think that if I can make learning more interactive and fun for them, they will practice more. I am committed to getting kids to practice beyond their required class time with me. If they are already online outside of school, why not encourage them to spend some more of that time learning?



I observed Jane coaching her students, who completed an online assessment in which Jane explained to them how the assessment would be used to determine their semester growth in the course. Jane's students were observed working independently on their personal laptops to complete this assessment. She assumed that the students would finish the online assessment during the class period and anticipated early finishers would make use of remaining time. Jane consistently instructed students verbally to work on another task, online once finished with the assessment. During her interview, Jane also remarked:

Technology is not a separate entity in my classroom; it is integrated into the skills, objectives, and strategies I introduce to my students all year. In high school, the kids are at a crucial transition stage, right now paper/pencil instruction is going away and online learning is taking its place. Learning modes are changing. Students are working on computers in and outside of the classroom to learn. The world is at all of our fingertips, the touch of a button. The time spent learning online is increasing for my students and I am connecting with them in new digital ways. I recognize that technology is also affecting how students must complete important exams, such as the AP exam, as it is now administered online. This represents a huge shift. The students in my classes are part of the technology generation, I am a part of it with them. I feel the need to embrace technology tools in my classroom.

### **Technology as an Instructional Priority**

The theme technology as an instructional priority emerged from the data set as the teachers explained that planning and instructional design strategies they prefer to use involve digital technology. The codes TP- teacher perception and T-technology were used during the data analysis steps I followed (Appendix D) in support of this theme. The teachers explained that technology in the classroom is an important teaching tool that takes priority over previous

methods of using books and teachers guides. The teachers explained that they value technology as their priority in instructional teaching and planning efforts and find inspiration and new ideas, online. The codes reveal the underlying meaning of this theme and are outlined below.

**Code TP: Teacher perception.** To assist in the learning process of his students as part of his daily teaching methods, Javier explained during his interview that the use of classroom technology is a necessary practice. During the interview he elaborated:

I look at technology as an additional way for students to express the artistic skills and concepts I teach. I have a process I use to guide my students through each objective we cover in class. When it comes to technology integration related to a concept I'm teaching, I find it very important to give the students some structured time to play and explore the tech tool. This exploratory use is sometimes done independently and other times I encourage my students to work in small groups to explore the tech tool after I introduce it.

Students with dyslexia have become more involved in classroom learning. Javier has realized that when they are given time and opportunities to experience new technology to practice learning objectives, his students with dyslexia become more involved. "I break down key points," Javier said, "from our lesson topics to help students grasp the content." Javier perceives text help software as a key method in which his students with dyslexia interact with the lesson texts many times. Javier supported student learning with the use of some classroom technology. Javier displayed a series of digital logos as part of the visual content of the class lesson. This logo imagery was made visual to Javier's students on a large computer board. He played a video clip for students that summarized the key points of his lesson discussion. The students worked in art sketchpads with pencils during the lesson. Javier wrote out the steps of

their lesson activity on a dry-erase board. I did not observe him reading these directions aloud to the whole group of students or using assistive technology.

Rick perceived using technology in his classroom as a support tool as a way to give students more options and choice in learning. Rick has found that technology has enabled his students with dyslexia to become more independent in their learning. During his interview, Rick elaborated:

Technology options for assignments and projects in my class give the students more flexibility. I like to give them options so that they can feel more connected to what we are learning and more invested in what they produce for me. I am dedicated to planning projects and assignments that are high interest with options for students to explore, I want them to make meaning and to connect to what we learn as much as possible. I see that technology allows me to give students a wider range of possibilities to explore than the pages of our textbooks.

**Code T: Technology.** During her interview, Trisha commented that her instructional planning strategies and teaching methods have become heavily integrated with technology. Trisha stated using technology in her classroom is a preferred way to deliver daily lesson content and course objectives to her students. She indicated that technology has enabled her to assist more of her students, especially those who struggle with reading and writing objectives. During her interview, Trisha further explained how she planned using technology:

Technology is super useful in how I plan for my classes. Having the one to one laptop program with our high school students has really helped with making quick changes and updates for students and it also provides them with greater access to our course content. I use Google Docs when I create notes and assignments for my students while I plan. I really like that the students can set up these docs and individualize how they access the

texts we study in class with. Using technology in this way in my classroom has been incredibly useful with the writing objectives I have to teach. I tend to work online with the students' rough drafts and we also engage with online peer editing practice as well. I have had greater success with student writing products in using Google docs to plan and implement writing assignments.

I observed Trisha interacting with her students on two writing assignments online.

Trisha's students worked with her to improve their writing products under her guidance. Trisha stated during her interview that she is mindful and deliberate in planning the use of technology in her classroom. She explained:

A certain benefit of using technology plan in my classroom is that it has streamlined my job in many ways. Online access has improved the way in which students work with my course assignments in ways that I like. I can change my plans very quickly and efficiently due to technology and I like how much more creativity I have pulled in to my lesson content and new ideas that I have incorporated from technology resources.

During the observation, I saw that Trisha worked with her students during the lesson by typing notes to share with the students, as they all discussed and analyzed the content Trisha had prepared on a PDF. The PDF was displayed on her laptop and Smartboard while the students worked on their laptops. I saw that Trisha consistently interacted verbally with her students during this collaborative work session.

Student engagement was high in Trisha's classroom. I observed more than 10 students voluntarily participate during the main lesson discussion portion of the class period. I observed that, under Trisha's instruction, students highlighted, annotated, and add to their assignment documents during the lesson. She indicated during her interview that she values the ability to

plan using technology to present content to students in a variety of visual and auditory ways to support their learning.

### **Technology as a Support Tool**

From my code bank (Appendix E), the codes T-technology and AT-assistive technology were used during the data analysis steps I followed (Appendix D) in support of theme technology as a support tool. The teachers explained that the students they interact with and teach who have dyslexia benefit from the inclusion of digital technology in the classroom. The codes reveal the underlying meaning of this theme and are outlined below.

**Code T: Technology.** I observed Jane facilitating an independent online assessment in her classroom. Jane's students completed a reading test session during the lesson, using their own laptops. Her students worked independently online the entire observation session and were prompted to continue working independently after completing the assessment on additional reading activities. I observed that Jane's students were working the entire class period and moved seamlessly from the assessment to the additional activities on their laptops. I noticed that the students demonstrated competence in completing tasks online with little additional instructional guidance by Jane. During the interviews, the teachers commented that the students with dyslexia in their classrooms require multiple exposures to the specific content they teach. They use technology to keep students with dyslexia organized and engaged with the language content they teach.

Irene commented,

In my classroom, the use of the central technology platform, Canvas, allows my students to access every element of my course from their laptops. Students can interact with the course content I create and share on Canvas and then create their own review tools based on what we learn together in class. I can provide rapid feedback and even audio

communication to support my students on Canvas; this also promotes more connectivity between the students and I [sic]. I can quickly tell if they are getting it or not, we are learning online, together. With the use of collaborative learning, I can gauge how my students are responding to the topics we have to cover.

During her interview, Tina explained in greater detail,

I feel that my students with dyslexia benefit from repeat, individual online practice with these programs. I use technology as a follow up way for my students to practice the skills they've learned from my lesson. Students get to practice more frequently on their laptops with the programs I integrate into each of my courses, and in this way, they can prepare for the course assessments.

In my observation, I saw that the flexibility technology has provided for Tina's students to learn and practice at their own pace was observed as highly useful in her class. She shared during her interview that the software she used provides helpful practice opportunities for students. During the observation, Tina encouraged student learning with the use of technology in her classroom. She prompted students to work on their computers to practice the math concept she had introduced at the beginning of the lesson. Tina's students first worked online using the software IXL, a math practice program designed to help students practice math concepts independently.

After a brief study session online using IXL, I observed the students completing a math assessment. The students were instructed verbally by Tina to login and complete the online math assessment. Students used their laptops to complete the math assessment. She assumed all students would access and complete the math assessment during the class period. She briefly monitored student progress by walking around the classroom. Tina relied mostly on verbal instructions to interact with students during this observation. The students in Tina's class

completed an online assessment during a portion of the observation; interaction and engagement with technology then continued as independent work study by students.

**Code AT: Assistive technology.** Students with dyslexia require multiple exposures to language commands and texts within a lesson. During their interviews, Javier and Jane expressed that they provide multiple exposure to new content to better meet this perceived need of their students with dyslexia. Jane provided access to her course content for students to interact with online through visual and auditory support using Google documents, PDF links, audio files, and templates that she created on her own for her students' use. The students interacted with these online resources after completing an online assessment during the time I observed her. Jane also took time to remind the students to use Google Read & Write, a program that visually highlights and reads aloud text content to students to assist in processing written content.

The usefulness and personal adaptability of assistive technology in Tina's classroom was observed as a way to get her students to practice math concepts. During her interview, Tina acknowledged that there are benefits of read-aloud and visual tracking support for her students with dyslexia. They use Texthelp and Google Read & Write when solving multistep word problems in math class.

I observed Irene providing assistive technology support to her students during the lesson via a language practice application called Spanish Dict and the text reader program Google Read & Write. She synced premade Google documents explaining the lesson assignment to the class website for students to access. Irene has learned that structured modeling and guided practice of the lesson content first helps her students engage fully with the tasks required. Irene was cognizant of the visual and verbal needs of her students, she consistently worked to coach, guide,

and support students during the lesson to eventually work on their own to complete the practice during the observation. She appeared comfortable operating her classroom laptop and projector.

During her interview, Martha stated that the specific use of simulations is particularly beneficial to students in her classes with dyslexia as the simulations are highly visual and interactive. Martha said that technology does not fully replace quality instruction in her classroom. “I don’t rely on technology in my classroom. Technology does not substitute my teaching style. Technology in my room enhances the content that I teach.” She supported student learning during the lesson with the use of simulations that were directly implemented to assist students in learning the visual content she taught during the lab experiment.

Martha introduced the lesson lab content with the use of a laptop and projector in which she accessed the web content and read the text of the site orally to her students. She clarified key points from the website content she read aloud for students. Martha did not invite her students to interact with the lab text content on any devices or programs of their own until she had fully reviewed the content she explained. Her students interacted with her teaching objectives and the lesson overview by completing a paper copy of the lab assignment after she engaged with the visual simulation software. Martha provided verbal instructions to her students during the lesson.

Support and accessibility for Trisha’s students were highly important to how she uses technology to assist her students. During her interview, Trisha said:

I use technology to help my students engage with the content I teach. I link audio support for my students to use for the text readings we use in class. I also like to post links of PDFs of the novels we read to also help students access the content from anywhere they happen to be. So, if they miss class, or need to review, it isn’t such a big problem. The



audio support I post for the students to use is very important in helping them read and review the content we cover in class.

She incorporated three related video clips to the students' work to help them understand the lesson topics. The group of students were observed viewing the three video clips during the lesson time as well. Trisha took this time to interact with students in the class as she stopped by each group and verbally assessed their progress. Google Read & Write was used by eight of Trisha's students during the work session; one of which was a student with dyslexia. The student was observed highlighting vocabulary on the assignment document and copying the vocabulary words into an organized list of terms and definitions. Assistive technology was observed being used by students during Trisha's lesson.

Karen's use of technology consisted of a laptop and Smartboard which displayed a Google document and a PDF that featured the lesson text content. She displayed the lesson text and read-aloud from the source as an additional means of support for students. Karen prompted her students consistently with verbal and visual cues while she modeled the lesson objectives for students. To engage her students with the lesson vocabulary terms, she modeled how to highlight specific terms in the PDF document and transfer the terms to the Google doc. Karen took time to monitor student progress. As they all worked on personal laptops, she walked the room and stopped at each group of students to assess their progress.

Karen modeled Google Read & Write during her lesson; she used the vocabulary and highlighting features from this assistive software program as she coached students. Karen supports deliberate, structured, and organized lessons in which technology plays an integral role in student learning. Karen relied on multiple exposures to the lesson text to support students while they practiced. The use of assistive technology was observed during Karen's lesson. The

assistive technology software was being used by the majority of the students in the class. During her interview Karen stated:

I find that integrating the use of technology using laptops with the students has lended [sic] greater flexibility to the lessons I facilitate. The students interact with the content I post online independently and in groups to learn and practice the objectives I'm teaching them. I also have greater confidence that the students can carry on learning when they are absent, in need of review, or studying for assessments because of the flexibility technology gives me.

I observed Rick's students working online throughout the observation session. The students interacted at times throughout the lesson but mainly stayed focused on the group work Rick gave them. I saw that Javier's student groups worked with paper materials for half of the observed session and then moved to explore time online using links that Javier suggested. The pacing and directional approach of Javier's teaching method kept the students in control, with his guidance second to their creation and work time during the class period.

The observation data have indicated the teachers are using technology in their classrooms in both planning and teaching methods. The observation data show that the teachers are aware of the students they teach that have dyslexia but overall, are unsure of how exactly to model instruction or plan in any specific manner that they perceive to be of use to these students. The teachers perceive technology to be useful but also indicated that they would like to discover more streamlined and personalized methods for interacting with technology to be more efficient and helpful as a teaching tool. The teachers communicated interest in learning how to plan and teach students with dyslexia with some hesitancy as to how to go about accessing training or resources to do so.

*Research Question 2. What are the experiences of teachers who use technology to teach high school students with dyslexia?*

Teacher participants each valued their own experiences in teaching with technology. Teacher participants also share experiences working with students who have dyslexia in their classrooms in varying degrees of distinction. These experiences were articulated during each participants' interview session in greater detail. These interview data indicated the teachers had only a general understanding of dyslexia, that is, a problematic reading disorder in which processing information presents a vast challenge to the student.

Three key themes emerged from these data to support the answer to Research Question 2: shared traits of students with dyslexia, technology as a transformative tool, and frequent interaction with technology. These themes were determined during the initial stages of creating the typological framework that I used to analyze the data set (Appendix D). Data transcribed and coded from interviews and observation sessions were analyzed in direct relation to these three themes, as stated above. The codes used to identify these themes were TE- teacher experience, AT-assistive technology, SN-special needs of students, T-technology, and D-dyslexia}. These codes were selected and used as they relate to Research Question 2. Each of the three emergent themes is supported by these codes and explained in detail below.

### **Traits of Students With Dyslexia**

During the interviews, the teachers discussed shared experiences in which they recognized common traits among students with dyslexia. The teachers also explained that technology in the classroom is an important teaching tool. The codes reveal the underlying meaning of this theme and are outlined below.

**Code D: Dyslexia.** During their interviews, Martha and Karen explained that dyslexia is a processing issue in the brain and it causes students to jumble up letters and syllables while

trying to read, write, and spell out words. The teachers described what dyslexia has looked like in their respective classrooms. In Javier's classroom, he described dyslexia as follows:

The person understands and processes information completely differently than a normal learner. Every single student I work with is different, different pace, different speed in working in my class, it is all unique, and I have found that the students I work with that have dyslexia tend to share similar requirements for extra time to work in and outside of class as well as greater foundational support in how I explain and show content to them.

Javier noted that the students he interacts with dyslexia need repeated verbal and visual cues to access and work with the content he teaches and assigns in class. The main distinction Javier identifies with students with dyslexia in his classroom centers around the need for additional work time and repeated exposures to new content and material.

The students Javier has taught with dyslexia have displayed shared characteristics of confusion or disorder of letters, trouble with processing reading and writing skills, and difficulty understanding assignments and tasks in class. I noticed that when asked to define and elaborate upon what dyslexia is, the other participants expressed similar details based upon their learned classroom experiences.

During the interviews, the teachers said students with dyslexia commonly share participation avoidance, as noted by Irene's experience. "They seem to use avoidance at times as they attempt to complete tasks, they are often easily discouraged when they do not understand," Irene explained. Martha and Javier explained that the students they teach with dyslexia take more time to complete assignments and often need further clarification when reading an assignment. Martha also explained that she has noticed in her experience the male students with dyslexia she has taught tend to have greater difficulty articulating their written thoughts than the female students. Martha elaborated:

I have not noticed specific abnormal or strange behavior from the dyslexic students I teach. I have noticed a hyper focus on reading from dyslexic learners in which they take much longer to read the text we cover in my class. Sometimes, I have also noticed that words are spelled how they sound, phonetically. The writing assignments I grade from dyslexic students are most noticeably areas of weakness, through problems with using vocabulary accurately, organization of the composition, and grammatical use.

Martha explained additional characteristics she has recognized in male students with dyslexia:

I also have noticed the male dyslexic students demonstrated a more abstracted and choppy writing style while the female dyslexic students I've taught could read, process and write much more clearly. I eventually learned to decipher the male students' writing style and I would often ask the male students to clarify with me after class and through email dialogue when I was not able to understand parts of their work.

In her teaching experience, Martha shared she is uncertain if some of these characteristics are coincidental or indicative of something else.

During his interview, Javier shared that the students he teaches with dyslexia tend to do well with open-ended assignments in which they are encouraged to explore and create a finished product. He has found that students with dyslexia tend to struggle with highly elaborate assignments that include multiple steps to complete the work. Javier remarked, "I use bullet points and visual examples to break down concepts further." In Javier's experience, simplifying information for students with dyslexia can be quite helpful while open ended, more creative assignments seem to engage these students to produce higher quality work.

Jane expressed concern during her interview that not all students with dyslexia appear to be properly identified. “Students can go underreported or untested for many reasons and as the teacher, I may not always know that a student I’m teaching has dyslexia.” Jane explained that she uses strategies to reach out to the students she teaches that have dyslexia through the technology she has access to. She elaborated further during her interview as to how she uses technology to reach these students in her classroom,

Technology plays an important part in the support of students in my classroom as they use it every day in my classroom. My students engage in coursework using their personal school issued laptops. We also work together on writing assignments as I will write on the computer board while the students work at the same time on their laptops. We share and discuss writing samples and pieces in this way which makes the process more visible and useful for students that need more visual support. Spell and grammar check features also assist my students on their writing products as they edit and revise their work. We research frequently in my class, using the laptops, and I have found that searching with key strategies in place online, helps students see and understand a bigger piece of the research process.

Jane expressed these thoughts as part of her approach to teaching. She encompasses a broad range of strategies to engage her students while attempting to support learners with dyslexia in this manner. She shared with me that she recognizes that through technology, she can reach out to many more students with online teaching support in and also outside of class time.

Tina and Trisha told me they have noticed that the students they teach with dyslexia tend to avoid participating in class, specifically when participation involves reading aloud. Tina and Trisha both remarked during their interviews that they have made efforts to check in verbally

with the students they teach with dyslexia to ensure they are on track. Both teachers remarked that frequent verbal check ins with students that have dyslexia has led to a more positive and inclusive learning dynamic in their classrooms. Martha also discussed how she provides clarification to the students with dyslexia she teaches. Martha explained:

I found the most helpful thing was to ask for verbal clarification from dyslexic students to understand them. The students I have taught that are dyslexic do not discuss dyslexia, if anything they cope and work very hard from what I can tell. They do not demonstrate an I can't kind of attitude in my classroom. From my observation, dyslexia does not seem to have hindered their success in school.

During her interview, Karen shared that the students she teaches with dyslexia need more time to read and write assignments; she has also learned these students produce more accurate, better assignments when they are able to access the text multiple times. Karen has learned that including audio versions and visual copies of all texts that she teaches has helped students with dyslexia with their reading and writing tasks. Karen indicated,

I've learned that students with dyslexia need more support with reading and writing through many exposures to the vocabulary and the text of the assignment we are working on. If I don't give these students extra support, I have noticed that they hesitate to participate or ask questions in class. A student with dyslexia characteristically needs greater and more repetitive access to text assignments. Audio versions of text are greatly useful to students with dyslexia. These students require more support with reading and writing through many exposures to the vocabulary and text of the assignment.

Karen believed it is a best practice to invest more time in planning strategies that incorporate additional reading and writing support for her students with dyslexia. In these

interview data, each participant provided some specific information about students with dyslexia. The participants were also able to characterize the students with dyslexia that they teach.

**Code SN: Special needs of students.** In Jane's teaching experience, collaborating with her students to learn online has put her into more of a supportive coaching role in her classroom. She told me that the level of connectivity and interaction she has achieved with her students has been especially useful for teaching her students with dyslexia. During writing units, Jane provides detailed feedback much more quickly to students to guide and support their progress. She types suggestions on to students' documents and discusses feedback with them in and outside of class due to the use of online classroom management and instructional delivery. Jane also said:

I see technology use in my classroom as a benefit to my students as it is such a big part of our world now, constant communication. My students' future progress requires that they become proficient with technology and learn to engage, interact, and communicate as well as possible online. I want to support that practice. I work to ensure that my students engage with technology always with a purpose, practice, and an opportunity to enhance their skills.

Jane saw her role as a 21st-century teacher as that of a companion and guide in learning for her students. She is concerned with staying on track with her understanding and familiarity with technology that will most benefit her students.

**Code TE: Teacher experience.** During the interviews, Javier, Irene, Jane, and Trisha indicated that from their teaching experience, students with dyslexia struggle with both reading and writing processes and assignments. Rick and Tina described their experiences working with students with dyslexia as a habit of switching letters and numbers around while reading and writing. Trisha and Martha said they have found through experience providing audio versions of



text to students with dyslexia gives these students the practice and extra time they need to understand the reading assignment. Rick characterized the students with dyslexia that he teaches as struggling at times with comprehension. During his interview, Rick noted:

Students with dyslexia read over the text more often to understand the content. Students with dyslexia experience confusion with they are trying to comprehend reading and writing assignments and tasks. They have difficulty understanding what they're reading and they struggle with the comprehension level of the texts we use in class.

In Rick's teaching experience, students with dyslexia have been more likely to engage with class and participate if they are given greater time and exposure to the assignment. He also explained that he takes time to clarify directions in his class both verbally and visually. Rick has learned that providing more than one style of guidance to his students tends to produce higher student involvement and better quality of work.

### **Technology as a Transformative Tool**

This theme emerged from the data set as I used the codes T-technology and SN-special needs of students in support of this theme. Analysis of data revealed that technology has transformed the teachers' classrooms. The teachers indicated that technology has greatly changed their classroom teaching and learning experiences. I learned that the teachers each have experience in using technology as a classroom tool. The codes reveal the underlying meaning of this theme and are outlined below.

**Code T: Technology.** During their interviews both Irene and Trisha commented upon their teaching experiences. They reflected that using technology with their students has transformed the classroom into an environment that encourages high levels of collaboration and engaging practice for the students. Both teachers explained during their interviews that they

have spent time learning how to interact with technology on their own laptops and planned specific course lessons using technology. Trisha explained,

I have made effort to continue to learn how to use technology to teach my students. In terms of best practice, I am always looking for new technology programs and software to use with my students. Technology is so relevant to my job, I always want to be sure I'm using the laptops with my students in the best ways possible.

I observed that technology is present in Irene's and Jane's classrooms. Both teachers have used technology to interact and connect with their students as part of instructional planning and teaching experiences. During her interview, Jane said:

In my classroom, technology is the central platform I use to teach my students on a daily basis. I use the platform Canvas in which all my course content is made available to my students to interact with every day in class with me and at home on their own. I have learned that supporting my students' learning through online instruction in alignment with my classroom lessons works well to support students in the learning process as they can practice and review what I teach them at home, away from the classroom with relative convenience.

Jane also stated during her interview that she finds technology in her classroom an especially relevant tool for teaching students with dyslexia. In her experience, Jane explained, the out of classroom access the students use to practice provides extra support they can use to understand and process the information she teaches inside the classroom.

I also observed that technology functioned as an inclusive digital learning tool for the teachers. Karen and Trisha shared Irene's experiences in using technology to connect with their students every day in the classroom. In Karen's experience, she noted during her interview that she has been able to incorporate high quality vocabulary lessons with the use of online resources

that allow her students to practice the terms and concepts she teaches in class. Trisha explained to me she has learned through experience. Providing audio content of the novels and stories she teaches has enabled her students with dyslexia to keep organized and on track with chapter due dates and related assignments.

Jane and Rick also said during their interviews that including technology in their classrooms has created an integrative digital space for them. Rick explained that he deliberately syncs instructional content online for his students and has moved to teaching fully online over the past couple of years. Jane explained she teaches entire writing and vocabulary units online. She indicated during her interview that she values this practice and experience as vital to her students' future learning and career experiences. Rick told me that he designs online course modules that integrate his major content themes with literacy and vocabulary objectives for his students. In Rick's experience, these modules provide students with self-guided learning support.

**Code SN: Special needs of students.** Martha saw significant inclusion of demonstrations and simulations as vital in supporting her students. She brought life-like simulations into her classroom with the use of online lab software and programs, explaining that

I like to support my students' learning with digital simulations in which they can see real world applications of the concepts I teach them on their laptops. These simulations create real time interactive experiences for my students that are rich and rewarding. The visual quality and reinforcement of the concepts I teach in class are better enhanced with the simulations my students complete.

Martha told me that she has found students tend to experience higher learning outcomes when they are directly engaged. Technology has enabled Martha to provide more of these experiences in support of her students. During her interview, Martha shared that she has also

learned that the amount of read aloud support and options for other audio software has been highly useful for her students with dyslexia.

During their interviews, Javier and Rick said technology is an important method for generating greater student support with the concepts they teach. Javier uses video content in his lesson to simplify the topics he teaches in class in support of his students. Rick uses text files to provide visual support for his students to work with online. Rick and Javier both expressed similar views in how they see technology as a learning tool that is meant to help students prepare for their future.

Tina told me that her students tend to be much more comfortable interacting with technology than she is. Tina shared that she has made some effort to learn more about how to teach using technology in her classroom, but she said she was underprepared and often only incorporates basic technology use, such as giving students online assessments or occasionally taking notes online. She explained that she does see benefits to including more technology into her teaching style but she was uncertain how to do so on her own. Tina explained that she would like to support her students through greater use of classroom technology. Tina stated,

The kids I teach know so much about technology, I feel like I'm always catching up to what they already know and understand. I do see a very positive relationship with technology and my students as they help each other during practice time in class on their computers. I think I want to learn more and use technology more, I do see benefits of course. I just sometimes feel like I don't know where to start. I have noticed how competent the majority of my students are in using their own laptops and devices. I want to catch up. I know it's important for their future to use technology. Some concerns I have are with the process of learning my course content through steps. I don't just want

kids Googling only the answer to a problem when they practice. I still want them to understand and do the practice part on their own.

During her interview, Tina also discussed concerns that students with dyslexia could use more specific means of support in her room, but she did not know how to change her teaching methods to support their learning requirements other than to break down problems, step by step, visually and verbally. These interview data suggest that the teacher participants are using at least some level of technology in their classrooms.

### **Frequent Interaction With Technology**

This theme emerged as I coded T-technology, and TE-teacher experience in the data set. Both codes supported the theme, frequent interaction with technology. Analysis of observation data revealed that the teachers used technology throughout their instructional teaching strategies. I noticed during the observations I conducted that the teachers interacted with technology with varying levels of comfort and experience. I analyzed the observation checklists (Appendix A) I used to assess the frequency of interaction with technology the teachers demonstrated. The codes I used to support this theme are outlined in greater detail below.

**Code T: Technology.** I observed Trisha and Karen using technology to drive student learning. During Trisha's entire observed lesson, she worked collaboratively with students to complete the discussion board assignment with them. During Karen's observed lesson, she coached students online, in intervals. Every 10 minutes of the lesson Karen checked their understanding and advanced to the next learning objective. Both these teachers were experienced. That is, I could see there was a high comfort level working online with the students in Karen's and Trisha's classrooms. I saw that students were engaged and on track with these two styles of online learning in Karen's and Trisha's classrooms.

I noticed the presence of technology in Rick's classroom is mainly that of an extension of a hybrid lecture style teaching method. Rick spent a few minutes guiding a focused, whole group discussion of the concept he taught during the observation session. Then, I noticed that Rick introduced the students to online content through a PDF he shared with the students and an assignment document that included instructions, examples, and vocabulary analysis questions. For the duration of the observed lesson, Rick's students worked online in collaborative groups to complete the assignment. Rick provided further support by checking in with each group during the lesson, at least one time. During this observation, technology served as a method to complete work that Rick created and shared with his students.

In Javier's classroom I observed that technology is fused into how the lesson information and ideas are introduced, shared, and explored with students. Javier spent time building up student interest in using verbal dialogue, some skits and role playing, and video clips on a large computer board. Javier then used technology to share bigger ideas with students to help them visualize what he is teaching in a way that led his students to consider new and creative ideas. I observed that there is a sense of purpose and active engagement on behalf of Javier's students. They seem to share enthusiasm for learning. Students were led to understand what Javier taught with enhancement from selected online video clips that closely aligned to the specific learning objectives of this class period. Javier appeared to motivate students to think and create with the aid of technology.

**Code TE: Teacher experience.** As I observed Irene, I noticed that her experience level in using a laptop and Smartboard appeared high. She was comfortable using these forms of technology to instruct and guide the students. In Irene's classroom, the lesson information was visible to students on a Smartboard. Irene had prepared the lesson content using an online document students followed during the observation session. Irene consistently modeled the

content for students verbally and visually with the aid of the Smartboard. Students were observed working online on the document that Irene was explaining to them. Irene constantly cued students verbally to engage with specific information on the document she referenced for them. Repetition of key points on this document also played a significant role in Irene's lesson.

I noticed during the observation that Irene used technology to introduce, guide, reference, and practice learning objectives with her students. Irene created four opportunities during the lesson for students to practice with her and then on their own. Irene's experience in modeling for students kept the lesson pacing well, and she interacted with many of her students during the lesson. I noticed that Irene uses technology to introduce, guide, reference, and practice learning objectives with her students.

Trisha and Karen both demonstrated experience in working cooperatively online with their students. This approach created greater active participation of students in both classroom settings. Both participants used verbal and visual cues as they delivered content and guided student practice time. Including technology in both classrooms reflected planning from both participants, and the style in which they kept students engaged through collaborative practice appeared familiar to students. Both teachers created classroom environments in which technology was used in tandem with quality teaching methods to deliver high-quality instruction to students.

#### **Chapter 4 Summary**

This chapter introduced the purpose of this study and the two central research questions. This chapter included a description of the sample in which each participants' detailed story was first described to the reader to provide some detail and context of each teacher. The selection of case study as the study methodology was also justified for the reader. A summary of the study findings was addressed, and a detailed presentation of the data and results was provided with in

depth information as to how data were collected and analyzed, step by step. The presentation of these data and results was organized by both research questions' emergent themes. The specific codes that were used to identify these themes were explained in detail. In Chapter 4 I presented the study data and results as an overview for the reader to see and understand what happened during data collection and analysis. In Chapter 5 I present the discussion and interpret the results and final conclusions for the reader.



## **Chapter 5: Discussion and Conclusion**

The purpose of Chapter 5 is to present the overall discussion of this study, the conclusions, and its implications. I present the key findings in as related to the literature discussed in Chapter 2 and through the lens of constructivism, the conceptual framework that grounded the study. Recommendations for future study and for practice, policy, and theory are presented as well.

### **Summary of the Results**

The study was guided by two central research questions:

3. How do the teachers of high school students with dyslexia perceive the use of digital technology to assist in the learning process?
4. What are the experiences of teachers who use digital technology to teach high school students with dyslexia?

These questions were created to address the topic of inquiry: high school teachers' perceptions in context of their working relationship with students who have dyslexia and teachers' attitudes toward the use of assistive technology in the classroom. The interview and observation sessions provided rich and descriptive information about this sample of teachers.

The results suggest that the sample of high school teachers perceived their students with dyslexia as individuals who benefit from teaching and learning opportunities with technology. The teachers indicated that they noticed how the students prefer to access course assignments and reading materials online and need more time and multiple exposures to learn, and technology appears to be providing this support. These characteristics were consistently described by the sample of teachers. Several teachers used technology daily in their classrooms. This frequent use of technology was not a consistent trend, though. Only some of the teachers used the online

learning management system, Canvas, to plan, post content, and interact with their students; other teachers used Canvas infrequently in their classroom.

Results demonstrated that at this site, high school teachers were somewhat aware of the needs of their students with dyslexia. Based on their experiences working with these students, the teachers were able to explain dyslexia as a learning disability. The results also suggest that this sample of teachers engaged with technology as a consistent teaching platform and as a classroom resource, and these teachers have attempted to collaborate digitally with their students to facilitate learning. However, the explicit use of assistive technology as a daily teaching tool, to benefit students with dyslexia, did not emerge from the whole group of teachers in the sample.

### **Discussion of the Results**

#### **Results: Research Question 1**

The first research question was, How do the teachers of high school students with dyslexia perceive the use of digital technology to assist in the learning process? The participants thought digital technology is useful for facilitation of content and development of instructional practice strategies. These results support the theme of technology as an instructional priority. Most of the teacher participants use technology as part of their daily classroom routine. The teachers also indicated that they would like to learn new methods for the technology they have access to in their classrooms.

The teachers expressed interest in learning more about how to use the text assist software Google Read & Write. They indicated they have had little to no training as to how this program should be used with their students with dyslexia. The teachers stated that they want to learn how to facilitate technology use with their students with learning needs, students with dyslexia, and other reading disorders.

In support of the theme technology as a support tool, the teachers stated that they use technology in their classrooms to assist students in the learning process. These results show that the teachers incorporated the use of technology to provide students with access to the content they teach from a variety of digital sources. They mainly used technology to support auditory and visual learning with the use of audio files and PDFs.

The teachers described students with dyslexia as individuals who struggle to read and write coherently. These results aligned with the perceptions teachers have of students with dyslexia as communicated in Chapter 2. They explained that they are attempting to support these needs of students with dyslexia with the use of technology. The participants characterized students with dyslexia as individuals in need of developed coping skills and additional support to succeed in their classes. The teacher participants stated that technology has enabled their students to interact with technology in a more personalized manner.

The theme of technology as an asset emerged from the way the teachers used collaborative online learning strategies with their students in their preferred styles of teaching as facilitators. The results show that the teachers work with students online and act as facilitators and learning coaches. The teachers act in this capacity, due to the flexibility that technology has provided for them.

### **Results: Research Question 2**

The second research question was, What are the experiences of teachers who use assistive digital technology to teach high school students with dyslexia? The teachers had used digital technology as a learning tool, which had transformed their classrooms. These results support the theme of technology as a transformative tool. The teachers' experiences with digital technology shaped their instructional decisions in teaching and changed many of their instructional strategies.

I observed each teacher using classroom technology. Several participants used online technology with their students specifically to support audio and visual learning. The software program Google Read & Write (a text to speech application) and Texthelp were being used in a few of the teachers' classrooms. These teacher participants facilitated online learning based on experiences working with students to achieve learning outcomes. These results indicate that the teachers are attempting to use digital technology to facilitate learning with their students.

The theme of traits of students with dyslexia was supported as the teachers recognized a need for more time to process new concepts and complete assignments for their students with dyslexia. The teachers identified other characteristics of students with dyslexia who they teach, including additional visual and auditory support and the need for multiple exposures to text assignments.

The theme of interaction with technology was revealed through the teachers' use of digital technology; most of the participant group offered online visual and auditory supports for their students. This use of digital technology suggests that the teachers provided their high school students with multiple methods to access and practice the content they were learning in class.

In sum, technology was an integral tool for teaching and learning during class time and outside of class. Teachers created and posted digital supports for their lessons online for students to use. They were observed leading guided instruction on websites and digital documents during several lesson sessions as methods for instructing students. Learning supports in the teachers' classrooms included Canvas, Google documents, and Google Read & Write. These specific learning supports provide both visual and auditory aid for students and suggest that the teachers using these tools are deliberately providing greater online support.

## **Discussion of the Results in Relation to the Literature**

Online learning has become deeply embedded in 21st- education (Chen & Keong, 2016; Handler 2016). There is a need to create inclusive online learning communities that foster independence and success for all students to actively engage in their studies both comfortably and productively (Handler; 2016). Using assistive technology tools and applications may provide a personalized approach to supporting students with dyslexia (Nasen, 2017), as these students are graduating high school and moving into postsecondary education settings in greater numbers. The participants communicated understanding of the prevalence of digital technology in education, acknowledging that technology use is quickly becoming an expectation in the classroom. Technology can be used in many viable means by teachers and students (Sullivan & Sahasrabudhe, 2017) and is becoming steadily more personalized (Alghabban et al., 2017). The need for quality instruction using digital technology in high school would support this transition in which students with dyslexia prepare to attend college and university settings. The largest group of students with disabilities attending postsecondary education are students with learning disabilities, including dyslexia (Perelmutter et al., 2017). These students may experience greater success in learning with the use and familiarity of assistive technology that can help them access and comprehend written content.

The teachers described a willingness to use technology with greater intention and a high level of interest in learning how to do so through professional development and training sessions. The participants indicated they would like to have some guidelines that promote a supportive learning environment for students with dyslexia in their classrooms, guidelines that encourage digital competency for students through the use of technology applications, and tools that promote greater learning outcomes. The use of digital technology should actively involve the learner (Nasen, 2017; Soriano-Ferrer & Morte Soriano, 2017). Teachers explained they would

like to use digital technology with their students as a platform to collaborate and interact with learning objectives. These characteristics are indicative of a profile in dyslexia, in which the learner's self-esteem is built up through positive experiences in learning (Nasen, 2017). These results suggest that the participants currently value digital technology in their classrooms but feel inadequately trained to facilitate digital learning for their students.

The processing speed and acquisition of language skills is slower in students with dyslexia and contributes to difficulty in completing reading and writing assignments for these learners (Arnett et al., 2017; Kouroupetroglou et al., 2017). The teachers expressed interest in learning new methods for teaching students with dyslexia using technology that provides language support in their classrooms. The results from interview sessions with the participants indicated that the participants do attempt to provide visual and auditory support for their students as they post PDF and audio file links online for their students to use. However, the participants explained they would like to learn about technology apps and tools that may provide greater support measures for students with dyslexia. Consideration of the preferred learning styles of students with dyslexia may provide greater support in personalized online learning for these students (Benmarrakchi et al., 2016). The participants indicated some interest in inclusive strategies they could use to promote more individualized online learning for their students with dyslexia. These results indicate there is a need for teachers to learn more about the cognitive and characteristic profiles of the students with dyslexia they teach to provide more specific and effective language instruction for these students.

Dyslexia is one of the most common learning disabilities and is described as a language disorder that characteristically creates difficulty in learning to read (Benmarrakchi et al., 2016; Handler, 2016; Soriano-Ferrer & Morte-Soriano, 2017). Participants demonstrated some knowledge of the condition of dyslexia but were mostly unable to discuss in any detail specific,

instructional strategies they employ to specifically benefit students with dyslexia beyond basic inclusion of PDF files and some audio formats of content in their classrooms. These results indicate there is a need for teachers to learn current, specific methods for teaching students with dyslexia in their classrooms.

### **Limitations**

Limitations are reflective of areas of potential weakness in a study (Simon, 2011). This study was limited to only the perceptions and experiences of a small sample of high school teachers at one school site. This sample did not represent all high school teachers and, therefore, is bound to only the information and experiences that the participants within the study sample provided. The accuracy of each participants' contributions depended on the overall willingness of each participant to respond honestly and fully.

### **Study Design**

The information I gathered and analyzed during this qualitative case study was limited by the specific interview questions I asked and the specific criteria I observed in their classrooms. Data were collected via face-to-face interview and observation sessions of each teacher participant. I collected, analyzed, and reported all data, thus limiting their interpretation by my own experience as a novice researcher.

### **Participants**

The study participants consisted of only eight high school teachers who worked in one North Carolina high school and who used technology and taught students with dyslexia. The study design yielded a unique set of data through the observation and interview sessions I conducted in the field. The information generated from the teachers during these sessions reflects only each participant's life experiences, not those of other high school teachers.

## **Research Method**

The research method was limited to a qualitative case study design. The study was designed to explore the phenomenon of the perceptions of teachers who use digital technology to teach high school seniors with dyslexia. This phenomenon is unique to specific human experience and therefore limited to the specific experiences of only the eight high school teachers. Though the purpose of a case study is to uncover how to better understand a relevant phenomenon in which the situation is not clearly defined (Hatch 2002; Yin, 2003; Zucker, 2006), the results of the study are not able to be generalized as the basis for all high school teachers' perceptions.

## **Data Collection**

These data were also limited in scope, as the information came from only one small group of teachers. The teachers in the sample served as the driving force of the case study (McMillan, 2012). These data account for the shared and observed experiences of this group of teachers. The time I spent collecting data presents another limitation. I collected observation data in each teacher's natural setting. This was limited to only single 45-minute increments in which the teacher and the group of students worked. The behavior of the teacher and students during each of these observation sessions is limited to what these individuals demonstrated during my time in the classroom and may not be fully accurate to a regular class session, as my presence was not normal to the classroom environment.

An additional limitation relates to the amount of time I spent in the field. The time I spent interviewing each teacher and later member checking their interview responses only accounts for 1.5 hours per teacher. These small increments of time are not able to substantiate any long-ranging information that could account for a greater depth of understanding. I did not work with the teachers beyond this specified time frame, as my research design has described.



Therefore, the interview and observation information I collected and analyzed is limited as well. The time I spent analyzing these data collected from interview and observation sessions was limited to a 4-month time frame in which I relied upon a typological analysis (Hatch, 2002; Harding, 2013) to compile these data. The data analysis procedures I followed did not exceed this time frame and are therefore limited.

### **Implications of the Results for Practice, Policy, and Theory**

In this section I discuss the implications of the results in the context of practice, policy and theory. I relate the results to the conceptual framework, constructivism, and explain implications of this study in relation to practice and policy in connection to the literature.

#### **Practice**

The gap in practice explored in this study is indicative of the need to understand the role and influence of assistive technologies as they are employed in the classroom. Digital technology is providing many new opportunities for people with learning disabilities (Kouroupetroglou et al., 2017). The teacher participants had access to digital technology in their classrooms to teach and interact with their students. However, as the results of this study indicate, they do not feel adequately trained to use the technology in their classrooms to full advantage for students with dyslexia. The teachers expressed some concern that a lack of professional development and training is preventing them from providing the instructional support students with dyslexia need in accessing new content and constructing new meaning of information (Callens & Tops, 2012; McCormack-Colbert et al., 2017).

The teachers are using their experiences as educators to inform the decisions they make on how to teach and support their students, yet they did not communicate high confidence that their use of digital technology is currently reflective of best practice in their classrooms. To assume that merely giving teachers access to newer digital technology is sufficient is a problem.

Teachers require training and instructional support to effectively use digital technology as a teaching platform (Chen 2017; Handler, 2016).

### **Policy Makers**

Though the results of this study in no way represent all high school teachers who use digital technology in their classrooms and teach students with dyslexia, this case study does indicate that this sample of teachers want to learn how to use digital technology more effectively in their classrooms. As more schools continue to shift toward technology-driven curriculum and teaching methods, from a policy viewpoint it would be in teacher's best interest for districts and policy-makers to include professional development and instructional support for teachers to effectively implement technology in their classrooms. At this location, I recommend that teachers first complete a survey in which they can better describe the areas of technology they are most interested in receiving additional training and support. Teachers should then be given the opportunity to attend training sessions that reflect their selected areas of need in using technology most effectively in their class to support student learning. These teachers indicated that they are willing to learn how to use technology to support students with learning disabilities and would benefit from professional development that provides technology training.

### **Constructivist Theory**

The results of this study suggest that the teacher participants are actively making meaning of the digital instructional learning experiences they are providing for their students with dyslexia. The teachers are building their knowledge of these experiences based on their own learning and perceptions they have acquired as educators. In relation to the conceptual framework of this study, constructivist theory, the teachers are making meaning, based on their own experiences. Constructivist theory emphasizes learners' active participatory role and the heightened recognition given to the social nature of learning (Liu & Matthews, 2005).

Constructivism encompasses the idea that learners build knowledge from within an individual perspective (Qiong, 2010) and that the meaning of this knowledge is derived from the process of personal attempts in learning. As the data and results from this study demonstrated, the teachers continue to make meaning of their own experiences.

However, based on the findings, participating teachers were not receiving the amount of instructional training and professional development they thought are required to maximize their facilitation of online learning for their students. The teachers expressed some concerns that they are not teaching their students with dyslexia as effectively as they would like. These concerns, according to the teacher, were linked to a lack of professional development opportunities.

Learners with dyslexia require precise orthographic skill to code, map, and make meaning from phonological information; this process is not automatic or synchronous to the introduction of new content (Taub, 2011). The teachers expressed interest in learning methods and strategies to introduce and reinforce content in ways that help students with dyslexia make meaning.

### **Recommendations for Further Research**

#### **Areas of Improvement**

Areas for improvement of this study for future researchers include additional interview and observation sessions, over an extended period of time, to gain a more detailed interpretation of a population of teachers' perceptions and experiences. A future replication of this study would benefit from a semester or yearlong field schedule in which the teachers are each interviewed and observed several times. The extended time spent to collect more frequent observation and interview data could generate a much richer portrayal of this approach to case study design. A replication of this study may also consider the benefit of a similar approach to the sampling method in perhaps a larger site in order to work with more participants.

## **Participants**

More participants in this case study may also lead to outcomes that could be of greater interest to more community members, such as other teachers. As for data analysis, an interpretive framework (Hatch, 2002) may provide a more holistic outcome than the typological framework I used. A more holistic framework may support themes and ideas that remained elusive under the typological analysis procedure. These recommendations may lead to a richer, more detailed case study experience in which more participants' responses are included in the discussion.

## **Additional Recommendations**

Additional recommendations include opportunities to study the perceptions and experiences of students with dyslexia, in addition to studying teachers' perceptions and experiences as in this study. The collaborative partnership between teachers and students is changing (Sullivan & Sahasrabudhe, 2017). Teachers and students are interacting with digital technology in new and changing ways and the outcome of these experiences is important to consider in context of twenty first century education. A qualitative case study that examines the experiences and perceptions of students who are interacting with digital technology and have dyslexia may provide key insights of value to the greater community of educators. The way that students and teachers interact with technology to learn is shifting (Sullivan & Sahasrabudhe, 2017), and the perspective of students is an important part of this discussion.

An additional important recommendation for future study also includes a quantitative methodological approach in which data related to this study are collected and examined to yield new results through statistical and survey-driven data. This approach may take the study into an entirely different direction, in which more information may be examined from a much greater sample.

## **Conclusion**

This chapter has discussed the results of the study in greater detail and in context of both central research questions. The teacher participants perceived students with dyslexia as individuals in need of greater language and instructional support. The teachers experienced digital technology as a useful instructional and planning tool in their classrooms. They also experience digital technology as a tool that requires greater access to professional development to be effective in their classrooms. These high school teachers considered and recognized the students they teach with dyslexia but did not think they were adequately trained to use technology applications and tools to support these students' learning outcomes more deliberately. This dissertation has addressed a gap in practice in which the conceptual framework of constructivism was embedded to study the perceptions and experiences of high school teachers who use digital technology and work with students that have dyslexia in greater detail. The methodology of qualitative case study was designed to learn more about this group of teachers to provide their story in greater detail.

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## Appendix A. Observation Checklist

Participant- \_\_\_\_\_ Setting- \_\_\_\_\_

Date/Time- \_\_\_\_\_

**# of dyslexic students:**

**Overview (teacher perception- students with dyslexia- assistive technology)**

Instructional style-

Technology use-

Assistive technology tools-

Interaction with class-

In what manner are objectives; introduced, explained, and taught through use of technology?

How are student with dyslexia being supported {multiple exposures; visual cues, auditory and visual supports }

| <b>Technology</b>        | <b>Visibility</b> | <b>Y</b> | <b>N</b> |
|--------------------------|-------------------|----------|----------|
| Vocabulary-              |                   | _____    | _____    |
| Literacy support -       |                   | _____    | _____    |
| Visual aids-             |                   | _____    | _____    |
| Verbal direction-        |                   | _____    | _____    |
| Check for understanding- |                   | _____    | _____    |
| Insights-                |                   | _____    | _____    |
| Questioning-             |                   | _____    | _____    |

| <b>From the teacher's instruction</b> | <b>Use</b> | <b>Y</b> | <b>N</b> |
|---------------------------------------|------------|----------|----------|
| Vocabulary-                           |            | _____    | _____    |
| Literacy support -                    |            | _____    | _____    |
| Visual aids-                          |            | _____    | _____    |
| Verbal direction-                     |            | _____    | _____    |
| Check for understanding-              |            | _____    | _____    |
| Insights-                             |            | _____    | _____    |
| Questioning-                          |            | _____    | _____    |

**Reflection:**



## **Appendix B: Interview Questions**

### **Interview Questions (teacher's perceptions about students with dyslexia)**

- Describe what you know and understand about dyslexia.
- What specific characteristics or behaviors have you noticed from students with dyslexia in your classroom?
- How do you use technology to engage students with dyslexia in your classroom?

### **Interview Questions (teacher's perceptions about technology)**

- Tell me about your personal views concerning the use of technology in your classroom.
- Explain how technology use is meant to assist and support the students you teach.
- Describe the relevancy of the use of technology within your own lesson planning and instructional practice.
- Describe the benefits and areas of concern you have concerning the use of technology in your classroom.

### **Conclude the interview session**

- Do you have suggestions about any additional topics or ideas related to today's interview content?

Thank you.

### **Reflection**

## Appendix C: Informed Consent Documentation

### CONSENT FORM

**Research Study Title:** How High School Students With Dyslexia Use Assistive Technology: A Teacher's Perspective.

**Principal Investigator:** Tara Granzen

**Research Institution:** Concordia University- Portland

**Faculty Advisor:** Heather Miller

### **Purpose:**

The purpose of this study is to learn about how high school teachers perceive students with dyslexia and how they use technology with these students. I expect to work with approximately ten teacher volunteers. No one will be paid to be a part of the study. Enrollment will begin June 20<sup>th</sup>, 2017 and end June 30<sup>th</sup> 2017. To be in the study, you will need to have recent experience teaching high school students with dyslexia. You will also need to use technology in your classroom on a fairly regular basis.

### **What you will be doing:**

First, you will be observed during one session and later interviewed during two face-to-face sessions. The observation will be documented with a checklist and notes. You will also be interviewed. The interviews will be audio taped. The findings of the study will be provided to you upon request.

### **Risks:**

There are no risks to participating in this study other than providing your information. However, I will protect your information. Any personal information you provide will be coded so it cannot be linked to you. I will not identify you in any publication or report. Your information will be kept private. All documents will be destroyed 7 years after I conclude this study.

### **Benefits:**

By participating in this research study, you will share information, which may be used to better understand how teachers work with and understand students that are dyslexic and how these teachers use assistive technology in the classroom.

### **Confidentiality:**

This information will not be distributed to any other agency and will be kept private and confidential. The only exception to this is if you tell us abuse or neglect that makes us seriously concerned for your immediate health and safety.

**Right to Withdraw:**

Your participation is greatly appreciated. However, you are free at any point to choose not to continue. You may skip any questions you do not wish to answer. This study is not required and there is no penalty for not participating.

**Contact Information:**

You will receive a copy of this consent form. If you have questions you can talk to or write the principal investigator, Tara Granzen (email tara.granzen@xxxxxxx).

If you want to talk with a participant advocate other than the investigator, you can write or call the director of the institutional review board, Dr. OraLee Branch (email obranch@cu-portland.edu or call 503-493-6390).

**Your Statement of Consent:**

I have read the above information. I asked questions if I had them, and my questions were answered. I volunteer my consent for this study.

\_\_\_\_\_  
Participant Name \_\_\_\_\_ Date

\_\_\_\_\_  
Participant Signature \_\_\_\_\_ Date

\_\_\_\_\_  
Investigator Name \_\_\_\_\_ Date

\_\_\_\_\_  
Investigator Signature \_\_\_\_\_ Date



Investigator: [Tara Granzen] email: [tara.granzen@xxxxxxx.org]  
c/o: Professor: [Heather Miller]  
Concordia University – Portland  
2811 NE Holman Street  
Portland, Oregon, 97221

#### **Appendix D: Steps of Typological Analysis (Hatch, 2002, p. 153)**

1. Identify typologies that will be analyzed.
2. Read the data, marking entries related to the identified typologies.
3. Read entries according to typology.
4. Record the main ideas in these entries on summary sheets.
5. Read the data and code entries according to patterns identified.
6. Keep a record of what entries go with which elements of the patterns.
7. Decide if patterns are supported by the data sets: search the data for non-examples of these patterns.
8. Look for relationships among patterns that have been identified.
9. Write patterns as one-sentence generalizations.
10. Select data excerpts that support generalizations.

## **Appendix E. Coding - Code Bank**

TP- teacher perception

TE- teacher experience

TA- teacher assumption

AT- assistive technology

T- technology

SN- special needs of students

## Appendix F. Preliminary Site Permission

March 21<sup>st</sup>, 2017

To Whom It May Concern,

Tara Granzen has site permission and access to teachers for her research. Please contact me if you need any further permission or clarification.

Thank you,

Xxxx xxxxxx  
High School Administrator  
xxxx.xxxxxx@xxxx.org  
xxx-000-00000

## **Appendix G. Introductory Email**

Hello fellow teacher,

My name is Tara Granzen and I am a doctoral student currently working on a research study through Concordia University-Portland. I am working on a case study in which I would like to learn more about how high school teachers use technology to engage with students that are dyslexic. I am emailing to ask if you would like to participate in my study. I will be conducting observations and interviews with high school teachers. Participation is completely voluntary and your answers will remain anonymous. If you are interested, please let me know as soon as possible.

Respectfully,

Tara Granzen  
Tara.granzen@xxxxxxxx.org  
[Researcher phone redacted]

## Appendix H. Readability Calculator Results

### CONSENT FORM

Text Readability Consensus Calculator Results

Link- readability calculator used- <http://www.readabilityformulas.com/freetests/six-readability-formulas.php>

Your Results:

Automated Readability Index: 8.6

Grade level: 13-15 yrs. old (Eighth and Ninth graders)

### RECRUITMENT EMAIL

**Text Readability Consensus Calculator Results**

Link to readability calculator used <http://www.readabilityformulas.com/freetests/six-readability-formulas.php>

Your Results:

Automated Readability Index: 8.9

Grade level: 13-15 yrs. old (Eighth and Ninth graders)



## **Appendix I: Member Check Questions**

1. Have I presented your responses fairly?
2. Have I presented your responses accurately?
3. Is there anything else you would like me to add to your responses?

## **Appendix J. Data Coding, Collection, Analysis**

In the following sections, I first explain the coding steps I used. Then, I explain how I collected interview and observation data in the field, in greater detail. What was done with these data once collected was slightly different than what I proposed. In these extended sections, I will explain these slight differences and how data were analyzed using the typological framework (Hatch) for all data collected. This information builds upon what I presented in the Research Methodology section of Chapter 4.

### **Coding**

This study began with a dual focus on two topics; assistive technology and dyslexia. From these topics, a series of key word search terms was created to retrieve reference material from peer reviewed journals. An analysis matrix was utilized to categorize and interpret reference information taken from the peer reviewed journals. Two central research questions were also developed at this stage, to anchor the investigation of the study. The search attributes, key concepts, and conceptual frameworks for each peer reviewed journal were included within the analysis matrix to distinguish patterns of information related to assistive technology and dyslexia. The information that I included within the analysis matrix was then developed into the main content of chapter two, the literature review. In the literature review, I learned about assistive technology and dyslexia in greater detail. After a review of Hatch (2002) and Harding (2013) concerning typological framework and coding techniques, I developed a code bank (Appendix E) directly related to the typological categories of technology usage and perception related to assistive technology and dyslexia. The code bank I created and used to analyze interview and observation data was in direct alignment to both central research questions.

A typological framework (Hatch, 2002) was selected in which I divided observation and interview data from the narrative summary sheets I created into categorical groups, which I

based on preset typologies {TE- teacher experience, T-technology, SN-student needs, AT- assistive technology, TP-teacher perception}. Each typological category was linked to the research questions and to theory (see Appendix D). I used these preset typological labels that I created while writing the literature review to serve as my code bank. These codes link directly to the topics that I discussed in greater detail in the chapter two literature review and also relate directly to both central research questions of this study.

### **Data Collection**

I collected data in three ways. First, I conducted face to face interviews with the teacher participants. Second, I completed observation sessions of the teacher participants in their classrooms. Third, I completed member check sessions with the teacher participants during their instructional planning times to review their interview and observation data with me, and to check for accuracy in how I interpreted the information.

### **Interview Data**

I collected interview data from the teacher participants during prearranged, forty-five minute interview sessions. During these sessions, I recorded audio files of each interview using Quicktime media player. I also took notes in my researcher's journal as I listened to each participant's interview responses. I wrote clarifying statements in which I summarized what the participant said during the interviews, to help me process meaning from each response. For example, when Martha went into greater detail about online simulations she used with her students, I wrote in my journal that though simulations appeared to be important to Martha, the essential information I learned from her detailed answer was that she felt the visual features of the simulations she used for her students helped them to see and experience the concept much more fully. My clarifying statements, such as this example, appear in sentence form on each page of notes I recorded by hand during each recorded interview session. This step assisted me

in processing the information at the time of interview and also later as I completed data analysis. I used interview questions (see Appendix B) directly related to both research questions to facilitate each interview session in the same order. I asked follow up questions during the interview sessions, including “I understand what you mean, can you give me an example from your experience?” and “Tell me more about your view,” in reference to each topic that was covered in the interview question set related to teacher perception. I used additional clarifying statements with some of the teacher participants during the interview sessions in order to better understand their answers at the time such as, “From what I am hearing, you mean,” and “Let me see if I understand what you mean.” I used clarifying statements and follow up questions during the interview sessions to help build my understanding and clarity of the participants’ responses, as provided during the interview process in relation to both research questions.

### **Observation Data**

I collected observation data from the teacher participants during prearranged forty-five minute observation sessions in their respective classrooms. During each observation session, I sat at each participant’s desk and used my researcher’s journal to record descriptive notes into the comments section that I included on the Observation Checklist template I created (Appendix A). For example, during an interview I noticed the teacher consistently modeled the assignment expectations the students were completing in a style I had not observed. I wrote out my reaction to her collaborative method of teaching with her students on the observation checklist copy I used during her session and wrote my immediate reaction in a couple of sentences in the comments section to help me process and later recall what I observed. I used this observation checklist (Appendix A) featuring content related to both research questions and specified topics from the literature within Chapter 2 related to assistive technology and dyslexia. I used digital

copies of the observation checklist template on my laptop and filled in the checklist template and typed notes while I observed each teacher in their classroom.

### **Member Checking**

I later shared my observation and interview notes with the teacher participants during brief conference sessions in which I met with the teachers during their planning times. During each member checking session, I took time to discuss the information taken from both the interview and observation session with each teacher. This was done to check for accuracy of my interpretations of their responses and to verify what I had observed in their classrooms aligned with each teacher's experience during the observation session. These member checking sessions were completed to triangulate the set of data, to provide greater validity to the study. The format of each member checking session was conversation oriented between myself and each teacher participant and I used a brief series of questions to help clarify what was discussed during each member check session (Appendix I).

### **Data Analysis**

I used typological analysis steps (see Appendix D) to analyze these data I collected (Hatch, 2002). In following the typological analysis steps I focused on identifying and organizing the information I collected, based upon patterns and relationships within these data. The patterns and relationships present within these data will be presented after I explain how I completed the typological data analysis steps in detail. I triangulated these data using the constant comparative method (Harding, 2013) as I constantly examined the interview and observation data during analysis.

## **Interview Data**

To analyze the interview and observation data I collected, I first began with transcription of each interview audio file. I transcribed this information by typing up each interview session as I listened carefully to each audio file recording of the interview sessions. Each file's information was transcribed onto a document on my laptop and saved. After I completed typing the transcription of each interview audio file, I read over each interview transcription document and then typed a one page narrative summary in which I simplified each participant's full data set into a concise, cohesive story. For example, I compiled the pages of Javier's detailed responses to the set of interview questions I asked him into one page, a narrative that simply highlighted his specific views and experiences with technology and the students he teaches with dyslexia. The purpose of the narrative summary was to tell each participant's story in context of both their perceptions and experiences related to both research questions. I included only information from the transcription that told the story of both research questions, central to my study; the narrative summary information was included that related to each participant's views and experiences concerning technology in the classroom and teaching experiences with students with dyslexia. I then coded each narrative summary sheet using a code bank I created (see Appendix E) to view and process the summary sheets, using typological analysis (see Appendix D). I followed the steps of this analysis procedure to better understand each set of participant interview data. As I worked through the narrative summary sheets using my code bank and the typological analysis procedure steps related to identification of patterns and relationships, I compared my findings within the entire data set of the interview transcriptions. I looked for patterns within each participant's narrative summary and then compared the set of participant summary sheets to examine commonalities within the entire interview data set.

## **Observation Data**

To analyze the set of collected observation data, I first carefully read and reviewed each participant's observation checklist. After observation sessions were completed, the checklists (see Appendix A) had each become quite lengthy and required extensive reading and review. I typed one page narrative summary sheets of each participant's observation checklist data. The purpose of the narrative summary sheet at this stage was to present a clear, cohesive story of what it was like in each participant's classroom, as I learned from their teaching experience in context of both research questions. I coded each observation narrative summary sheet using the same code bank I created (Appendix E) to view and process the summary sheets in context of typological analysis (Appendix D). I then followed the same steps of this analysis procedure to better understand this observation data. As I worked through the narrative summary sheets using my code bank and the typological analysis procedure steps related to identification of patterns and themes, I again compared my findings within the greater observation data set. I identified patterns within each participant's narrative summary and then compared the set of participant summary sheets to examine commonalities within the complete observation data set. The steps I followed for analysis of the interview data was also followed for analysis of the observation data.

Upon completion of these steps of data analysis of the observation and interview information, I began writing the larger story of the data set in which I worked to communicate what these data sets mean. I organized this information by first describing the participant group then relaying the presentation of these data by explaining the emergent themes and patterns that were identified during the analysis process and became the framework for the study findings.

## Appendix K. Statement of Original Work

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University-Portland Academic Integrity Policy during the development and writing of this dissertation.

2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly referenced. All permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association*.

Tara Granzen

(Digital Signature)

Tara Granzen

(Name)

05/09/18

(Date)