Case Study: Examining Perceptions of Students with Low Vision in online Courses

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ABSTRACT

CASE STUDY: EXAMINING PERCEPTIONS OF STUDENTS WITH LOW VISION IN ONLINE COURSES

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Department of Educational Technology, Research and Assessment
Northern Illinois University, 2020
Cindy York and Faith Demir, Co-Directors

This qualitative case study explored the most helpful accommodations for students with low vision in online courses. Utilizing online surveys and individual interviews, this case study took place at a U.S. public university in the Midwest. The theoretical framework for this study was Universal Design for Learning (UDL). The findings indicate that students with low vision prefer receiving text and audio information. Additionally, the findings showed that extended time was the most helpful accommodation, alternative formats for materials, headings, and color-contrasting for online content were the most helpful accessibility aspects, and screen readers were the most helpful assistive technology. The findings also reported the participants’ perspectives about including audio-recorded PowerPoint lectures and adding audio features for the discussion boards. Moreover, the participants suggested the instructors should record video to deliver online materials. These findings are significant because they will help instructional designers and online instructors design effective online courses and provide accommodations with the appropriate support that students with low vision need to be successful in online courses.
CASE STUDY: EXAMINING PERCEPTIONS OF STUDENTS WITH LOW VISION IN ONLINE COURSES

BY

ASMA MARGHALANI
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL TECHNOLOGY, RESEARCH AND ASSESSMENT

Doctoral Co-Directors:
Cindy York and Fatih Demir
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To all the participants in this case study, you gave me an understanding of your perceptions and accommodation needs. Without you, there would be no dissertation.

My graduate school friends need to be thanked for their support as well. Abier Akiery and Rania Kokandy, thanks for always being there (and on trips) no matter what.
DEDICATION

I dedicate my dissertation to my parents, Fuad and Sarah. They have believed in me and supported my endeavors throughout my life. Every moment I wanted to give up when I faced challenges, they inspired me to continue by saying, “We will pray for you, so just keep trying, we know you have the courage and strength to accomplish your goals.”

A special gratitude to my sisters and brothers: Abdullah, Ohood, Ibrahim, Razan Mohammed, and Moyad. Thank you all for supporting me through this journey and for giving me the encouragement I needed to complete the degree. I would not be who I am today without the love and support of my family.
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CHAPTER 1
INTRODUCTION

In the last two decades, due to flexibility and accessibility, online courses are becoming increasingly popular among non-traditional students and learners who have (in)visible disabilities (Gordon, 2014). Students with disabilities need support, particularly students with low vision need special accommodations in online courses because they have some difficulties dealing with the technologies (Corn, 2018; Crow, 2008; Fichten et al., 2009; Summers et al., 2014). Universal Design of Learning (UDL) provides several accommodations for postsecondary students with low vision through using assistive technology and providing a variety of accessible features for this type of vulnerable population (Crow, 2008). Relevant research shows (Corn, 2018; Lorenzin & Wittich 2019; Okiki, 2019) that low vision students will succeed academically when they take online courses with proper accommodations. To explore which types of accommodations, based on the UDL principles, are deemed appropriate for online settings, this qualitative study seeks to understand the perceptions of students with low vision.

This introductory chapter examines relevant information on online courses and synthesizes literature on the specific needs of this population of students. The initial literature review has revealed a lack of empirical research on accommodations for students with low vision in online courses. In an attempt to fill the gap in the existing literature, this study highlighted
the significance of the research on specific types of accommodations for students with low vision who have experience with online courses. Universal Design of Learning (UDL) served as the theoretical framework, and the three research questions were formulated to guide the study. This chapter also includes the limitations, delimitations, assumptions, and definitions of the main concepts.

Background

Online courses attempt to create a type of learning environment and serve as a process of connecting students, instructors, and learning resources when they are not physically present in the same location (Park & Choi, 2009). In 1997, the first online course platform was launched at famous universities, such as Yale, Cornell, and University of Pittsburgh. In the same year, a Learning Management System (LMS) known as Blackboard™ was founded and has become widespread to deliver online instruction and it is still utilized in many educational institutions and universities across the globe (Morton, 2016). Online courses use asynchronous and synchronous technologies. Synchronous technology requires students and instructors to work at the same time but not in the same place through using video conference (Palmer, 2012). In contrast, asynchronous technology does not require students and instructors to work at the same time (Palmer, 2012). They can work independently at a convenient scheduled time for each of them.

In the last three decades, online courses have significantly increased in higher education (Betts et al., 2013). Recently, 30% of postsecondary students are enrolled in at least one online course in one of the U.S higher education institutions (Cole et al., 2014). Although the number of online courses has increased, students with disabilities enrolling in institutions of higher
education have also increased over the last twenty-five years (Lyman et al., 2016). Cook and Gladhart (2002) stated that 10% to 15% of postsecondary students identify themselves as disabled. While higher education has attempted to make online courses more effective and accessible for all students, some instructors and/or institutions may overlook the needs of students with disabilities (Kharade & Peese, 2012). According to the American Disabilities Act (ADA), a disability is a physical or mental impairment that substantially limits one or more major life activities. To be labeled as disabled, a person must have a history or record of such an impairment, or a person should be perceived by others as having such an impairment. These self-identified students with disabilities should have equal opportunities in their online courses as other students.

Low vision is a common type of visual disabilities (Richardson, 2014). It is defined as the functional limitation of the eye or eyes or the vision system (American Foundation for the Blind, 2015). The American Foundation for the Blind (AFB) defines low vision as a condition caused by eye disease in which visual acuity is 20/70 or poorer in the better-seeing eye and cannot be corrected or improved with regular eyeglasses (AFB, 2015). Students with low vision usually have several academic difficulties (Moola, 2015). One of these difficulties is using technology because sometimes they cannot adjust technology according to their needs. Consequently, the emergence of online courses has brought challenges for students with low vision (Argyropoulos et al., 2019; Summers et al., 2014).

Literature on the experiences of students with low vision is scarce, and most seminal articles focus on students with disabilities without specifying the type of disability (Lorenzin & Wittich 2019; Okiki, 2019). However, some relevant studies (e.g., Lee & Oh, 2017; Richardson, 2014) had observed that students with low vision are not often active in online courses due to the
challenges they face in interacting with learning materials. On the other hand, several studies suggest online courses are beneficial for students with low vision since they provide remote learning experience (Barnard et al., 2012; Haegele et al., 2018; Kharade & Peese, 2012) and allow instructors to provide remote instructional assistance to the students anytime and anywhere even if they live far from the main campuses of the universities (Holmgren, 2018).

Therefore, most institutions of higher education in the U.S. incorporate the principles of Universal Design for Learning (UDL) into the educational and instructional materials. UDL is a framework for improving instruction because it helps provide equal opportunities for all learners to succeed. This strategy provides flexibility in how learners access, engage with, and demonstrate what they understand and increases the quality of learning materials for everyone (Rose & Mayer, 2008). UDL helps instructors and instructional designers, particularly for online courses, create environments that provide easy access for all disabled and nondisabled students (Burghstahler, 2006). UDL matters because of an increasingly varied student population; instructors are often challenged to design and implement the curriculum. UDL helps offer a variety of strategies and resources to satisfy a range of learning requirements, make learning possibilities more accessible, and increase student achievement.

UDL principles support students with low vision who have some challenges in online courses by providing resource and flexibility access to engage the students complete learning (Houston, 2018). Most of the research has found that UDL is essential for integrating students with visual impairments into higher education (Al-Azawei et al., 2016; Houston, 2018; McKenna & Velasco, 2018). Kim-Rupnow, Dowrick, and Burke’s (2001) literature focused on disability and its connection to students who have challenges with online courses. However, their research did not address UDL as a beneficial aspect for disabled student’s success in online courses.
Online courses contribute to the inclusion of students with low vision (Fichten et al., 2009), and UDL should be an integral aspect of research that examines their issues and struggles. In addition, UDL helps to give students with disabilities equal opportunities to access courses without adaptation (Rose & Mayer, 2008). UDL also helps reduce barriers and increases access for students with low vision (Rose & Mayer, 2008; Phillips et al., 2012).

In higher education, UDL works on the principle of understanding the diversity in the population to provide equal learning access for all individuals. In addition, it can be used for both traditional and online courses, but particularly for online courses to minimize the challenges for students who struggle with online materials/resources (Dell et al., 2015). According to CAST (2008) and Rose and Mayer (2008), there are three UDL principles: representation, action and expression, and engagement. UDL guidelines illustrate the connections between each principle and the three types of disability support sources: accessibility accommodations, assistive technologies, and reasonable accommodations. The first principle of UDL is representation, which involves providing learners with various ways of acquiring information and knowledge that have a connection to the accessibility formats that require instructors to provide various resources to facilitate students’ access to the learning materials. The second principle is action and expression, which provides students with various routes to access the necessary materials using assistive technology. The third principle is engagement, which enables an instructor to tap into students’ interests, challenge them appropriately, and motivate them to learn through facilitating resources.

This study sought to explore the perceptions of the experiences of students with low vision in online courses to identify what accommodations offer the greatest support and what accommodations, based on UDL guidelines, would be beneficial. This research was intended to
provide recommendations for future instructors and instructional designers to consider when creating online courses for students with low vision.

Problem Statement

There is a growing body of literature on accommodations specifically for science and math for K-12 students with visual disabilities. STEM subjects are the most commonsubjects students struggle with because of the small symbols in formulas and visual images (Fraser & Maguvhe, 2008; Habulezi et al., 2017; Watson & Johnston, 2004). Conversely, only a few studies focused on visual disabilities at the postsecondary level. Recent literature at this level addressed instructors’ perceptions and experiences in providing accommodations for students with disabilities in online courses (Phillips et al., 2012). Previous studies have compared academic accommodations in online course environments and traditional learning environments for disabilities in general without identifying each disability type’s needs (Barnard & Sulak, 2010). Other studies have focused on students who are blind or have visual impairments receiving accommodations in higher education (Kharade, & Peese, 2012; Hewett et al., 2017). In addition, some studies focused on comparing enrollment rates and achievement rates for students who receive accommodations (Canto et al., 2005; Lee & Oh, 2017). Most of the research, if not all, have addressed all disability types regarding accommodations either in the traditional classroom or in online courses (Betts et al, 2013; Crow, 2008; Pittman & Heiselt, 2014; Terras et al., 2015); however, the field of instructional technology needs more research on students with low vision in online courses. For example, some studies (Alahmadi, 2017; Corn, 2018; Hewett et al., 2017) recommended more research is needed on technologies such as smart devices and virtual media that may help students with low vision in certain academic skills, such as reading
or research. Other studies (Jessup et al., 2018; Terras et al., 2015) suggested that research should focus on the need for students with low vision to be more engaged and active in online courses. The current study helps improve the online courses by illustrating the experiences (both opportunities and challenges) and perceptions of accommodations for students with low vision. Instructors, educators and designers can benefit from the study when designing their online courses and help the students who struggle with accessing online course materials and resources.

Significance of the Study

Online courses can be a valuable opportunity for students with low vision if suitable education methods and appropriate accommodations are available (Kharade, & Peese, 2012; Phillips et al., 2012). Since online courses are delivered by using instructional technology, the study sought to understand which types of technology can accommodate students with low vision, and, therefore, reduce their challenges in online courses. The demand for accommodations and support for postsecondary students with low vision justifies the need for more research exploring the helpful types of technology educators and instructors can use in the online learning environment.

Purpose of the Study

The purpose of this study was to explore what accommodations can be used to facilitate learning in an online course for postsecondary students with low vision. The qualitative case study was conducted at a postsecondary institution offering online courses as a way to explore a topic that to date has very little empirical literature associated with it. This exploratory
qualitative case study (Patton, 2002) enabled the researcher to uncover guidelines for online course instruction and implementation of accommodations for students with low vision.

Research Question

This study was guided by the following research questions:

1. What are the information delivery methods in the past online courses that students with low vision perceive to be most helpful regarding their learning?
   a. How were students able to manipulate those information delivery methods to help their personal preferences for learning?
   b. If unable to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?

2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?

3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?

Theoretical Framework and Constructs

The UDL theoretical framework approach guided this study. In the 1990s, Anne Meyer and David Rose first laid out the principles of UDL. They and their colleagues at the Center for Applied Special Technology (CAST, 2008) introduced UDL as a framework for improving teaching and learning in the digital age, sparking an international reform movement. Since UDL requires equal access for all users, it helps to provide accessibility accommodations in online
courses for students with low vision. In addition, it helps instructors to not just look at the reasonable accommodations but also look at accessibility accommodations and assistive technologies that students with low vision may need to use in online courses. UDL suggests instructors should support students who need individual accommodations. If a student is blind, deaf, or has limited mobility, instructors need to work with the Disability Resource Center (DRC) or other support services to translate course materials and design alternative and equivalent assessments. Instructors should also ensure that the environment is conducive to the students’ learning. Even simple, proactive measures such as offering early access to the syllabus and textbooks can have a significant positive impact on the accommodation process.

According to CAST (2008), there are three principles of UDL: representation, action and expression, and engagement. The first principle is representation, which provides accessing information in several formats such as audio, video or hands-on learning to help students have different ways to access the instruction and learning materials. The second principle is action and expression, which supports the accommodations using assistive technology. The action and expression principle refers to the different ways that students can use assistive technologies to navigate and express what they know in a learning environment. The assistive technologies help students with disabilities navigate and express what they know through voice-activated switches, expanded keyboards, and navigate or interact with a single switch. The last principle is engagement, which ensures that students receive support services such as reasonable accommodations to reduce challenges and be motivated to re-enroll in online courses. Reasonable accommodations are modifications or adjustments to resources for learning materials, tasks, or environments to help reduce challenges in an academic program and increase participation for students with disabilities (U.S. Department of Education, 2007). This study used
a survey and interviews to explore the perceptions of using UDL principles and the most helpful accommodations for students with low vision in online courses.

Definition of Terms

The following terms are important to this study:

Accessible PDF. An accessible version of a PDF provides an alternative view of the document that works with screen readers, marking up and commenting.

Assistive Technology (AT) device. According to the Individuals with Disabilities Education Act (Sec. 602), assistive technology device is “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, used to increase, maintain, or improve functional capabilities of people with a disability” (Presley & D’Andrea, 2015, p. 18).

Asynchronous online learning. Learning does not use a set schedule (Palmer, 2012). For example, a class might conduct a discussion through a message board, with students posting their contributions whenever they log on.

Blended courses. The courses include both online and face-to-face sessions.

Legal blindness: In the United States, this refers to a medically diagnosed central visual acuity of 20/200 or less in the better eye with the best possible correction and/or a visual field of 20 degrees or less (American Foundation for the Blind, 2015).

Low vision. The vision that cannot be corrected with regular glasses, contact lenses, medicine, or surgery (American Foundation for the Blind, 2015).

Online courses. Online courses are defined as a system and process of connecting students, teachers, and learning resources when they are not in the same location (Park & Choi, 2009).
Perception. The perspective of and experiences with equally receiving information and support in online courses (CAST, 2008).

Postsecondary. Undergraduate and graduate students who are enrolled in community colleges and private or public colleges and/or universities.

Reasonable accommodation. Reasonable accommodations are “modifications or adjustments to the tasks, environment, or to the way things are usually done that enable individuals with disabilities to have an equal opportunity to participate in an academic program or a job” (U.S. Department of Education, 2007).

Students with low vision. Low vision is an impairment in vision that, even with correction, adversely affects a student’s educational performance (American Foundation for the Blind, 2015). The student may access information through visual, auditory, and/or tactual modes.

Students with total blindness. The complete lack of light perception and form perception, and is recorded as “NLP,” an abbreviation for “no light perception” (American Foundation for the Blind, 2015).

Synchronous online learning. Schedule learning that requires the students and instructor to collectively meet online at the same time (Palmer, 2012).

Universal Design for Learning (UDL). A set of principles for curriculum development, including the flexibility of curriculum and instruction that give all individuals, equal opportunities to learn (Meyer & Rose, 20002).

Assumptions

The study was based on the experiences of the participants; thus, it was assumed the participants would answer the survey questions in an honest and candid manner but might not be
willing to spend time typing details for the open-ended questions. To offset this potential limitation, the questionnaire included limited open-ended questions and allowed participants to provide their contact information only if the participant was comfortable for an interview. The interview included the remaining open-ended questions that have might required more details. In addition, it was assumed that most participants might not know the specific name for their low vision condition, so additional definitions were added to the questionnaire for clarification.

Delimitations

The reporting of this study focused on a group of students with low vision and did not capture the experience of others with different types of visual disabilities. The study did not focus on the learning methods or include online sections that used blended learning. Finally, the educational level was also limited to undergraduate or graduate students.

Chapter Summary

It was identified in this chapter that students with low vision face challenges in online courses and require special accommodations. Thus, this study aimed to explore available accommodations for postsecondary visually impaired students, focusing specifically on the student population who has low vision and has experienced online learning. The research questions include:

1. What are the information delivery methods in the past online course that students with low vision perceive to be most helpful in regard to their learning?
   a. How were students able to manipulate those information delivery methods to help their personal preferences for learning?
b. If they weren’t able to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?

2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?

3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?

Dissertation Organization

Chapter 1 provides an overview of this research, including the rationale of the study, problem statement, research questions, and a discussion of the theoretical framework for the study. Chapter 2 is the literature review, which presents facts regarding post-secondary students’ with low vision life and academic challenges and barriers when using accommodations in online courses. A synthesis of relevant literature shows the specific challenges and needs of low vision students as well as the possible accommodations online courses can provide to low vision students.

Chapter 3 presents the methodology of the study. This case study used the online survey and interviews to collect the data from participants who met the following criteria: post-secondary students, had low vision, and had experienced online courses. The study took place at a state school in Illinois, U.S. Lastly, Chapter 3 includes the data analysis procedures to identify the themes and patterns found in data collection. Chapter 4 presents the findings of the study. The findings include the online survey results and the results from the interviews and open-ended survey questions. The themes include information delivery, most helpful accommodations,
assistive technology, accessibility and a wish list for the students with low vision in online courses. Chapter 5 interprets the major findings from Chapter 4. This chapter also highlights the potential limitations and challenges confronted by the researcher. Moreover, it discusses the recommendations and implications for future research.
CHAPTER 2
LITERATURE REVIEW

Introduction

The purpose of this chapter is to review the literature on the key areas of this study: online courses, students with low vision in online courses, and the universal design of learning (UDL), including the accessibility, assistive technology, and the reasonable accommodations. Then the chapter reviews the gaps in this literature. The chapter first defines the online courses and reviews the history of online courses. This is followed by the literature on postsecondary students with low vision, particularly during online courses in higher education. Then the chapter considers the origins of the theory of universal design of learning (UDL), which is the theoretical grounding of this study. Additionally, it describes the accessibility, assistive technology and the accommodations that most disabled resources center (DRC) provide for students with low vision. Disability legislation is also reviewed to understand the university supports for the disability students, including those with low vision in higher education. Finally, the chapter provides an overview of the gap in the literature focused on accommodations that facilitate learning in online courses for students with low vision.
In the last 30 years, technology has clearly had a strong impact on education (Gray & DiLoreto, 2016). Online courses are part of this impact and have broad implications for the field of Educational Technology (EdTech). Online courses are the natural result of distance learning adopting new communication technologies and then being co-opted or redefined by those technologies (Gray & DiLoreto, 2016).

Online courses started in 1982 at the Western Behavioral Sciences Institute in La Jolla, California, but the popularity of the online courses began in 1989 when the University of Phoenix started offering educational programs through the internet. In 1993, with the invention of the first Internet web browser developed by the University of Illinois, online learning became widespread (Nicholson, 2007). In 1997, the first online learning platforms were launched at famous universities, such as Yale, Cornell and the University of Pittsburgh. In the same year, Learning Management Systems (LMS) such as Blackboard became widespread for delivering online instruction and are still utilized in many colleges and universities across the globe (Nicholson, 2007).

Researchers argued the various positive and advantageous positions taken with respect to online courses (Gray & DiLoreto, 2016; Panacci, 2015). Online courses provide flexibility in scheduling, using asynchronous technology to allow students to take examinations, access a wide variety of materials, complete assignments, and be involved with group discussions according to schedule students develop (Knightley, 2007). For instance, students often complete their course studies at night after finishing work and other family responsibilities; they have the capability to respond to learning activities on their own time. However, they need to manage their time within
the time limits of the course (Knightley, 2007). In addition, online courses provide flexibility in
delivery, using synchronous technology. For example, students may use video conferencing by
an appointment to meet with the class or/and instructor. As a result of using synchronous and
asynchronous technologies through online courses, students improve technical skills (Gray &
DiLoreto, 2016) that can be transferred to many professions, including creating and sharing
documents, incorporating audio/video materials into assignments, and completing online
sessions. Online courses are beneficial for individuals who face difficulty pursuing education
such as those with disabilities, location, time constraints, work responsibilities, etc. (Gray &
DiLoreto, 2016; Panacci, 2015).

In contrast, online courses also have disadvantages. Not all students in online courses are
successful in this type of learning setting (Horzum et al., 2015). Knightley (2007) mentioned
that some students do much better working with other people, while some work better alone. He
also stated that some students in online courses prefer working directly with the instructor rather
than working on their own. Therefore, students in online courses need to be motivated to
complete online courses successfully (Knightley, 2007; Panacci, 2015). Many students
completing online courses have little or no interaction with their peers, causing less motivation to
learn (Chyung, 2007). On the other hand, 66% of the students in online courses wanted limited
face-to-face interaction. Palmer (2012) found that 48% of students in online courses like the
flexibility that gives the students the opportunity to attend classes wherever they have internet
access. Moreover, online courses usually have deadlines for assignments, tests, commenting on
lectures, etc. Panacci (2015) shows that the students need to have strong time management and
organizational skills in online courses because it is vital to stay on top of their work with the
appropriate amount of time to complete each task and balance the coursework against other
priorities in life. Most students in online courses worry about missing out on the social aspect of learning or that they will be isolated, in that social interaction is one of the most important motivations (Panacci, 2015). Horzum et al. (2015) found that students are motivated when they exchange e-mails with other classmates enrolled in the same course to communicate about course material and to share experiences and information. In addition, communicating with the course instructor provides an opportunity to ask questions or discuss course material, which makes students more motivated (Horzum et al., 2015; Palmer, 2012). Online courses can have a negative impact if instructors and students are not using effective methods to be motivated to learn and be successful in this type of learning (Horzum et al., 2015).

Online Courses for Students with Low Vision

Low vision is one of the visual disabilities identified for causing significant difficulty seeing even after one’s vision is corrected with eyeglasses, contact lenses, surgery or medicine (National Eye institute, 2019). The most common types of low vision include loss of central vision, loss of peripheral (side) vision, blurred vision, generalized haze, extreme light sensitivity and night blindness (National Eye institute, 2019). The loss of central vision creates a blur or blind spot, but a person’s side (peripheral) vision remains. This makes it difficult to read, recognize faces and distinguish most details in the distance. With side vision intact, however, mobility is usually unaffected. People who lose their peripheral vision cannot distinguish anything to one side or both sides or anything directly above and/or below eye level. Central vision remains, however, making it possible to see directly ahead. Typically, loss of peripheral vision affects mobility. If it is severe, it can slow reading speed because the person can only see a few words at a time. This is sometimes referred to as tunnel vision. With blurred vision, both
near and far vision is out of focus, even with the best possible correction with eyeglasses. People with generalized haze have the sensation of a film or glare that may extend over the entire viewing field. Extreme light sensitivity occurs when standard levels of light overwhelm a person’s visual system, producing a washed-out image and/or a glare. People with extreme light sensitivity may suffer pain or discomfort from relatively normal levels of light. People with night blindness cannot see outside at night under starlight or moonlight or in dimly lighted interior areas such as movie theaters or restaurants. Some of the low vision symptoms are dimness, haziness, and difficulty recognizing faces, reading labels and safely moving around (Wolffe & Sacks, 1997). Researchers have observed that most people with low vision have difficulty with daily tasks like reading the mail, shopping, cooking, and paying the bills (Haegele et al., 2018).

Online courses benefit students with low vision because they can find a solution for the challenges of physically attending on campus, which can pose great difficulty for them (Kharade & Peesa, 2012; William et al., 2006). Feucht and Holmgren (2018) reported that students with low vision drop out because they cannot drive to the campus and do not live close to the campus. Walking around campus is also a challenge because sometimes it requires students with a very low vision to use aids such as a cane or a guide dog because, in some cases, students with low vision cannot even see the small things or they cannot see things in bright or dark places. Therefore, they often have a difficult time self-navigating outside of well-known environments and prefer to be indoors (Long et al., 1990), and some prefer to study and work in small physical spaces (Haegele et al., 2018). As a result, low vision affects a person’s ability to learn or perform many tasks, which severely limits his/her life opportunities for education and employment (Long et al., 1990). Kharade and Peesa (2012) found that the flexibility in the location, scheduling, and delivery of online courses reduces the challenges for attending on
campus by providing flexibility in time and place of delivery; therefore, online courses have become such a great option for students with low vision to complete their educational degrees and be more motivated to succeed (Kharade & Peese, 2012).

Besides flexibility, online courses allow students with low vision to adjust the instructional material through assistive technologies according to their needs (Crow, 2008; Fichten et al., 2009) during learning, reading, writing and acquiring academic and nonacademic skills (Hewett et al., 2017; Rosner & Perlman, 2018). In addition, using assistive technologies in online courses helps students facilitate learning and receive equal learning opportunities (Hewett et al., 2017). Because of this equality, students with low vision can be more active and motivated to participate in online activities such as discussion and group work. Assistive technologies help to improve the quality of learning for students with low vision (Crow, 2008). Online courses with assistive technologies encourage students with low vision to be active participants and share ideas with classmates and instructors remotely in online course activities (Crow, 2008; Fichten et al., 2009; Hewett et al., 2017).

Universal Design for Learning (UDL)

For higher education to help more users benefit from the flexibility and other advantages of online courses, teachers and instructional designers need to follow the UDL principles. UDL’s objective is to provide all students equal access to learning resources and help to reduce the problems students have in accessing the course materials and content (Dell, Dell, & Blackwell, 2015). UDL allows delivery of the content, assignments, and activities in a flexible and customized manner. According to Meyer, Rose, and Gordon (2014), there are three principles of UDL. The first principle is multiple means of representation meaning that students can obtain
information in different forms of resources. The second principle is multiple means of expression, which means that students can demonstrate their knowledge through alternatives. The third principle is the multiple means of engagement. The instructors can develop different activities or several forms of engagement to attract students’ attention and increase motivation.

These UDL principles in online courses should be implemented with diversity in mind, (i.e., ethnic, age, social class, and learning needs of students,) and instructors should plan their courses to achieve successful results for all types of students. In addition, applying UDL principles can help students have several options for participation, accessing and using learning materials in online courses. Dell et al. (2015) discussed a guiding set of UDL principles for online course development in higher education.

UDL is designed to address the diversity and ability/disability of individuals and their environment (Dell et al., 2015). The first principle of UDL is representation, which means providing information in several formats such as audio, video or hands-on learning to help students have different ways to access the instruction and learning materials (CAST, 2008). This definition applies the same to online courses but with includes considering the accessibility of the delivery methods such as the websites and learning management systems (LMS).

The second principle of UDL is the action and expression, which helps students differ in ways they can navigate and express what they know in a learning environment (CAST, 2008). One of the actions and expression principle guidelines of UDL from CAST (2008) is the physical action guidelines. The physical action guidelines mean properly designed curriculum materials provide a seamless interface with common assistive technologies that allow individuals with movement impairments to navigate and express what they know through voice-activated switches, expanded keyboards, and others, navigation or interaction with a single switch CAST,
2008). Physical action guidelines help to optimize access to tools and assistive technologies. The following are the UDL checkpoints to optimize access to tools and assistive technologies to open doors for learning with accessible tools and devices.

- Provide alternate keyboard commands for mouse action
- Build switch and scanning options for increased independent access and keyboard alternatives
- Provide access to alternative keyboards
- Customize overlays for touch screens and keyboards
- Select software that works seamlessly with keyboard alternatives and alt keys

The third principle of UDL provides multiple means of engagement, which enables an instructor to tap into students’ interests, challenge them appropriately, and motivate them to learn (CAST, 2008). Rose et al. (2006) focused on a course and found UDL principles can serve as tools or guidelines for postsecondary faculty rather than as a set of definitive rules. Rose et al. (2006) also identified that the applications of UDL principles helped faculty define their course goals and objectives and choose media and materials, teaching methods, and assessment techniques, including discussion groups, lectures, textbooks, and the course website. Faculty found that by providing multiple options for using textbooks and media, they received higher rates and quality of engagement in these aspects of the course. In addition, using UDL principles helped students and instructors provide multiple ways of accessing information to increase participation and foster active engagement in online courses (Rose et al., 2006).

In addition, according to CAST (2008) the engagement principle of UDL has a guideline of sustaining effort and persistence including the following checkpoints of various demands and resources to optimize challenge:
Differentiate the degree of difficulty or complexity within which core activities can be completed

- Provide alternatives in the permissible tools and scaffolds
- Vary the degrees of freedom for acceptable performance
- Emphasize process, effort, improvement in meeting standards as alternatives to external evaluation and competition

Reasonable Accommodations

There are several types of reasonable accommodations: presentation accommodations, response accommodations, setting accommodations and scheduling accommodations (Barnard-Brak & Sulak, 2010). The presentation accommodations and response accommodations are the most common types of accommodations for those using assistive technologies (Lyman et al., 2016). Presentation accommodations modify the presentation of material and/or directions, including modes of access: visual, tactile, auditory, or a combination of visual and auditory. For example, some students with visual disabilities need a screen reader. Response accommodations adjust the way students can respond or allow students to complete assignments, tests, and activities in different ways or to solve or organize problems using some type of assistive device or organizer. For example, a student may benefit from closed captioning of a video being viewed in the classroom. Setting accommodations change the location in which a student receives the assessment. Scheduling accommodations adjust the time allowances or scheduling of instruction and/or testing such extend exam time (Lyman et al., 2016).

Research has shown that students who receive accommodations are motivated to complete courses and re-enroll in online courses because they experienced the effectiveness of
accommodations in reducing the barriers and challenges (Ostrowski, 2018; Rosner & Perlman, 2018).

K-12 schools are supportive settings in which school administrators and parents work together to ensure students receive an appropriate education through the IEP process by determining their needs and providing support services for them. A student with an IEP, as part of the Individuals with Disabilities Education Act (IDEA, 2004), may receive different educational services in a special or regular educational setting, depending on the student’s needs. In addition, there are certified teachers of students with visual impairments (TVI). TVI are specialists who serve every child who meets the criteria of visual impairment (Petrie et al., 2009). The TVI is also responsible for assessing the student with low vision as well as determining and aiding in adaptations and modifications as well as creating IEPs. These responsibilities are established under P.L. 101-476 of the Individuals with Disabilities Education Act of 1990 (IDEA).

In contrast, U.S. universities and colleges make efforts to accommodate different types of disabilities, including students with low vision who struggle with online courses (Summers et al., 2014). Providing accommodation does not mean that the course materials are not accessible or do not follow UDL (Fichten et al., 2009). Sometimes students with disabilities have specific needs such as extended time, large print, note taker, record, etc. (Watson & Johns, 2004). According to Crow (2008), accommodation generally refers to the retrofitting or adoption of a technology according to the specific needs of an individual. According to ADA (1990), accommodations are a means of providing qualified students with disabilities an opportunity to benefit from an educational experience similar to their non-disabled counterparts. In higher education, students with disabilities should be aware that receiving accommodations has
different processes in K-12 and in higher education. In higher education, there are no Individualized Education Plans (IEP) so instructors no longer need to adapt materials as in K-12 (Chan, 2016). However, to benefit from those accommodations, students with disabilities in higher education are responsible for disclosing their disability to the disabilities resource center (DRC) and informing the program and the DRC about their specific needs so that their disability can be accommodated. Crow (2008) contended the following list describes the most commonly provided accommodations for traditional classrooms:

- Priority scheduling and registration
- Notice of books and resources required for each class, allowing the student time to arrange for taped versions
- Preferential seating to better hear or see what goes on in class
- Permission to use equipment such as tape recorders, “talking” computers, or computer notetaking equipment in the classroom
- Adaptations for a regular class, mid-year, and final exams, such as extended time, taped exams, readers, and/or scribes for exam taking, as needed
- Adaptations in certain required classes (such as physical education), course waivers, or course substitutions
- Orientation to classrooms, buildings, and the campus
- Tactile and large-print maps of the campus and surrounding community
- Adaptations that ensure access to campus shuttle buses, escort services, and other campus transportation
- Audio recorded textbooks
• Access to computers with voice systems and large-print
• Access to closed-circuit televisions (CCTVs), large-print copiers, large-print books, and computers with large-print software
• Access to talking calculators, raised-line drawing kits, four-track tape recorders, talking spell-checkers, and laboratory equipment

Research has shown the effectiveness of students with disabilities receiving accommodations in higher education (Goegan & Harrison, 2017; Ofiesh & Hughes, 2002). Accommodations are effective for increasing GPAs and enrollment status (Canto, et al., 2006; Moisey, 2004). Canto et al. (2006) focused on the impact of accommodations on GPAs for students with learning disabilities (LD). The researchers examined the educational outcomes of three groups of college students who received an evaluation due to academic difficulties: those diagnosed with LD who subsequently registered for services through the university student disability resource center, those diagnosed with an LD who did not register for services, and those who were evaluated but did not receive a diagnosis. The results reported that there were no differences in post-evaluation GPAs among the groups. However, both groups with an LD demonstrated within-group improvements in their GPA following the date of their evaluation, whereas students without LD showed no improvement. Students who were not diagnosed with LD were more likely to drop out of school than students with an LD. These results showed the effectiveness of receiving accommodations.

As an example of effective accommodations, extending time to finish course tasks helped motivate students and improve learning performance. Ofiesh and Hughes (2002) addressed the accommodation of extended-time for postsecondary students with LD and found that the students with LD improved significantly under the extended-time condition. Those findings suggest that
the range of time for most students with LD to finish a test is a half to double time provision. Goegang and Harrison (2017) also examined the effect of extended time for 38 postsecondary students with an LD on writing performance. The results showed that 19 students without an LD were matched with 19 students with an LD on several factors – such as cognitive, linguistic, and literacy measures – and wrote essays under regular and extended time conditions. In addition, results showed that students with an LD demonstrated an increase in writing fluency with extended time.

The role of instructors in providing effective accommodations for students with disabilities is also important for their academic success. Wright and Meyera (2017) identified a relationship between students needing accommodations and instructors’ self-efficacy in complying with accommodations. Based on their study, they noted that the willingness and flexibility of university instructors to comply with and provide accommodations for students with disabilities is critical to their academic success. In addition, they examined how communication between students needing accommodations and university instructors impacted the instructors’ self-efficacy or instructors’ perceptions of a student’s condition. Specifically, Wright and Meyera explored the relationship between student self-disclosure of a disability and instructors’ empathy, flexibility, and self-efficacy in meeting the need for student accommodation. Results revealed that the more a student self-discloses about a needed accommodation, the more self-efficacy an instructor has in providing that accommodation. In their study, empathy and flexibility were both significant predictors of self-efficacy for the low-disclosure condition, whereas, for the high-disclosure condition, only flexibility was a significant predictor of self-efficacy.
Several studies (Barnard-Brak & Sulak, 2010; Goegan & Harrison, 2017; Phillips et al., 2012) have examined accommodations and disabilities in general, with very few studies focusing on visual disabilities or online education courses. Additionally, most of the research examining visual disability combines blindness and low vision. There was no single study that had specifically examined each of the types separately or the appropriate accommodations for visual disabilities.

As the number of post-secondary students with disabilities in online courses continues to rise, some studies (Phillips et al., 2012; Terras et al., 2016) focused just on online course settings. Terras et al. (2016) found that online courses may afford students with disabilities enhanced opportunities for academic success, although the participants indicated that disabilities presented concentration and scheduling challenges. Phillips et al. (2012) addressed this issue and examined the online accommodation experiences by faculty at one public university. Roughly 24% of faculty said they had made accommodations for students with verified disabilities and 15% reported experience with making online accommodations for students who stated they had disabilities, but they had not been verified through the disability resource center. They found that due to their limited experience at making online accommodations, a majority of faculty (54%) were unsure whether they had the knowledge or adequate technology and support to provide online accommodations. The faculty in Phillips et al.’s study recommended ongoing support from the disability resource center and training for new and experienced faculty to increase the awareness about the needs of students with disabilities. They also asserted that students who needed assistance should be proactive in contacting the disability resource center and familiarizing themselves about available university resources.
The number of students with visual disabilities who need accommodations has increased in higher education, especially for those who have low vision (National Center for Education Statistics, 2016). Disability legislation and accommodations provided by disability resource centers have helped to increase the number of enrolled students with disabilities (SWD) to demonstrate greater academic achievement and higher graduation rates (Ostrowski, 2016). However, there is still a low graduation rate for students with disabilities compared with their peers without disabilities (Richardson, 2014). Low enrollment and graduation rates for SWD have in part led researchers to question the effectiveness of DRCs and the accommodations that they provide. The available research on effectiveness of accommodations is limited (Canto et al., 2005; Terras et al., 2015), and much of it is focused on learning disabilities (LD) as well as on elementary and secondary student populations. Due to the increase of students in higher education who need accommodation, more research needs to be conducted.

However, the literature has shown that there are several reasons that lead some students with disabilities to not use DRCs and/or accommodations (DeLee, 2018; Lyman et al. 2016). Most of the barriers grow because students with disabilities do not want to appear different than other students (DeLee, 2018). The barriers vary due to the differences in disability types and aids/devices needed. Lyman et al. (2016) conducted a qualitative study through interviews with students with disabilities. The results of their study showed that self-sufficiency, negative experiences with professors, and fear of future ramifications were the most common barriers faced when using accommodations. The self-sufficiency is related to a desire to avoid negative social reactions, insufficient knowledge, and the quality and assistance of DRC and its accommodations. In addition, Squires et al. (2018) found that the primary reason for not requesting accommodations were to assert the students’ intentions to be independent.
Some institutions provide accommodations, but they are ineffective because they do not meet the needs of students with disabilities. Sokal and Vermette (2017) examined over 8,000 test administrations across two universities to determine whether students with disabilities were being given the necessary extended testing time accommodations and whether their use of extended time decreased over the course of their programs. Findings revealed that commonly accepted recommendations about the appropriate duration of accommodations were not suitable in meeting individual students’ needs and students used more time as they moved through the first three years of their postsecondary programs. The researchers recommended both individual needs and capacities should be considered for receiving accommodations.

In addition, learning setting and disability types may affect students’ attitudes toward requesting accommodations in a traditional classroom and online courses. Barnard-Brak and Sulak (2010) found that the attitudes of students with disabilities toward requesting accommodations in the traditional versus online courses environments students did not differ significantly. However, the results of their findings showed that students who reported having visible disabilities appeared to have more positive attitudes toward requesting accommodations in online versus traditional learning environments compared with students who preferred not to disclose their disabilities. As seen from the research, there is no attitude difference in learning setting; however, there was a different attitude in disability types; students who had a visible disability had a more positive attitude toward seeking accommodations compared to those who had a hidden disability.

Addressing the needs of students at a Canadian university, Ostrowski (2016) argued for improving access to accommodations for students with visual impairments. He explained the challenges of postsecondary education hinder accessibility of LMS and consequently, the success
of such students. In addition, there are limitations in current university policies and practices that should be addressed to provide potential solutions. Findings showed that further systemic changes are needed to improve the quality and timeliness of accommodations for students with visual disabilities.

Accessibility Accommodations

Accessibility is an important priority in online courses delivered by top universities such as Harvard University, UC Berkeley, and MIT (Alahmadi, 2017). Following their trend, many colleges and universities have started to make program and policy changes in their online courses (Zuriff, 1996). Accessibility addresses the design of technology rather than the needs of specific individuals (Alahmadi, 2017). Accessibility means providing course materials and tools that can be used by all types of students, regardless of their physical and/or developmental impairment. When a course is accessible, most students, even those with disabilities, can reach the material equally. All can get access to the course delivery system, navigate the course content, submit assignments, and successfully use all course tools. The most common example of accessibility includes obtaining printed materials in alternate formats (Pittman et al., 2014). Other examples involve the inclusion of a statement of support for students with disabilities in the course syllabus. In addition, all video content (web, DVD, and VHS) should be captioned and transcripts of audio-based material and video-based materials should be available if they cannot be captioned.

There are several benefits of accessibility in online courses. Accessibility allows students to use flexible materials that can be adjusted according to their special needs and preferences (McKenna & Velasco, 2018; Pittman, et al., 2014). Audio, images, graphics, animations, video,
or text are often the tools for presenting information and clarifying the relationships among objects, actions, numbers, or events. However, visual representations are not equally accessible to all students, particularly visually impaired students (McKenna & Velasco, 2018). Thus, it is essential that online courses be designed with UDL representation principles for accessibility features for all types of students to ensure that all students have equal access to information (CAST, 2008). UDL’s representation principle has guidelines, including checkpoints for the accessibility in online courses. The three guidelines are perception, language and symbol, and comprehension.

First, the perception guideline (see Table 1) is related to the students’ interaction with flexible and accessible content rather than depending on a single sense such as sight, hearing, movement, or touch. Perception guidelines include the three following checkpoints: offer ways of customizing the display of information, offer alternatives for auditory information, and offer alternatives for visual information (CAST, 2008).

The second guideline is language and symbol (Table 2), which provides options for language and symbols to help those students with different forms of representation in their facilities. For example, some students can understand that an equal sign (=) means that the two sides of the equation need to be balanced but might cause confusion to a student who does not understand what it means. According to CAST (2008), a picture or image can carry very different meanings for the students from differing cultural or familial backgrounds. Therefore, sometimes inequalities become apparent when information is presented to all learners through a single form of representation. An important instructional strategy is to ensure that alternative representations are provided not only for accessibility but for clarity and comprehensibility across all learners (CAST, 2008). There are five checkpoints for the language and symbol
guideline: clarify vocabulary and symbols, clarify syntax and structure, support decoding of text, mathematical notation, and symbols, promote understanding across languages and illustrate through multiple media.

According to CAST (2008), the last guideline of the representation of UDL principles is comprehension (see Table 3), which includes four checkpoints: activate or supply background knowledge, highlight patterns, critical features, big ideas, and relationships, guide information processing and visualization and maximize transfer and generalization.

Table 1

Perception Guideline

<table>
<thead>
<tr>
<th>Offer ways of customizing the display of information.</th>
<th>Offer alternatives for auditory information.</th>
<th>Offer alternatives for visual information.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The size of text, images, graphs, tables, or other visual content.</td>
<td>Use text equivalents in the form of captions or automated speech-to-text (voice recognition) for spoken language. Provide visual diagrams, charts, notations of music or sound.</td>
<td>Provide descriptions (text or spoken) for all images, graphics, video, or animations.</td>
</tr>
<tr>
<td>The contrast between background and text or image.</td>
<td>Provide written transcripts for videos or auditory clips.</td>
<td>Use touch equivalents (tactile graphics or objects of reference) for key visuals that represent concepts.</td>
</tr>
<tr>
<td>The color used for information or emphasis.</td>
<td>Use visual analogues to represent emphasis and prosody (e.g., emoticons, symbols, or images).</td>
<td>Provide auditory cues for key concepts and transitions in visual information.</td>
</tr>
<tr>
<td>The volume or rate of speech or sound.</td>
<td>Provide visual or tactile (e.g., vibrations) equivalents for sound effects or alerts. Provide visual and/or emotional description for musical interpretation.</td>
<td>Allow for a competent aide, partner, or “intervener” to read text aloud.</td>
</tr>
<tr>
<td>The speed or timing of the video, animation, sound, simulations, etc.</td>
<td></td>
<td>Provide access to text-to-speech software.</td>
</tr>
<tr>
<td>The font used for print materials.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(CAST, 2008)
### Table 2

#### Language and Symbol Guideline

<table>
<thead>
<tr>
<th>Clarify vocabulary and symbols</th>
<th>Clarify syntax and structure</th>
<th>Support decoding of text, mathematical notation, and symbols,</th>
<th>Promote understanding across languages</th>
<th>Illustrate through multiple media</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Pre-teach vocabulary and symbols, especially in ways that promote connection to the learners’ experience and prior knowledge</td>
<td>- Highlight structural relations or make them more explicit</td>
<td>- Highlight structural relations or make them more explicit</td>
<td>- Make all key information in the dominant language (e.g., English) also available in first languages (e.g., Spanish) for learners with limited-English proficiency and in ASL for learners who are deaf</td>
<td>- Present key concepts in one form of symbolic representation (e.g., an expository text or a math equation) with an alternative form (e.g., an illustration, dance/movement, diagram, table, model, video, comic strip, storyboard, photograph, animation, physical or virtual manipulative)</td>
</tr>
<tr>
<td>- Provide graphic symbols with alternative text descriptions</td>
<td>- Make connections to previously learned structures</td>
<td>- Make connections to previously learned structures</td>
<td>- Link key vocabulary words to definitions and pronunciations in both dominant and heritage languages</td>
<td>- Make explicit links between information provided in texts and any accompanying representation of that information in illustrations, equations, charts, or diagrams</td>
</tr>
<tr>
<td>- Highlight how complex terms, expressions, or equations are composed of simpler words or symbols</td>
<td>- Make relationships between elements explicit (e.g., highlighting the transition words in an essay, links between ideas in a concept map, etc.)</td>
<td>- Make relationships between elements explicit (e.g., highlighting the transition words in an essay, links between ideas in a concept map, etc.)</td>
<td>- Define domain-specific vocabulary (e.g., “map key” in social studies) using both domain-specific and common terms</td>
<td></td>
</tr>
<tr>
<td>- Embed support for vocabulary and symbols within the text (e.g., hyperlinks or footnotes to definitions, explanations, illustrations, previous coverage, translations)</td>
<td>- Embed support for vocabulary and symbols within the text (e.g., hyperlinks or footnotes to definitions, explanations, illustrations, previous coverage, translations)</td>
<td>- Embed support for vocabulary and symbols within the text (e.g., hyperlinks or footnotes to definitions, explanations, illustrations, previous coverage, translations)</td>
<td>- Provide electronic translation tools or links to multilingual glossaries on the web</td>
<td></td>
</tr>
<tr>
<td>- Embed support for unfamiliar references within the text (e.g., domain specific notation, lesser known properties and theorems, idioms, academic language, figurative language, mathematical language, jargon, archaic language, colloquialism, and dialect)</td>
<td>- Highlight structural relations or make them more explicit</td>
<td>- Highlight structural relations or make them more explicit</td>
<td>- Embed visual, non-linguistic supports for vocabulary clarification (pictures, videos, etc.)</td>
<td></td>
</tr>
</tbody>
</table>

(CAST, 2008)
Table 3

Comprehension Guideline

<table>
<thead>
<tr>
<th>Activate or supply background knowledge</th>
<th>Highlight patterns, critical features, big ideas, and relationships</th>
<th>Guide information processing and visualization</th>
<th>Maximize transfer and generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Anchor instruction by linking to and activating relevant prior knowledge (e.g., using visual imagery, concept anchoring, or concept mastery routines)</td>
<td>• Highlight or emphasize key elements in text, graphics, diagrams, formulas</td>
<td>• Give explicit prompts for each step in a sequential process</td>
<td>• Provide checklists, organizers, sticky notes, electronic reminders</td>
</tr>
<tr>
<td>• Use advanced organizers (e.g., KWL methods, concept maps)</td>
<td>• Use outlines, graphic organizers, unit organizer routines, concept organizer routines, and concept mastery routines to emphasize key ideas and relationships</td>
<td>• Provide options for organizational methods and approaches (tables and algorithms for processing mathematical operations)</td>
<td>• Prompt the use of mnemonic strategies and devices (e.g., visual imagery, paraphrasing strategies, method of loci, etc.)</td>
</tr>
<tr>
<td>• Pre-teach critical prerequisite concepts through demonstration or models</td>
<td>• Use multiple examples and non-examples to emphasize critical features</td>
<td>• Provide interactive models that guide exploration and new understandings</td>
<td>• Incorporate explicit opportunities for review and practice</td>
</tr>
<tr>
<td>• Bridge concepts with relevant analogies and metaphors</td>
<td>• Use cues and prompts to draw attention to critical features</td>
<td>• Introduce graduated scaffolds that support information processing strategies</td>
<td>• Provide templates, graphic organizers, concept maps to support note-taking</td>
</tr>
<tr>
<td>• Make explicit cross-curricular connections (e.g., teaching literacy strategies in the social studies classroom)</td>
<td>• Highlight previously learned skills that can be used to solve unfamiliar problems</td>
<td>• “Chunk” information into smaller elements</td>
<td>• Provide scaffolds that connect new information to prior knowledge (e.g., word webs, half-full concept maps)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Progressively release information (e.g., sequential highlighting)</td>
<td>• Embed new ideas in familiar ideas and contexts (e.g., use of analogy, metaphor, drama, music, film, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Remove unnecessary distractions unless they are essential to the instructional goal</td>
<td></td>
</tr>
</tbody>
</table>

(CAST, 2008)
Assistive Technologies

Assistive technology is one of the tools that students with disabilities need to facilitate learning in online courses. There is a difference between assistive technology and accommodations (Lyman et al., 2016) in that not all accommodations need to use assistive technologies. Assistive technology is a tool that helps accommodate disabilities (Barnard-Brak & Sulak, 2010). Accommodations are the services that provide equal access to courses materials and evaluation for students with disabilities and minimize the challenges in their academic performance (Barnard-Brak & Sulak, 2010). According to the Individuals with Disabilities Education Act (2004), assistive technology is “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, used to increase, maintain, or improve functional capabilities of people with a disability (p. 320).” Fichton et al. (2009) identified some accommodations that use assistive technologies that are beneficial for students with low vision. They surveyed students with visual impairments (blind and low vision) to explore the most effective assistive technologies for supporting their learning. They found that 50% of the students with low vision used different types of software that helped them enlarge what was on the screen (such as magnification and zoom) and software that improved the quality of writing (such as grammar and spell check, colors, and highlighting). In addition, the majority of students with low vision also indicated they frequently utilize other types of technology, such as large-screen monitors, scanning and optical character recognition software, and alternative mouse (such as trackball and mouse keys). Other technologies were used less frequently were dictation software, adapted keyboards such as large keys and an on-screen keyboard, and refreshable braille displays.
Other types of assistive technologies, such as tactile maps, can help the mobility of students with disabilities on campus. Feucht and Holmgren (2018) evaluated a process for developing tactile maps based on users’ needs and preferences and highlighted the necessary features of tactile maps to provide independent, efficient, and safe travel around a university campus. Their qualitative study revealed that participants who have low vision noted which features of a tactile map were critical for them. The finding of their study showed that three of the participants preferred microcapsule lines to braille embossed lines, while one participant identified the usefulness of both features. Map features that contribute to readability and efficacy of use include the medium, the layout, and the combination of orientation maps that provide an overview of a large area highlighted as beneficial for participants. They also mentioned mobility maps, which contained more detailed and are designed to help the traveler in unfamiliar areas. Based on their findings, Feucht and Holmgren (2018) suggested that colleges and universities should gather data and create tactile campus maps for students with low vision or blindness. Assistive technologies such as tactile maps are one of the accommodations that help students who have movement challenges due to their physical or visual impairments.

Disability Legislation

While UDL may eliminate the need for some accommodations, some students may still need individualized accommodations (Crow, 2008). Individualized accommodations related to disability are essential for some students with disabilities when there is no other way to meet their needs. Therefore, Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA, 1990) and the Assistive Technology Act (1998) require reasonable accommodations to be made.
Section 504 (1973) provides equal benefits, opportunities, and services on college campuses and other federally funded academic and corporate institutions to students with disabilities. This section is an inherent component of the Rehabilitation Act of 1973. It is one of the first acts of disability rights legislation in the U.S. and is monitored by the Office of Civil Rights in the USDE. According to Section 504, every student who is a “qualified individual with a disability” must be provided with appropriate accommodations, including equal access to classrooms. If schools do not receive federal funding, they may be exempt from Section 504, but they still have to adhere to an alternate form of legislation that protects disability rights. In general, Section 504 of the Rehabilitation Act of 1973 requires institutions of higher education to provide students with disabilities the same opportunities as non-disabled students.

In 1998, Section 508 was added to the 1973 Rehabilitation Act to cover electronic and information technology (EIT). Section 508 is centered on technology, differing from Section 504 that is centered on accommodating the specific needs of individual persons. Many changes were introduced to Section 508 in January 2017 and took effect January 18, 2018.

The Americans with Disabilities Act (ADA, 1990) protects students at both public and private academic institutions under Title II and Title III legislation. The ADA is governed by the U.S. Department of Justice. According to this Act, students with disabilities are protected against discrimination in services, programs and activities provided by public institutions via Title II, while students at private schools are afforded the same protection through Title III provisions. Title III also requires all eligible institutions to administer education in an environment accessible for all students.

Other legal regulations are the Assistive Technology Act (1998) and the Illinois Information Technology Accessibility Act (IITAA). The Assistive Technology Act protects
students with disabilities in that state-run institutions may be eligible for grants to purchase assistive technologies and devices for students with disabilities, including wheelchairs, voice-amplifying learning systems, and other software. The Illinois Information Technology Accessibility Act requires Illinois agencies and universities to ensure their websites, information systems, and information technologies are accessible to people with disabilities. While the Americans with Disabilities Act and Section 504 of the Rehabilitation Act already require states to ensure accessibility, the IITAA establishes specific standards and encourages states to address accessibility proactively.

Chapter Summary

Although there have been several areas of investigation regarding online courses in higher education, there is still a need for more formalized qualitative studies to explore the accommodations for students with low vision in online courses. The current study sought to fill that gap because incorporation of low vision accommodation resources has the potential to increase enrollment and the instructional effectiveness of online courses. There are legal and ethical responsibilities for universities to develop online courses for students with low vision (Rose et al., 2006). However, some institutions are not as accommodating as they should be. Ostrowski (2016) addressed one of issues related to online courses, which is the inability to accommodate students who may need a different kind of help than that offered in traditional courses. Studies (e.e., Barnard-Brak & Sulak, 2010; Goegan & Harrison, 2017; Phillips et al., 2012) have focused on students with disabilities pursuing degrees in higher education, but there is limited research on students with visual disabilities, specifically students with low vision, in
online courses. Finally, the current study contributes to literature on the use of low vision accommodations based on UDL principles in online courses.
CHAPTER 3
METHODOLOGY

Introduction

This study utilized a qualitative case study method to explore the perceptions of students with low vision regarding accommodations based on the Universal Design for Learning (UDL) principles present and/or are needed in online courses. Data for this research were collected through multiple data sources: a survey, individual interviews, and field notes. This chapter provides information about the role of the researcher, the theoretical approach to the study, the research design, the research setting, the participant criteria, and the data collection protocol as well as the data analysis and trustworthiness of the study.

Role of the Researcher

The researcher of this study has Stargardt’s disease, the most common form of inherited juvenile macular degeneration (National Eye Institute, 2015). She was born visually impaired. The progressive vision loss associated with Stargardt’s disease is caused by the death of specific photoreceptor cells known as cones located in the central portion of the retina, called the macula and the fovea centralis (NEI, 2015). The cones are responsible for what is known as photopic vision – e.g., color, contrast, and clarity. Most of the remaining retina is composed of rod cells responsible for scotopic vision (e.g., light, dark, and motion). The peripheral retina and photoreceptor cells are unaffected by macular degeneration. Rod cells function in lower levels of
light, allowing her to have a better vision. However, when she goes out in the sun, it is hard for
the researcher see well; her vision is much better at night. This is the same process people
experience when someone takes a flash picture of them and they see a dark afterimage for a short
period. Unfortunately, in macular degeneration, the spot or decrease in vision may last much
longer. The macula has the highest concentration of cones, the cells that provide color vision.
Thus, the degeneration of the macula results in damage to the cone color cells. The researcher of
this study can still see color, but color perception may become more and more impaired in
advanced macular degeneration.

The researcher’s personal experience with online courses in higher education goes back
to 2012 when she started her Master’s in Instructional Technology at California State University,
San Bernardino. The second quarter was the first time the researcher had a completely online
course. Now, the researcher is a Ph.D. candidate in the same field and is taking some online
courses. Most of the instructors use Blackboard™, a learning management system (LMS), to
deliver information, interact with the students, and allow students to have discussions. The
researcher has had personal experience contacting the DRC to request accommodations for low
vision, although most accommodations were requested for the traditional classroom, such as
large print and dark colors. They were helpful for classroom activities that used mostly paper.
However, sometimes more accommodations are needed for online course activities. For
example, it is hard to use a magnifier to interact with the instructor and classmates via chat and
read the PowerPoint slides at the same time. Most of the effective instructors during the
researcher’s Ph.D. program in Instructional Technology have provided PowerPoint slides with
black font color before the online session meeting. This is especially important for persons with
Stargart’s or other cone-rod dystrophies, as color vision is sometimes greatly affected.
Based on personal experience while requesting accommodations for online courses, the researcher chose to conduct this research to help others who have the same or comparable situations and need support to reduce difficulties. The purpose of this research was to determine the most helpful accommodations currently available and to explore what other accommodations for the future might assist students with low vision needs in online courses.

Research Design

The rationale for employing a qualitative research approach in this study was the assumption that this form of research could help the researcher understand the participants’ experiences and perceptions of the related to having low vision while taking online courses (Hatch, 2002; Moustakas, 1994; Patton, 2002; Yin, 2015). For instance, a qualitative approach allows researchers to examine the phenomenon while seeking an answer to questions that start with “what.” As the study aimed to explore which accommodations students with low vision find helpful, “What” question were beneficial for examining the participants’ experiences with online courses (Creswell, 2009). Therefore, a qualitative approach enabled the researcher to conduct a detailed and rich exploration of the accommodations that can help reduce low vision difficulties in online courses.

Creswell (1998, 2009) categorized qualitative research methods into five approaches: narrative, grounded theory, ethnography, phenomenological, and case study. First, the narrative was rejected because of its focus on the individual to form a cohesive story, which is not necessary for this study. Second, grounded theory was rejected because this study did not develop a theory. Third, ethnography was rejected because this study did not intend to focus on the exploration of a culture. According to Creswell (2009), “ethnographic designs are qualitative
research procedures for describing, analyzing, and interpreting a culture-sharing group’s shared patterns of behavior, beliefs, and language that develop over time” (p. 462). Fourth, phenomenological was also rejected because it requires a combination of methods, such as conducting interviews, reading documents, watching videos, or visiting places and events, to understand the phenomena on the setting examined. In addition, phenomenological requires between 5 and 25 interviews to build a sufficient dataset to look for emerging themes and to use other participants to validate findings. A case study method was chosen because it allowed the researcher to conduct an exploratory, detailed and in-depth investigation of a single event, situation, setting and individual over a period of two semesters.

Case studies emphasize data about people’s experiences for describing and reporting stories of their lives (Hatch, 2002; Moustakas, 1994; Yin, 2015). According to Creswell (1998), case study is defined as “a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes” (p. 61). In addition, case studies are bound by time and context (Yin, 2009). In the case study, the research was bound by time (two semesters) and context (a public university in the Midwest in the U.S.).

Research Questions

The study was guided by the following research questions:

1. What are the information delivery methods in the past online courses that students with low vision perceive to be most helpful regarding their learning?
a. How were students able to manipulate those information delivery methods to help their personal preferences for learning?

b. If unable to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?

2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?

3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?

Setting, Sample and Participants

The study took place at a U.S. public university in the Midwest with a total enrollment of students 17,169 for Fall 2018. According to the university’s 2018 website, there were 12,788 undergraduates, 4,121 graduates, and 260 College of Law. As the mission states, the school “celebrates its diverse population in all its forms, including gender, race, ethnicity, ability, spirituality, sexuality, age, and individual identities.” The school had international and out-of-state students, including 1,211 international students from 77 different countries. The average age of undergraduates was 22 years old compared to the average age of the graduate students at 32 years old (University Fact Sheet, 2018). The female/male categories for undergraduates were 50.8% male and 49.2% female and for graduate students were 46.6% male and 53.4% female. This Midwest public university offered approximately 20 undergraduate and graduate degrees online and 10 additional certificates fully online.
This study used purposeful sampling because the researcher selected the students with low vision enrolled in online course settings. Creswell (2009) stated that in qualitative research, researchers identify participants and sites using purposeful sampling based on places and people that can best help a researcher understand the central phenomenon. The concept of purposeful sampling refers to the selection of participants who can “inform the research study purposefully” (Creswell, 2007, p. 125). Based on the Creswell’s (2009) recommendations, the eligibility criteria for this study included that the participants should be adult students who were over of the age 18, who had a low vision, and who had taken or were taking online courses at the university level. However, specific exclusion criteria were also set for potential participants because their visual acuity had to be 20/70 or less. For purpose of this study, low vision identifies as “a person who has difficulty accomplishing visual tasks, even with prescribed corrective lenses, but who can enhance his or her ability to accomplish these tasks with the use of compensatory visual strategies, low vision and other devices, and environmental modifications” (Corn & Koenig, 1996, p. 4). Low vision is defined as having a visual acuity that is 20/70 or less in the better-seeing eye, which cannot be corrected with regular glasses, contact lenses, medicine, or surgery (National Eye Institute, 2019). Visual acuity is a number that indicates the sharpness or clarity of vision. A visual acuity measurement of 20/70 means that a person with a 20/70 vision sees what a person with unimpaired (or 20/20) vision can see from 70 feet away as measured with standard Snellen eye chart (see Figure 1; American Foundation for the Blind, 2015). Some examples of low vision may be that students have loss of central vision, loss of peripheral (side) vision, blurred vision, generalized haze, extreme light sensitivity, and night blindness, but never less than 20/200, which infers legal blindness.
The interview participants were selected from those who completed the survey and provided contact information in the last question where participants expressed their willingness to be interviewed. Out of the six, only two were willing to participate in individual interviews. Therefore, the researcher used snowball sampling to increase the small number of interview participants, recruiting one more interviewee. Snowballing refers to asking the potential interviewees to provide names of individuals who meet the criteria set for this study and might be interested in being interviewed (Creswell, 2009). Thus, three participants agreed to be interviewed. The goal of a two to four-person sample size for the interview was achieved. As the interview questions were tailored to gain an in-depth understanding of the phenomenon, the researcher decided to limit the sample size to a small number. This allowed the researcher to be immersed in the research and to establish continuing and fruitful relationships with the respondents (Patton, 2002). Therefore, the small number of participants in this study facilitated
the researcher’s close association with the respondents and enhanced the validity of fine-grained in-depth inquiry in naturalistic settings.

Data Sources

Survey

To develop the survey questions for the data collection, the researcher used the checkpoints UDL guidelines provide for each principle (CAST, 2008). The researcher developed the online survey using Qualtrics, a simple web-based software. The first part of the survey includes a consent form (See Appendix A).

The survey includes 25 questions (see Appendix B), including demographic questions, Likert scale items, and open-ended questions. The first 10 questions in the survey asked demographic questions related to the participants’ age, educational degree, major and online courses, and type of low vision condition. If the participant answers “No” to one of the following questions: “Do you have low vision problems?” and/or “Have you taken online or blended courses during your college/university study?”, the participant could not continue with the rest of the survey.

The main part of the survey contains questions in which respondents were asked, based on a Likert scale, to rate the helpfulness of accommodations in online courses based on the UDL principles. The remaining parts of the survey included open-ended questions designed to gain an understanding of the participants’ ratings and subjective experiences using accommodations to complete online courses. The survey questions were formulated based on the research questions
and the UDL principles (see Table 4). The survey took approximately 10 to 15 minutes to complete. The last question asked for a volunteer participant for follow up interviews.

To test the reliability of the survey, the survey was Beta tested in November 2019 with three graduate student respondents prior to starting the study. These students were not counted as the participants. This step was to improve the quality of the survey. It helped identify problems such as unclear wording and clarified the time to complete the survey. Based on the participants’ feedback, changes such as adding, eliminating and altering questions were made to improve the survey.

**Individual Interviews**

Individual interviews were conducted to gain more detailed information from the students with low vision regarding their perceptions of accommodations in online courses. Individual interviews are a popular qualitative approach for collecting data in educational research in that the researcher asks questions and records answers from only one study participant at a time (Patton, 2002).
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Instruments Survey</th>
<th>UDL Principles</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are the information delivery methods in the past online courses that students with low vision perceive to be most helpful in regard to their learning?</td>
<td>Q11 a-b-c-d-e-f-g-h-i-j, Q14, Q17, Q19, Q23 f-g-h-i-j-n-o</td>
<td>Representation</td>
<td>The checkpoint listed from the UDL principle guideline (CAST, 2008): Table #1 Perception Guideline Table #2 Language and Symbol Guideline Table #3: Comprehension Guideline</td>
</tr>
<tr>
<td>a. How were students able to manipulate those information delivery methods to help their personal preferences for learning?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. If unable to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?</td>
<td>Q12 a-b-c-d-e-g-h-i, Q13 a-b-c-d-e-f, Q15, Q18, Q21 a-b-c -m</td>
<td>Action and Expression</td>
<td>Checkpoints to optimize access to tools and assistive technologies to open doors for learning with accessible tools and devices (CAST, 2008).</td>
</tr>
<tr>
<td>3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?</td>
<td>Q16, Q20, Q23 d-e j-k-l</td>
<td>Engagement</td>
<td>The “engagement” principle of UDL has a guideline of sustain effort and persistence including the checkpoints of various demands and resources to optimize challenge</td>
</tr>
</tbody>
</table>

(CAST, 2008)
The interview questions were semi-structured, including 10 open-ended questions (see Appendix C). The questions were based on the three principles of UDL to seek the participants’ specific subjective experiences about using or requiring accommodations in online courses (see Table 5). The interview questions were se prepared in advance; however, probing questions were used when necessary to clarify or substantiate response. The interview questions provided some parameters for conducting the discussions.

The researcher conducted one practice interview with a student who had previously taken the practice survey. The practice interview helped the researcher familiarize herself with the interview protocol and to judge the quality of the answers and the degree to which the respondents understood the questions. Practicing with people who were similar to participants can make a large difference to the information and help make changes in the questions (Patton, 2002). Thus, required changes were made to the interview questions based on the pilot study participants’ feedback.
Table 5
Research Questions Aligned the Interview

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Instruments Interview</th>
<th>UDL Principles</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) What are the information delivery methods in past online course that students with low vision perceive to be most helpful in regard to their learning?</td>
<td>Q 1 Q 2 Q 3 Q 8</td>
<td>Representation</td>
<td>The checkpoint listed from the UDL principle guideline (CAST, 2008): Table #1 Perception Guideline Table #2 Language and Symbol Guideline Table #3: Comprehension Guideline</td>
</tr>
<tr>
<td>a. How were students able to manipulate those information delivery methods to help their personal preferences for learning?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. If unable to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?</td>
<td>Q 3 Q 6 Q 7 Q 9</td>
<td>Action and Expression</td>
<td>Checkpoints to optimize access to tools and assistive technologies to open doors for learning with accessible tools and devices (CAST, 2008).</td>
</tr>
<tr>
<td>3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?</td>
<td>Q 5 Q 8 Q 7</td>
<td>Engagement</td>
<td>The “engagement” principle of UDL has a guideline of sustain effort and persistence including the checkpoints of various demands and resources to optimize challenge (CAST, 2008).</td>
</tr>
</tbody>
</table>

(CAST, 2008).
Recruitment

Participant recruitment was completed through two methods. First, the researcher contacted an associate professor in the Special and Early Education Department (SEED) of the target university by email (see Appendix D) to ask them to distribute the survey link to the students he/she was teaching who met the criteria. The associate professor forwarded the invitation email, including the survey link to five students who met the study’s criteria. Four out of five completed the survey.

The other method of recruitment was an email (See Appendix E) asking the director of the disability resources center (DRC) to forward an invitation email (see Appendix F) with a survey link to students who had registered with the DRC and identified as students with low vision. The DRC director forwarded the invitation email to students who had registered with the DRC, identified as visually impaired, and received accommodations from the DRC. Three students completed the survey. However, one of the participants was excluded because his visual condition was total blindness rather than low vision.

In response to the last online survey question, the participants expressed their willingness to be interviewed. Out of the six, two agreed to participate in individual interviews and provided their contact information. The researcher used snowball sampling for recruiting one more interviewee.

Consent

The first item on the online survey was the consent form that indicated the participants allowed their survey data to be used in this case study. The participants needed to agree to the
consent form before the other survey items would appear. The consent form explained the purpose of the research and provided a description of the survey questions and the time needed to complete the survey. The consent form included the statement about maintaining the participants’ confidentiality and an assurance that participation was voluntary so the participants could withdraw at any time without penalty or prejudice.

Prior to the interviews, each participant either signed a consent form (see Appendix G) or gave verbal consent in the case of telephone interviews. The consent form asked their permission to voluntarily participate and to be audio recorded. Participants were informed that pseudonyms would be used when reporting their responses.

**Data Collection**

After the research was approved by the university’s Institutional Review Board (IRB) (see Appendix H), the data collection process began with distribution of the online survey by the associate professor in the Special and Early Education Department and the DRC director during the Fall 2019 semester. Six students with low vision participated in the online survey. The individual interviews were conducted after the online survey window closed. After the participants completed the survey and provided their preference contact information, the researcher contacted the participants via email or phone to set up the interview date/time and location. The individual interviews were completed during the second week of the Spring 2020 semester.

The individual interviews were audio-recorded. Interviews were conducted face-to-face or via the telephone depending on the participants’ preference. There were two face-to-face interviews and one telephone interview. The face-to-face interviews were conducted one-on-one
with the researcher and the participant in a mutually agreed upon location. One of the participants chose to have her interview in the library and the other participant chose the learning center. The duration for each interview was 45 to 60 minutes.

Data Analysis

In qualitative designs, it is common for data analysis techniques to emerge from the data and evolve throughout the process of data analysis (Merriam, 1998). A demographic table provides readers with various demographic information for each participant (Patton, 2002). By analyzing the demographic items in the online survey, the researcher developed a demographic description table (see Table 6). The online survey items were analyzed to answer each research question. Extracting the data from the items Q11, Q12, Q13 and Q23, the researcher created tables to demonstrate the responses to the most helpful accommodations (see Tables 9, 10, 11, 12).

The researcher hired a professional transcription service (Rev.com) to transcribe the interviews. The researcher read the responses to the open-ended questions on the survey and the textual data of the interviews multiple times to gain a deeper understanding of information provided by the participants (Creswell, 2012). Prior to data analysis, the researcher created a codebook based on each research question, including the information delivery methods coded as ID and highlighted with yellow color, most helpful accommodations coded as HA and highlighted in green, assistive technology coded as AT and highlighted in blue, accessibility coded as AA and highlighted in pink, and the wish list coded as WLA and highlighted in red. The researcher analyzed the data line-by-line to code (see Appendix I).
First, the researcher applied an open-coding strategy to analyze the responses from open-ended online survey questions and the interviews by looking specifically for words related to pre-defined codes. For example, when the participants mentioned a screen reader, the researcher coded it as AT and highlighted it in blue. Also, when the participants mentioned they preferred text information in online courses, the researcher coded it as ID and highlighted it yellow, which refers to the information delivery methods (see Appendix I).

According to Patton (2002), the process of coding starts with segmenting and labeling similar codes to form descriptions and broad themes. Therefore, the researcher labeled each of the pre-defined codes as themes. The themes were used to respond to each research question: information delivery methods addressed research question Q1; most helpful accommodations, assistive technology and accessibility referred to the research question Q2, and the wish list of the students with low vision responded research question Q3 (see Appendix I).

Trustworthiness of the Study

To ensure the trustworthiness of the study, the researcher employed strategies such as clarifying the role of the researcher, data triangulation, and member checking as suggested by Merriam (1998). Qualitative inquirers triangulate among different data sources to enhance the accuracy of a study. To provide better accuracy of the findings, the researcher applied the same codes and themes for the open-ended questions and the interviews. For example, the researcher compared the responses from the open-ended questions and the interviews and coded with the same code such as the most helpful accommodations. According to Creswell (2012), triangulation is the process of corroborating evidence from different individuals (e.g., a principal and a student), type of data (e.g., observational field notes and interviews), or methods of data
collection (e.g., documents and interviews) in description and themes in the qualitative research” (p. 259). Therefore, this study was triangulated through data drawn from the survey and interviews and contrasted with the existing literature in the field.

Moreover, the researcher used member-checking to enhance and ensure the trustworthiness of the study. Member checks may involve sharing all findings with participants and allowing them to analyze and comment critically on the findings (Creswell, 2007). To do the member checking, the researcher sent the transcript to each participant. Two out of three participants reviewed the transcripts and confirmed the accuracy of the transcript. After the data analysis finished, the researcher sent the themes to receive their feedback. The researcher received two responses and they agreed with themes.

Generalizability

The aim of this study was to explore the most helpful accommodations for some students with low vision in online courses. The results of this study could be generalized to other students who have a visual impairment. Accordingly, others can examine the study for an understanding of the accommodations, accessibility and assistive technology. This research can be referenced when studying similar situations in other states and countries. The transferability of the findings and results of this research was enhanced by providing detailed descriptions of the responses of the participants that permitted the researcher to evaluate the applicability of the findings to other contexts.
Ethical Considerations

The research was in compliance with the Northern Illinois University (NIU) IRB criteria. The participants signed a consent form that clarified the risks and benefits and explained they could withdraw at any time without any penalty. Confidentiality was protected in that data were stored on a password protected computer and the participants were given pseudonyms. Transcripts will be kept for five years.

Chapter Summary

This chapter presented the research design, study setting, criteria for participant selection and sampling procedure, the data collection sources, and data analysis as well as a description of the steps taken to ensure the trustworthiness of the study. Through a qualitative case study, the researcher explored the participants’ experiences and perceptions of online courses regarding accommodations for students with low vision.
CHAPTER 4

RESEARCH FINDINGS

This study explored the most helpful accommodations based on universal design learning (UDL) principles for students with low vision in online courses. The data were gathered through an online survey (six participants) and three individual interviews. The participants involved in this study included students with low vision who had taken or were currently taking online courses at the university level at a public university in the Midwest U.S.

This chapter includes two sections. The first provides an overview of the survey results for each research question. The second section presents the results drawn from the interview questions and the survey open-ended questions pursuant to the research questions. The research questions that guided this study were

1. What are the information delivery methods in the past online courses that students with low vision perceive to be most helpful regarding their learning?
   c. How were students able to manipulate those information delivery methods to help their personal preferences for learning?
   d. If unable to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?

2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?
3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?

Description of Participants

Six students with low vision completed the survey. The demographic information of the participants includes their age, highest educational degree completed, major, online course type, and vision condition. The participants included students ranging in age from 18 to 54 from different academic majors: accountancy, construction engineering, ecology, and environmental biology, English studies, environmental health, and special education. The participants were undergraduate and graduate students (see Table 6). Table 6 shows that 42.86% (n=3) of the participants had experience with fully online courses and 57.14% (n=4) of the participants had experience with blended courses, including online sessions and face-to-face classes. The participants’ visual conditions varied: 16.67% (n=1) of the participants had a loss of peripheral (side) vision, 33.33% (n=2) of the participants had blurred vision, 16.67% (n=1) of the participants had extreme light sensitivity, and 33.33% (n=2) identified their visual condition included multiple symptoms (e.g., light projection, all, night blind, no side, and loss of central and totally blind).
Table 6

Summary of Demographic Information for Online Survey Participants

<table>
<thead>
<tr>
<th>Age</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>33.33%</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>54</td>
<td>16.67%</td>
<td>1</td>
</tr>
</tbody>
</table>

**Highest Educational Degree Completed**

<table>
<thead>
<tr>
<th>Degree</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School/GED</td>
<td>14.29%</td>
<td>1</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>14.29%</td>
<td>1</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>42.86%</td>
<td>3</td>
</tr>
<tr>
<td>Ph.D./Ed.D. or similar doctoral degree</td>
<td>14.29%</td>
<td>1</td>
</tr>
</tbody>
</table>

**Major**

- Accountancy
- Construction Engineering
- Ecology and environmental biology
- English Studies
- Environmental Health
- Special education

**Type of courses**

- Fully online courses. 50% 3
- Fully online courses and blended (hybrid). 50% 3

**Visual Condition**

<table>
<thead>
<tr>
<th>Condition</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Peripheral (Side) Vision</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Blurred Vision</td>
<td>33.33%</td>
<td>2</td>
</tr>
<tr>
<td>Extreme Light Sensitivity</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Other, Please describe.</td>
<td>33.33%</td>
<td>2</td>
</tr>
<tr>
<td>Light projection</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>All. Night blind. No side. And loss of central</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Survey Results

The results of the online survey revealed the participants preferred face-to-face courses more than online courses. Two participants responded they somewhat agreed or agreed with the statement: “As a low vision student, I prefer online courses rather than face-to-face,” but three participants responded they somewhat disagreed or strongly disagreed, while one participant responded as being neutral.

Table 7

Q23_a: As a low vision student, I prefer online courses rather than face-to-face.

<table>
<thead>
<tr>
<th>Answer</th>
<th>%</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Agree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Somewhat agree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Somewhat disagree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Disagree</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>33.33%</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>6</td>
</tr>
</tbody>
</table>

In addition, the online survey revealed that the need for accommodations in online courses depended on the course content. Four participants responded they somewhat agreed or strongly agreed with the statement: “course content (math, science, language, etc.) affects the
need for accommodation. ” However, one participant disagreed, and one participant remained neutral (see Table 8).

Table 8

Q23_ k. Course content (math, science, language, etc.) affects need for accommodation.

<table>
<thead>
<tr>
<th>Answer</th>
<th>%</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>50.00%</td>
<td>3</td>
</tr>
<tr>
<td>Agree</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Somewhat agree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Somewhat disagree</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Disagree</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>6</td>
</tr>
</tbody>
</table>

Furthermore, the online survey respondents were asked to assess the level of helpfulness of the accommodations they had received in online courses (see Table 9). Five participants responded that accommodations for online courses should include alternative formats for textual materials such as electronic texts (Word, PDF, straight/plain text) because they are helpful, but one participant identified the alternative format for textual was not applicable. In addition, four respondents identified alternative formats of digital audio-visual recordings as very helpful. However, one respondent identified requesting alternative formats of digital audio-visual recordings as an accommodation was not helpful for online courses and one participant responded the option was not applicable.
The survey results also showed that the six participants identified extended time for exams as helpful accommodations in online courses. Three respondents classified getting class materials in advance for more time to process information before class was extremely helpful, while two participants responded that was not applicable, and one participant remained neutral.

In addition, four respondents identified providing differentiated mentors (i.e., teaching assistants/tutors who use different approaches to motivate, guide, give feedback or inform) as one of the accommodations that is not applicable, but two respondents identified it as an extremely helpful accommodation. Two participants specified additional helpful accommodation for online courses: one participant suggested notes from other classmates and the other participant recommended that the disability resource center should liaise with instructors of online courses (see Table 9).

Regarding accessibility in online courses, the results of the online survey (see Table 10) revealed that five respondents identified that all links and tabs in online courses should have unique names, a very helpful accessibility aspect in online course. However, one participant identified it as not applicable. In addition, the survey results showed that some accessibility accommodations in online courses were not applicable to any of the six participants, such as closed captions on video media (DVDs, videotapes, video podcasts, other video formats). In addition, five participants identified transcripts of video or audio presentations as not applicable, while one participant identified it as very helpful. Four respondents identified images of texts that were available in online courses or an alternative such as PDFs made from scanned pages were extremely helpful to slightly helpful, while one participant identified it as not applicable.

Three respondents also revealed that the text and background color having enough contrast was helpful, while the three other participants considered that as not applicable or not at all helpful.
Q11: Which of the following reasonable accommodations have you received in online courses?

<table>
<thead>
<tr>
<th>Q11. Reasonable accommodations</th>
<th>Extremely Helpful</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Slightly Helpful</th>
<th>Not at all Helpful</th>
<th>Not Applicable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Requesting alternative formats for textual materials: electronic texts (Word, PDF, straight/plain text).</td>
<td>66.67%</td>
<td>4/16.67%</td>
<td>1/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/16.67%</td>
<td>1/6</td>
</tr>
<tr>
<td>b. Requesting alternative formats of digital audio-visual recordings.</td>
<td>50%</td>
<td>3/16.67%</td>
<td>1/0%</td>
<td>0/0%</td>
<td>0/16.67%</td>
<td>1/16.67%</td>
<td>1/6</td>
</tr>
<tr>
<td>c. Provide differentiated mentors (i.e., teaching assistants/tutors who use different approaches to motivate, guide, give feedback or inform).</td>
<td>33.33%</td>
<td>2/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/66.67%</td>
<td>4/6</td>
</tr>
<tr>
<td>d. Extended time for exam and/or assignments.</td>
<td>66.67%</td>
<td>4/33.33%</td>
<td>2/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/6</td>
</tr>
<tr>
<td>e. Getting class materials in advance for more time to process information before class.</td>
<td>50%</td>
<td>3/0%</td>
<td>0/0%</td>
<td>0/16.67%</td>
<td>1/0%</td>
<td>0/33.33%</td>
<td>2/6</td>
</tr>
<tr>
<td>Other (Please specify)</td>
<td>33.33%</td>
<td>2/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/2</td>
</tr>
<tr>
<td>Notes from other students arranged by the student accommodations center</td>
<td>16.67%</td>
<td>1/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/0%</td>
<td>0/1</td>
</tr>
</tbody>
</table>

Table continued on next page
In most respects, my experiences with Offices for Students with Disabilities across the four universities I’ve attended have been positive ones in terms of materials access, testing accommodation, and helping liaise with professors who did not understand a given accommodation or the

| In most respects, my experiences with Offices for Students with Disabilities across the four universities I’ve attended have been positive ones in terms of materials access, testing accommodation, and helping liaise with professors who did not understand a given accommodation or the | 16.67 % | 1 | 0% | 0% | 0% | 0% | 0% | 0% | 0 | 1 |

Additionally, three participants responded that providing text descriptors for any relevant image, graph, or chart used within the course or within any document or presentation was helpful, but the three other participants identified it as not applicable (see Table 10). In addition, two respondents identified using visual analogs to represent emphasis and prosody such as emoticons, symbols, or images was not at all helpful for them, and three respondents reported it was not applicable. However, one participant identified that as very helpful.

Moreover, the participants were asked to assess the helpfulness of providing compatible online materials with spellcheckers, grammar checkers, and word prediction software. The results showed that four respondents identified the software as helpful in online courses, but two responded they were not applicable. Three participants responded that text-to-speech software (voice recognition, human dictation, and recording) was helpful, while the other three participants identified it as not applicable. Four participants responded that calculators, graphing
calculators, geometric sketchpads, or pre-formatted graph paper were not applicable, while two participants responded very helpful and slightly helpful (see Table 10).

Additionally, respondents were asked to assess the level of the helpfulness of the assistive technologies they used in previous online courses. The online survey results revealed that five respondents identified Word Processor programs as helpful assistive technology in online courses, but one participant identified they were not applicable. The other helpful assistive technologies were enlarged text and audiobooks. Three respondents identified enlarged text and audiobooks as extremely helpful, while the three other participants considered enlarged text and audiobooks as not applicable, not at all helpful, or neutral, respectively. In addition, three respondents identified JAWS and Text to Speech (e.g., Math Talk) as helpful assistive technology; however, the three other participants identified the technology as not applicable. Also, three participants identified reader scanners and Kurzweil 3000 as helpful, while the other three participants considered them not applicable. On the other hand, five participants identified the magnifier as not helpful and not applicable in online courses, while one participant identified the magnifier as very helpful (see Table 11). Additionally, the survey results revealed that the participants would like to have some changes in the accommodations in their online courses. Table 12 shows that three respondents (50%) strongly agreed that if they were an instructor or the director of a disability resource center, they would like to improve and explore new and innovative technologies to be used in online courses.
Table 10

Q12: Which of the following accessibility accommodations did you find the most helpful?

<table>
<thead>
<tr>
<th>Q12. Accessibility</th>
<th>Extremely Helpful</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Slightly Helpful</th>
<th>Not at all Helpful</th>
<th>Not Applicable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. All links are uniquely named</td>
<td>16.67% 1</td>
<td>50% 3</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>6</td>
</tr>
<tr>
<td>b. Closed captions on video media (DVDs, video tapes, video podcasts, other video formats)</td>
<td>0% 0</td>
<td>0% 0</td>
<td>0% 0</td>
<td>0% 0</td>
<td>0% 0</td>
<td>100% 6</td>
<td>6</td>
</tr>
<tr>
<td>c. A transcript of the video or audio presentation is available</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>66.67% 4</td>
<td>6</td>
</tr>
<tr>
<td>d. Images of texts are available, OR an alternative is provided. (Examples of text images are PDFs made from scanned pages).</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>33.33% 2</td>
<td>0% 0</td>
<td>33.33% 2</td>
<td>6</td>
</tr>
<tr>
<td>e. Text and background color have enough contrast</td>
<td>16.67% 1</td>
<td>33.33% 2</td>
<td>0% 0</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>33.33% 2</td>
<td>6</td>
</tr>
<tr>
<td>f. Text descriptors are provided for any relevant image, graph, or chart used within the course or within any document or presentation.</td>
<td>16.67% 1</td>
<td>16.67% 1</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>0% 0</td>
<td>50% 3</td>
<td>6</td>
</tr>
<tr>
<td>g. Use visual analogs to represent emphasis and prosody (e.g., emoticons, symbols, or images)</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>0% 0</td>
<td>33.33% 2</td>
<td>50% 3</td>
<td>6</td>
</tr>
<tr>
<td>h. Compatible with spellcheckers, grammar checkers, word prediction software</td>
<td>33.33% 2</td>
<td>33.33% 2</td>
<td>0% 0</td>
<td>0% 0</td>
<td>0% 0</td>
<td>33.33% 2</td>
<td>6</td>
</tr>
<tr>
<td>i. Compatible with text-to-speech software (voice recognition, human dictation, and recording).</td>
<td>0% 0</td>
<td>50% 3</td>
<td>0% 0</td>
<td>0% 0</td>
<td>0% 0</td>
<td>50% 3</td>
<td>6</td>
</tr>
<tr>
<td>j. Compatible with calculators, graphing calculators, geometric sketchpads, or pre-formatted graph paper</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>16.67% 1</td>
<td>0% 0</td>
<td>66.67% 4</td>
<td>6</td>
</tr>
</tbody>
</table>
Table 11

Q 13: Which of the following assistive technology did you find the most helpful?

<table>
<thead>
<tr>
<th>Q13. Assistive Technology</th>
<th>Extremely Helpful</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Slightly Helpful</th>
<th>Not at all Helpful</th>
<th>Not Applicable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>n                 %</td>
<td>n             %</td>
<td>n                %</td>
<td>n</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>a. Magnifiers</td>
<td>0.00%</td>
<td>0</td>
<td>16.67%</td>
<td>1</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>b. Enlarged Text</td>
<td>50.00%</td>
<td>3</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>16.67%</td>
</tr>
<tr>
<td>c. Reader scanner</td>
<td>0.00%</td>
<td>0</td>
<td>50.00%</td>
<td>3</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>d. JAWS Screen Reader</td>
<td>33.33%</td>
<td>2</td>
<td>16.67%</td>
<td>1</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>e. Kurzweil 3000</td>
<td>16.67%</td>
<td>1</td>
<td>16.67%</td>
<td>1</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>f. Audiobooks</td>
<td>50.00%</td>
<td>3</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>16.67%</td>
</tr>
<tr>
<td>g. Text to Speech (e.g., Math Talk)</td>
<td>33.33%</td>
<td>2</td>
<td>16.67%</td>
<td>1</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>h. Word Processor</td>
<td>66.67%</td>
<td>4</td>
<td>16.67%</td>
<td>1</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Table 12

Q23. The following are statements related to your experience in receiving accommodations in online courses.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither agree nor disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. If I were an instructor or the director of the DRC, I would explore new and innovative technologies.</td>
<td>50%</td>
<td>3</td>
<td>16.67%</td>
<td>1</td>
<td>16.67%</td>
<td>1</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>b. If I were an instructor or the director of the DRC, I would strive to improve the traditional accommodations.</td>
<td>50%</td>
<td>3</td>
<td>33.33%</td>
<td>2</td>
<td>16.67%</td>
<td>1</td>
<td>0%</td>
<td>0</td>
</tr>
</tbody>
</table>
Participant Profiles for Interviews

Interviews were conducted with two of the survey respondents and one recruited through a snowballing technique. Table 13 displays the three participants’ profiles using their assigned pseudonyms.

Table 13

Interview Participant Profile

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Age</th>
<th>Major and Educational Degree</th>
<th>Registered in the DRC</th>
<th>Number of online courses has taken</th>
<th>Low vision Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karen</td>
<td>22</td>
<td>Special Education, Master student</td>
<td>Yes</td>
<td>3 to 6 courses</td>
<td>Retinitis Pigmentosa</td>
</tr>
<tr>
<td>Ruby</td>
<td>24</td>
<td>Special Education, Master student</td>
<td>Yes</td>
<td>3 to 6 courses</td>
<td>Optic Nerve Coloboma</td>
</tr>
<tr>
<td>Sarah</td>
<td>54</td>
<td>Construction, Bachelor’s</td>
<td>Yes</td>
<td>10 courses and more</td>
<td>Blurred Vision</td>
</tr>
</tbody>
</table>

Karen

Karen is a 22-year-old master’s student in the Special and Early Education Department. In summer 2017, she was diagnosed with low vision. She has retinitis pigmentosa. People with retinitis pigmentosa have difficulty seeing at night and have a loss of side (peripheral) vision.

Karen registered with the DRC and started receiving accommodations. She is the only one who has low vision in her family. Karen has a dog service that accompanies her everywhere.
Ruby

Ruby is a 24-year-old master’s student in the visual disabilities program in the Special and Early Education Department. Ruby has had optic nerve coloboma since she was born. According to the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) (2019), “coloboma is a congenital defect in the structure of either the eyelid or the eye.” A small or large developmental defect may occur in the deeper structures of one or both eyes. The defect involves the optic nerve, which connects the eye to the brain. The eye is occasionally smaller than normal.

Sarah

Sarah is a 54-year-old undergraduate student enrolled in the construction engineering program. Sarah born with a low vision condition called blurred vision. With blurred vision, both near and far vision is out of focus even with the best possible correction from eyeglasses. Sarah stopped her education after high school and then became a parent. When she became a parent, she noticed that her daughter had similar issues. When her daughter got into school, Sarah watched how the school now provided accommodations more than before. Her experience with her daughter made her want to go college by taking classes one at a time and registering with the disability resources center. She had to do in-person classes for the first two years, but in the last two years she had been taking mainly online classes because of her multiple responsibilities.
Results by Interview Questions and Survey Open-ended Questions

This section presents the results of the three interviews and the open-ended survey questions. The themes from the coded data include the participants’ perspectives of the information delivery methods, the most helpful accommodations, accessibility, assistive technology, and the wish list for students with low vision.

**Information Delivery Methods**

The interviews and the open-ended questions revealed several areas related to the information delivery theme. The participants’ responses show they do not request different accommodations based on whether the information delivery is face-to-face or online. Ruby said, “I’d say they’re pretty much the same.” Karen mentioned that she does not request additional accommodations in online courses by stating, “I wouldn’t personally add more accommodations in an online course than face-to-face.” However, the need for accommodations in online courses or in face-to-face courses depends on the course content. The participants mentioned that sometimes they need more accommodations for science and math courses. Ruby said, “Then I think I would need more accommodation because it has more images and graphics” and “if it’s like a class that has to do with a lot of reading articles and research, I don’t think I would need as much support.”

When the participants described their preference for an online course or a face-to-face course, all participants responded that they prefer face-to-face courses because they can have direct communication with the instructors and ask for support when needed. Sarah said, “I prefer face-to-face when the professor understands that I have issues. This means when we have a test
and he want us to do it in five minutes, he has to give me 10.” Karen also preferred face-to-face because of the direct communication; she said, “I just feel like I learn better face-to-face versus when it’s online, you can’t ask. You don’t get direct feedback from questions and things like that.” Ruby added, “To explain to professors what I need. If they can like to see me. And we can actually talk in person.”

However, the participants enrolled in online courses because they like to study and work at their convenience. Sarah mentioned that she had a challenge driving and being on campus, “Well, I have to take myself online because I live in the suburbs. I can’t drive out to campus.” In addition, the participants liked the synchronous information delivery method in online courses to have direct communication with the instructor and receive the information via audio. Ruby said, “I prefer mostly face-to-face classes, but I do like online classes for synchronous sessions as face-to-face interaction.”

When discussing the information delivery methods including text, audio, and video, the interview results revealed that students with low vision identified text and audio as the most beneficial with regard to their learning experience in online courses. Ruby preferred the text format in online courses and said, “So I would like to see and read text materials.” Also, Karen mentioned that “I usually prefer just text by itself.” On the other hand, Sarah preferred to receive audio information: “I prefer audio 100%.”

**Most Helpful Accommodations for Students with Low Vision**

The interview results showed the types of accommodations that mitigated the challenges of students with low vision in online courses. The participants identified the accommodations helped them to be more independent people and not need to ask someone else for help. Karen
said, “Being able to have that accommodations and assistive technology … gives me access to the course and it allows me to be able to do as many things, but without having live help, as possible.” All interview participants identified that extended time for exams and assignments was the most often requested accommodation they needed to succeed in their online courses. Ruby said, “I feel more comfortable and engaged when I receive the extended time.” Karen mentioned that the accommodations helped her reduce stress and gave her equal access to the test: “without receiving extended time accommodation, I would feel like I don’t have enough time.” She added, “I feel my grades won’t reflect what I actually know, and I just probably wouldn’t have as good of a grade as if I did get accommodations.”

When the participants explained their challenge in online courses, they mentioned taking the time to read or to have someone read the online materials for them. Karen stated that she faces difficulty reading the quizzes and usually asks someone to help her read the quiz. She said, “Sometimes just it’s the timing of when I take a test. Sometimes people have to read it to me.” Therefore, she identified extended time is the most helpful accommodation she needs to succeed in online courses. She contended:

Online accommodations would be time and a half for exams and in any class and the ability to record lectures … So when I didn’t have that, it was always harder to complete all of the questions on the exams. So I’d say it helped me in that sense.

In addition, Sarah mentioned that someone needs to read for her, or she uses a screen reader during online tests to convert any text on the screen to audio. She stated that she spends a longer time than a normal person does to complete the materials: “I take mainly online classes. Everything needs to be read to me, [I] ask someone to read the online quiz questions for me.”

The online survey responses of the related open-ended question asked the participants to specify the most helpful accommodation they received in online courses. Three of six
participants specified extended time as the most helpful accommodations for helping them complete the online tasks. The participants’ responses were the following:

- “extended time on quizzes and tests … allows me to recheck my work over and over as I make many mistakes due to vision.”
- “I usually get a longer time to finish the test and I ask for an extended time to check my answers.”
- “Time and a half for test and projects”

### Accessibility

The interview participants identified three accessibility design aspects: alternative formats for materials, headings, and color contrasting for online content as the most helpful accessibility accommodations regarding their learning experiences. Ruby responded that she has a lot of reading requirements to complete the online assignments as a graduate student. She clarified, “Word documents and RTF are the most beneficial types of alternative formats for textual online materials. Having formats like word documents or RTF are super helpful to access the text and use Read Aloud feature when I need it.”

Sarah added, “I avoided reading. I avoided doing anything that wasn’t just hands-on like the building because I’m actually in the construction trades.” She also mentioned that she has difficulty reading a book but she can read text font “Arial’ and size 16 or 18. She said, “sometimes I get notes, teacher’s notes and I actually have to change the font to just an Arial font because the New Times Roman is hard for me to read. Yeah, it has too many like little curves in it and the letters are too close.” Therefore, she requests alternative formats for the online textual materials to audio: “Well, everything needs to be audio for me.”
In contrast, Karen described that she prefers Adobe accessible PDF versions that include features that allow students with low vision access text that is more readable and allows taking notes, searchable text, and tracking of information.

I would like to see that used more and more like accessible PDF documents instead of just like taking a picture. I think it’s just giving me more access. For example, being able to look at like a PowerPoint in an accessible format. I can use it more easily to take notes and to keep track of information instead of having to like struggle through the slide.

The survey results displayed some of the participants’ responses to the open-ended questions on what alternative formats were the most helpful accommodations. The participants’ responses were the following:

- “Alternative text format is the most often requested accommodation that I know of for myself or anyone else with a visual impairment.”
- “For me, the majority of accommodations for online classes are alternative text and video/image descriptions.”
- “Enlarged text. And using my computer.”

Additionally, the participants identified heading and color contrasting for online courses that helped them find and use online course materials. Ruby and Karen mentioned that designing online courses with headings guided them while navigating the online environment. Ruby said, “I’d say headings help split things into sections.” Karen said, “have a lot of headings to navigate that makes things easier.” In addition, Sarah mentioned that using contrast color for the text and background facilitates reading the PowerPoints. She described her current challenge reading some colors:

one of the classes I have now, he has a lecture, it’s short, it’s a simple lecture. But then he has a PowerPoint and that does not have any audio to it and it’s kind of a struggle for me to read through that. It’s actually on the university [brand]; the background is red with the black and the gray and that’s actually hard to read. I think that’s hard to read.
An additional accessible design that one of the interview participants reported was added description for videos. Sarah said, “I’d say more ideal description from videos” would help students with low vision understand what is happening in the video.

**Assistive Technology**

The results showed that not all students with low vision in online courses needed to use assistive technology such as a magnifier and/or screen reader. Karen mentioned that she does not use any assistive technology in her online courses. She said, “My vision, I can see fine centrally. I just don’t have any peripheral vision. So, magnifying or enlarging things for me doesn’t help that much.” However, she explained that her vision condition may progress, and she may need to use assistive technology in the future, “My condition is progressive, so maybe in the future I would need to use CCTVs or other assistive technology. But right now, I think I’m fine.”

Sarah and Ruby use screen reader software, which they mentioned as the most helpful assistive technology for them. Ruby said:

> And so being able to have, like for example, the articles that we had to read were in two formats. They were in like a scanned in PDF and they were in like a word document. And so I was able to use my screen reader to read the word document and I had access to the course material without having to ask somebody to help me read it or help me scan it and to be able to change the scanned document.

Sarah and Ruby use the Read Aloud feature in Word. For the web pages and other documents, they use screen reader software Narrator in Windows. They mentioned that they do not install JAWS or Kurzweil 3000 on their computers. Ruby used JAWS in the past; however, she is not using JAWS anymore because the screen reader is available in Windows and helps her read long articles.
The survey results also indicated the usefulness of screen readers in online courses. The participants’ responses were the following:

- “books in the library going text to speech helped me access the materials for my class”
- “Text to speech software tends to work very well”
- “Using screen reader for PDFs that are tagged for accessibility or alternative materials that have embedded video players are visible to the screen-reading software.”

**Wish List for Students with Low Vision in Online Courses**

The last theme revealed some of the improvement suggestions students with low vision wished would exist in online courses. Audio and instructor video were the two alternative formats that were not included in most online course accommodations. The participants described two ways of using audio in online courses: audio with PowerPoint and audio response in the discussion boards. Sarah suggested that instructors in online courses should use audio with PowerPoint slides to facilitate learning; she said “when the teacher has a PowerPoint, it’s great, but I have to read it. I want it to read to me and I want the word to stand out as are being read.” Ruby suggested adding the option of audio to participate in the discussion boards; she said:

I think more audio would be really helpful. So I don’t know if this is something that necessarily instructors would have jurisdiction over, but I guess just having it’s different alternatives, communicating with discussion boards, you know maybe having like an audio option to leave audio responses. They’re having a more simplified platform. So that would be one of the things on my wish list.

Additionally, all the participants suggested that instructors in online courses should record videos to help the students be engaged in their learning. Karen said she would like more
videos to understand some subjects; however, she did not specify the video types. She said, “Say we were assigned to read a chapter and then the teacher would have provided a video or something explaining certain things. I think that’s always helpful.” On the other hand, Ruby and Sarah identified the benefit of receiving instructor-recoded videos. Ruby said, “I wish the professors would do in-person videotaping of themselves.” Moreover, Sarah added that seeing the body language helps to engage the students in online courses; she said,

> When the instructor goes into the connect and has a PowerPoint and he’s just talking, I think that’s okay. But it would be really nice if you actually saw him because movement, your body gestures are engaging.

Sarah also recommended the instructors should record video to explain the course content to improve the students’ learning performance; she said,

> Everything was online. It would have been so cool if the teacher had done what my classroom teacher did and said, “Okay, here’s 20 minutes, here’s the problem on the chalkboard. I’m video recording myself and this is what you do and, oh, you think about this and now, you go to the next step and you have to remember that. And then …” That would have been great. I mean I know that some minor technical classes, safety will say, “Look, my last class was a safety class.” I mean, I can’t imagine an instructor going, if I taught the class … Ultimately I would like to teach but if I taught the class, I probably would read the book, they’re like safety hazards. So let’s say in the parking lot or in a building, I probably would record it. “This is a safety hazard.”

**Chapter Summary**

Chapter 4 presents the results of the study. The results were drawn from the online survey as well as the interviews and open-ended survey questions. The themes include information delivery, most helpful accommodations, and a wish list of the accommodations students with low vision would like to exist in online courses. Chapter 5 discusses the research results in relation to the literature and UDL principles as well as presents the implications, examines the limitations, and offers recommendations for future research.
CHAPTER 5
DISCUSSION AND CONCLUSION

The purpose of this chapter is to interpret the major findings from Chapter 4. This chapter also highlights the study’s potential limitations. Moreover, it presents the recommendations and implications for future research.

Interpretation of the Findings

The researcher used an interpretive research paradigm that asserts the reality is based on human experiences (Patton, 2002). Examples from the perspectives of the participants illustrate the real experiences of students with low vision. The study included online survey responses from six participants and interviews with three participants. The major findings from this study are presented under the themes: information delivery, most helpful accommodations, accessibility and assistive technology, and a wish list from the students with low vision. The study was guided by the following research questions:

1. What are the information delivery methods in the past online courses that students with low vision perceive to be most helpful regarding their learning?
   a. How were students able to manipulate those information delivery methods to help their personal preferences for learning?
   b. If unable to manipulate the information delivery methods, how would they have preferred to be able to manipulate them?
2. How have accommodations and assistive technologies mitigated the perceived challenges of students with low vision in online courses?

3. Which types of accommodations and assistive technologies could better contribute to the engagement, participation, and learning of online course content for students with low vision?

**Information Delivery Methods**

The findings show that students with low vision preferred different information delivery methods in their online courses. This theme relates to the first research question and sub-questions, as the ensuing data reveals that the students with low vision preferred text and audio information delivery methods, which is supported by the UDL representation principle that encourages educators to use several modes of information delivery formats to enhance student learning (CAST, 2008). The findings from this study also underscore the need to deliver online instruction using audio and text to help students with low vision better understand the instruction and learning materials. Most of the existing studies (e.g., Goodridge et al., 2017; Sankey et al., 2011; Tambunan et al., 2019) focused on online courses discussing the diverse learning style of students and multiple representations of the materials to enhance students learning. However, there is a need for research that focuses on the information delivery preference of the students with low vision in online courses.

The results reveal that students with low vision prefer audio information delivery methods. This finding is consistent with relevant literature (e.g., Argyropoulos, et al., 2019) that addressed preferences and choices of students with vision impairments and found the medium of listening, or aural reading, was the best performance medium for studying. The participants also
expressed that they have better-developed listening skills; thus, the use of audio made it easier for them to understand and acquire new knowledge. For instance, Sarah and Ruby were born with low vision and contended their enhanced listening skills helped them get the information. In addition, they agreed that audio facilitated their understanding of the online content materials. This finding is consistent with Saleem and Al-Salahat’s (2016) study, which identified that people who lost their eyesight early in their life gained listening skills and learned to use their hearing more efficiently than people without vision loss.

**Most Helpful Accommodations**

The findings of this study also show that accommodations in online courses reduce some of the challenges for students with low vision. This theme relates to the second research question, as the participants have identified extended time as the most helpful accommodation because they took time reading the material or someone could read it for them. For instance, Karen mentioned that when she received extended time, she was able to complete her assignment better than when she did not receive the extended time. This finding is consistent with the literature that demonstrated the benefit of extended time in reducing challenges for students with disabilities (e.g., Goegan & Harrison, 2017). According to Crow (2008), reducing students’ challenges by providing support helps them complete the tasks effectively and independently. Paralleling Crow (2008), the participants stated they still needed extended time in online courses to be engaged in and complete the course tasks. For example, Karen said that she could not finish the online quiz without spending an additional half hour on the materials in her online courses. According to the American with Disabilities Act (1990), extended time is one of the reasonable accommodations higher education should provide for students with disabilities.
Accessibility and Assistive Technology

There were three major findings related to accessibly and assistive technology. The first finding reveals that alternative formats for materials—such as Word documents or Rich Text formats (RTF) and Adobe accessible PDF files—were the most helpful accommodations in the online courses. These alternative formats allowed students with low vision to make changes according to their own needs and use text-to-speech assistive technology such as screen reader software or the Read Aloud Word file feature. All participants highlighted that the alternative formats provided them equal access to the online materials. In addition, this finding is consistent with research (e.g., Pascual, 2014; Spooner, 2014) that found students with low vision preferred to use alternative formats because it allows them to edit and make changes that best suit their needs. For example, Sarah explained that she could only read the Arial font; therefore, having the materials in Word allowed her to change the font to Arial because Times New Roman was hard for her to read. This finding is consistent with Houston’s (2018) study that recommends using sans-serif fonts in online course materials because serif font types help make online content more legible to all students, including those with visual impairments. Common sans-serif fonts include Arial, Trebuchet, and Helvetica. On the other hand, some serif font types—such as Times New Roman, Courier, New Century Schoolbook, and Palatino—have semi-structural details or small decorative curves on the ends of some of the strokes, making the letters and symbols challenging to read. Overall, this finding aligns with the UDL representation principle that focuses on the accessibility of instructional materials for all students, including students with disabilities, thereby providing them equal access (CAST, 2008).
The second finding was the participants identified assistive technology within alternative formats as one of the most helpful accommodations. The finding showed that text-to-speech reader software, such as a screen reader, was the most helpful assistive technology for students with low vision to read online course materials. Sarah mentioned that she always needed to use assistive technology such as a screen reader to convert the text materials to audio. Other participants mentioned that using a screen reader reduced their challenges when reading online materials, as they did not have to seek assistance in reading the materials. In addition, the finding showed that Word processing was the most helpful assistive technology because of its Read Aloud feature. These findings are consistent with the literature that identified text-to-speech assistive technology as the most beneficial to suit the individual needs of students with low vision (e.g., Fichton et al., 2009; Hersh & Johnson, 2010; Nees & Berry, 2013). In addition, this finding is tied to the action and expression UDL principle, which asserts that individuals with disabilities should get opportunities for independence through the use of assistive technologies as the technologies help them overcome barriers in the educational environment (CAST, 2008).

However, the findings of this study were not consistent with some literature on magnifiers as helpful assistive technology. The participants expressed that they have the visual ability to read the original document. Karen mentioned that magnifying or enlarging text were not helpful for her in online courses. Sarah mentioned that she avoids reading and she prefers using speech to text assistive technology to receive information through audio mode. According to this finding, magnifiers as the main method of providing accommodations were less useful than the ability to choose which forms of assistive technology were most beneficial for the online courses. The participants needed to hear the information or conversations in online courses so they did not need to use a magnifier but instead used speech to text features such as Read Aloud.
or screen readers. This finding suggests online course designers should provide more accessibility options for online materials to allow individuals to choose which type of assistive technology will work best for them.

The third finding showed two aspects of design to increase accessibility and to facilitate reading for students with low vision: headings and color contrasting for the online content. The participants indicated that headings are helpful for directing their attention to key concepts and for navigation; however, the current study did not reveal specific types of headings/styles for students with low vision. This finding is consistent with literature (e.g., Kearns et al., 2013) that recommends online course designers should create online materials with headings and use high-contrast colors, plain backgrounds, and scalable text for low vision or colorblind students as they allow users to skim the page quickly. Headings allow students with low vision to locate the information more easily and grasp the main ideas of the text (e.g., Fichten et al., 2009; Houston, 2018).

Online materials with low contrast can be difficult to read for students with low vision, making color contrast necessary to improve accessibility (e.g. Houston, 2018). Sarah mentioned that she had difficulty reading the online PowerPoint slides because of the black and gray text font contrasted on a red background. She expressed this background color was not suitable for her visual condition. However, the current study did not expand on color contrasted of online materials. Houston (2018) suggests avoiding some color combinations that are not easy to read for students with low vision, such as blue links on black backgrounds, red text on green backgrounds, or other combinations in which the contrast is not enough. Although, Houston’s (2018) study did not find a list of color combinations that can assure accessibility for students
with low vision, his study suggests that materials in online courses should be presented using a
dark font color contrasted with a pale background.

Finally, UDL principles and literature (e.g., Kharade & Peese, 2012; Pittman & Heiselt, 2014) address additional beneficial accessibility aspects for students with low vision; however, the findings of the current study showed some of these aspects were not applicable for these participants’ in their online courses. Aspects that were not present in online courses for most of the participants in this study were closed captions on video media; a transcript of the video or audio presentation; visual analogs to represent emphasis and prosody (e.g., emoticons, symbols, or images); and text descriptors for any relevant image, graph, or chart. However, Sarah mentioned that added description for videos was helpful for understanding the video content. This finding supports the UDL representation principle, which suggests that presenting information in several formats increases accessibility.

Wish List for Students with Low Vision in Online Courses

The findings revealed that these students with low vision needed two additional accommodations: audio response and instructor video. They contended that students with low vision would benefit from submitting their responses to discussion board as audio files. This would reduce time spent on formatting the answer, such as using a screen reader to double-check the response and allow them to focus on content. This finding is consistent with Ching and Hsu (2015) who addressed audio discussion modality in online courses; however, the literature does not specifically address the needs of students with low vision.

In addition, the participants expressed the need for videos in which their instructor presents the content. This finding is consistent with the literature (e.g., Choi & Johnson, 2015) that
addressed the positive effect that instructor-recorded videos explaining the content have on students as the recorded videos improve the students’ understanding and engagement with the material. Relevant literature (e.g., Kim et al., 2019) suggests that audio representation of the content helps make curricula more accessible to students with low vision. Therefore, the findings of these studies show the need for inclusion of audio discussion modality and instructors’ audio representation of the content to reduce the challenges and enhance the learning of students with low vision.

Limitations of the Study

The greatest limitation of a qualitative study is the lack of generalizability (Creswell, 2012). This study cannot be generalized to other people’s disabilities or to the non-disabled population. The inclusion criteria of the sample are appropriate and, therefore, assure that all participants had experienced the same or similar phenomenon of the study. Students with low vision were limited to those who do not meet the definition of legal blindness. In addition, the participants must not have had a concomitant consideration besides the low vision, such as hearing loss or cognitive or mobility impairment. This study was dependent on voluntary self-reporting of data from a sample of participants at the target university in the Midwest United States. Most of the students with disabilities are not comfortable talking about their disabilities. This is more common with low vision because it is not an apparent disability (George & Duquette, 2006).

The study was limited to postsecondary students with low vision who have had at least one online course experience at the postsecondary level within the last three years. This situation creates multiple limitations regarding data collection. The participants’ perceptions may be based
on only one course, which could have limited their experience to just that situation. Additionally, the number of interviews was limited by the number of volunteers from the completed surveys. Participants could choose not to participate in the study, which may have reduced the overall population. Also, data analysis by open coding was limited because the researcher’s first language is not English, which could have caused challenges understanding the data and promoted the need for an expert reviewer to ensure all themes and data were connected. The researcher did the open coding process by herself. In addition, member checking was a limitation of this study because only two of the three participants checked the transcript and just one of the participants checked the second email that included the results themes.

Lastly, the researcher of this study meets many of the demographic criteria: the researcher has low vision, is a post-secondary student, has requested accommodations, and has online learning experience. Interpretation of the results may have been biased by the researcher’s experiences and background.

Implications of Research

The findings of this study serve as a foundation for providing accommodations for students with low vision. The literature review presents research on universal design for learning (UDL), especially as it relates to accommodation, accessibility and assistive technology for students with low vision. This study contributes to a body of information about information delivery methods for students with low vision in online courses. The study will help instructors and online designers who might teach online courses or might want to improve online courses. This study could primarily impact those students with low vision who take online courses and face challenges, so they will have a better learning experience in online courses. Literature (e.g.,
Barnard-Brak & Sulak, 2010) found that students with invisible disabilities are often not comfortable disclosing their disabilities. The findings showed the extended time on tests and assignments is the most valuable accommodation. Moreover, the findings of this study also indicate online instructors should provide audio responses to accommodate students with low vision in online courses.

The findings from this study can move disability resource centers (DRC) toward a deeper understanding of how to provide accommodations as well as what types of accommodations support students with low vision in online courses. Te DRC services can use the findings to better understand the needs of students with low vision in online courses. In addition, the findings impact the DRC connections to professors who do not understand a given accommodation or their obligations to students with low vision in online courses.

Recommendations for Future Research

Recommendations for future research included in this section are based on a review of the literature and analysis of the findings from the current study. This study focused on one type of visual impairment; however, a much broader study could include other visual impairment types. In addition, this case study focused on fully online courses, so future research could be replicated in blended courses, including face-to-face and online sessions of similar sizes and student populations.

The UDL theoretical framework can help future researchers replicate the study by focusing on specific principles of universal designs for learning (UDL) because such factors affect students’ with low vision engagement in online courses. Other research could expand the case study to examine students’ and/or professors’ perceptions of the accommodations and
assistive technology for engaging students with low vision in online courses. In addition, this study was limited to students with low vision; therefore, future studies can expand this case study to examine instructors’ challenges when providing accommodations for students with disabilities in online courses.

The findings for this study showed students with low vision identified a screen reader as the most helpful assistive technology in online courses. Future studies could employ a quantitative approach to compare two groups of students with low vision to examine the effectiveness of using specific assistive technology in online courses. In addition, this study’s findings included the students’ with low vision preferences for information delivery methods; future studies could employ quantitative methods to compare groups of students receiving different information delivery methods in online courses to understand the relationship between information delivery method and learning performance.

Conclusion

The overall purpose of this qualitative case study was to explore the most helpful accommodations and assistive technologies for students with low vision in online courses. An online survey and individual interviews were conducted to obtain in-depth data. There were six respondents for the online survey and three interview participants.

The findings of this study indicated that the participants had two preferences for information delivery method (text and audio). This findings support the representation principle of UDL that recommends using several information delivery methods to promote equal access to content in online courses. The findings also showed that extended time is the most helpful accommodation for students with low vision to promote independent learning, while text to
speech software is the most helpful assistive technology. This finding promotes consideration of the action and expression principle of UDL in online courses to give students more than one way to interact with the material and enhance learning. Moreover, this study found that the most helpful aspects for online content accessibility for students with low vision were headings, color contrasting, and alternative formats for materials, such as Word documents, Rich Text formats (RTF) or Adobe accessible PDF files.

Overall, this study reveals that online courses require the inclusion of more accommodations and better implementation of UDL principles to meet the needs of students with low vision. Consideration of the findings may bring about significant understanding and renovation of online courses designs that will guarantee equal learning opportunities for students with low vision. Online designers, instructors and disability resource centers may benefit from this study as the findings can guide their decisions for providing support to students with low vision.

On a more personal note, the combination of a background in education and the desire to improve qualitative research skills was a major contributor to pursuing this study. This study increased the researcher’s knowledge of the research process. The data collection process provided the researcher with opportunities to interact with the participants and better understand the intricacies of online course design for students with low vision. In addition, the challenges posed in this study encouraged the researcher to further develop her research skills.
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APPENDIX A

CONSENT TO PARTICIPATE IN A RESEARCH SURVEY
I agree to participate in the research project titled *A Case Study: Examining Perceptions of Students With Low Vision in Online Courses* that is being conducted by Asma Marghalani, a doctoral candidate at Northern Illinois University. I have been informed that the purpose of the study is to explore accommodations as well as barriers in online courses for post secondary students with low vision who have an online course experience.

I understand that if I agree to participate in this study, I will be asked to respond to questions that address my university’s provisions regarding accommodations to online courses for students who have low vision.

I understand that my identity will be kept confidential and that any responses to the questions in this survey will be published anonymously. I am aware that my participation is voluntary, that I may withdraw at any time without penalty or prejudice, and that if I have any additional questions concerning this study, I may contact Asma Marghalani at [z1757975@students.niu.edu](mailto:z1757975@students.niu.edu) or Cindy York Ph.D. (NIU faculty advisor) [cindy.york@niu.edu](mailto:cindy.york@niu.edu) or (815) 753-8193. I certify that I am 18 years of age or older. I understand that if I wish further information regarding my rights as a research subject, I may contact the Office of Research Compliance at Northern Illinois University at (815)753-8588. I realize that Northern Illinois University policy does not provide for compensation for nor does the University carry insurance to cover injury or illness incurred as a result of participation in University sponsored research projects.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation. If you decide not to participate, please exit the survey. If you decide to participate, please respond to the following questions.

- [ ] I give my consent. Please begin the survey.
- [ ] I decline to participate. Exit the survey.

*Skip To: End of Survey If I agree to participate in the research project titled A Case Study: Examining Perceptions of Stud... = I decline to participate. Exit the survey.*
APPENDIX B

ONLINE SURVEY
Q1 What is your age in years?

18
19
20
21
22
23
24
...
67

Q2 What is your highest educational degree completed?

- High School/GED
- Associate Degree
- Bachelor’s degree
- Master’s Degree
- Ph.D./Ed.D. or similar doctoral degree
- Other, please describe____________________________________________

Q3 What is / was your major?

____________________________________________

Q4 Have you taken online or blended (hybrid of online and face-to-face) courses during your college/university study?

- Yes, Fully online courses.
- Yes, Blended (hybrid) courses.
- Yes, both fully online courses and blended (hybrid).
- No, I do not have any online course experience.

Skip To: End of Survey If Have you taken online or blended (hybrid of online and face-to-face) courses during your college... = No, I do not have any online course experience.

Q5 Were these online courses asynchronous or synchronous? Asynchronous online course: Course does not require instructor and students be online at the same time, which means students can check the learning materials, submit and post their contributions whenever they log onto Blackboard.

Synchronous online course: Learning follows a schedule that requires the students and instructor
to meet online at the same real time. Synchronous learning uses technology such as webinars, virtual classrooms, or audio-video conferencing to give students a closer social connection with instructor and their peers.

- Asynchronous
- Synchronous
- Both Asynchronous & Synchronous

Q6 During which higher education degree did you take your FIRST online course?

- Associate degree
- Bachelor’s degree
- Master’s degree
- Ph.D./EDD or similar doctoral degree
- Other, please describe ________________________________

Q7 How many online courses have you taken (including any current courses)?

- 1 to 3 courses ...
- 10 or more courses

Q8 Do you have a low vision condition?

- Yes
- No

*Skip To: End of Survey If Do you have a low vision condition? = No*
Q9 Which of the following best describes your visual condition?

- ☐ Loss of Central Vision
- ☐ Loss of Peripheral (Side) Vision
- ☐ Blurred Vision
- ☐ Generalized Haze
- ☐ Extreme Light Sensitivity
- ☐ Night Blindness
- ☐ Other, please describe ____________________________________________

Q10 Did you register with the Disability Resource Center (DRC) or a similar office at your university?

- ☐ Yes
- ☐ No

Q11 The following questions ask you to assess the level of helpfulness of the reasonable accommodations you have received in online courses.
How helpful have you found the following reasonable accommodations that you have **received** in any online course you have taken?

<table>
<thead>
<tr>
<th></th>
<th>Extremely Helpful</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Slightly Helpful</th>
<th>Not at all Helpful</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Requesting alternative formats of digital audio-visual recordings.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>c. Provide differentiated mentors (i.e., teaching assistants/tutors who use different approaches to motivate, guide, give feedback or inform).</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>d. Extended time for exam and/or assignments.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>e. Getting class materials in advance for more time to process information before class.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>f. Other (Please specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Q12 The following questions ask you to assess the level of helpfulness of the accessibility formats you have **received** in online courses.

How helpful did you find the following accessibility accommodations?
<table>
<thead>
<tr>
<th></th>
<th>Extremely Helpful</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Slightly Helpful</th>
<th>Not at all Helpful</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>All links are uniquely named.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>b</td>
<td>Closed captions on video media (DVDs, video tapes, video podcasts, other video formats).</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>c</td>
<td>A transcript of the video or audio presentation was available.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>d</td>
<td>Images of texts were available, OR an alternative was provided. (Examples of text images are PDFs made from scanned pages).</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>e</td>
<td>Text and background color had enough contrast.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>f</td>
<td>Text descriptors were provided for any relevant image, graph, or chart used within the course or within any document or presentation.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>g</td>
<td>Used visual analogs to represent emphasis and prosody (e.g., emoticons, symbols, or images).</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
h. Compatible with spell checkers, grammar checkers, and/or word prediction software.

i. Compatible with text-to-speech software (voice recognition, human dictation, and/or recording).

j. Compatible with calculators, graphing calculators, geometric sketchpads, and/or pre-formatted graph paper.

k. Other (Please specify)  

Q13 The following questions ask you to assess the level of the helpfulness of the assistive technologies you have received in online courses.

Which of the following types of **assistive technologies** did you find the most helpful?

<table>
<thead>
<tr>
<th>Extremely Helpful</th>
<th>Very Helpful</th>
<th>Somewhat Helpful</th>
<th>Slightly Helpful</th>
<th>Not at all Helpful</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Magnifiers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Enlarged Text</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Reader scanner</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>d. JAWS Screen Reader</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>e. Kurzweil 3000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Audiobooks</td>
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<td></td>
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<tr>
<td>Q14 Based on your experience, please provide additional details about accommodations in online courses. Which specific accommodations did you find most helpful to complete online courses?</td>
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<td>---------------------------------------------------------------------------------------------------------------</td>
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<td>___________________________________________________________________________</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Q16 What was the most challenging aspect regarding requesting accommodations for your low vision in online courses?</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________________________________________________________________________</td>
</tr>
<tr>
<td>___________________________________________________________________________</td>
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<tr>
<td>___________________________________________________________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q15 What was the most challenging aspect regarding receiving accommodations for your low vision in online courses?</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________________________________________________________________________</td>
</tr>
<tr>
<td>___________________________________________________________________________</td>
</tr>
<tr>
<td>___________________________________________________________________________</td>
</tr>
</tbody>
</table>
Q17 At what point in your online courses do you generally request accommodations from the DRC or instructors?

- Before the semester/class begins
- From the beginning of the semester
- Exam time
- Anytime I need
- I do not request accommodations
- Other ________________________________

Q18 If you do not request accommodations from the DRC or instructors, do you self-accommodate for online courses?

- Yes
- No

Q19 If At what point in your online courses do you generally request accommodations from the DRC or instructors?
Q19 What self-accommodations do you typically choose for yourself in online courses?

________________________________________________________________
________________________________________________________________
________________________________________________________________

Q20 Have you utilized other campus services that have assisted you with your disability to be successful in your online courses? (Tech Support, Counseling Center, etc.)

☐ Yes
☐ No

Skip To: Q21 If Yes, Please, explain and describe the type of the service for your online courses.

________________________________________________________________

Skip To: Q22 If No

Q22 What advice would you give to a student with low vision, concerning accommodations and services at the university level for online course success?

________________________________________________________________
________________________________________________________________

Q23 The following are statements related to your experience in receiving accommodations in online courses. Please rank the statements based on your experience your level of agreement or disagreement:
<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat agree</th>
<th>Neither agree nor disagree</th>
<th>Somewhat disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. As a low vision student, I prefer online courses rather than face-to-face class.</td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
</tr>
<tr>
<td>b. Prior to starting my degree program that contained online courses, I had some concerns about being in the program (concerns about either my abilities or concerns about getting support from instructors or the university) related to my low vision.</td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
</tr>
<tr>
<td>c. The reasons for not declaring my low vision or not requesting accommodations is because traditional accommodations have not met my needs.</td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
<td><img src="o" alt="Answer" /></td>
</tr>
</tbody>
</table>
d. The level of my motivation to complete online courses was negatively affected by the lack of accommodations. In other words, the lack of accommodations reduced my motivation in the online course.

e. The level of my motivation to complete was positively affected by the quality of accommodations I received. In other words, my motivation increased because of the quality of accommodations.

f. The accommodations provided helped me reduce the degree of difficulty or complexity of course activities.

g. Accommodations have helped me to spend less time completing online course tasks.
h. Course subject content (Math, Science, Language, etc.) affected my need for accommodations. In other words, the subject of the course made a difference on whether or not I needed accommodations.

i. Course accessibility design affected my need for accommodations.

j. The accommodations helped me participate actively in online activities, discussions, group work, etc.

k. If I were an instructor or the director of the DRC, I would explore new and innovative technologies to help students with low vision in online courses.
1. If I were an instructor or the director of the DRC, I would strive to improve the traditional accommodations for students with low vision in online courses.

m. Using the accommodations provided helped optimize my access to tools and assistive technologies.

n. Using the accommodations helped me use the online resources and learning materials more effectively.

o. Overall, I am satisfied by the accommodations I received in my online course experiences.

Q24 I would like to follow up this survey with more in-depth interviews if possible in order to collect rich data. If you are willing to participate in the interview, please provide me with contact
information that is the most convenient for you. If you are not willing to participate in an interview, please leave the following boxes blank.

○ Name ____________________________________________

○ Phone _____________________________________________

○ Email _______________________________________________

Q25 What questions do you have for the researcher? Is there anything the researcher did not ask that you would like to tell her regarding accommodations for online course taking at the university/college level? Please feel free to write anything you would like the researcher to know. Thank you for participating in my dissertation research.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
APPENDIX C

SEMI-STRUCTURED GUIDING INTERVIEW
Part 1:
1. When were you diagnosed with low-vision?
2. In which educational level did you recognize you needed more support and accommodations from the school or teachers/instructors?
3. Do you have other family members who have the same or a similar condition?
4. Do you learn from them? Or did you teach them how to deal with low vision in academic setting?

Part 2:
1. As a student with low-vision, do you prefer online or face-to-face courses?
   - Face-to-face course
   - Online course
   - Hybrid/Blended course
   - All types of courses
     a. Why do you prefer that type of course?

2. What are the information delivery methods (text such as pdf or word document, audio, video) that you find to be most beneficial with regard to your learning in the past online courses?
   a. How did you use those methods of delivering information to help your personal learning preferences?
   b. What currently unavailable methods of providing the information would you like to become available in the future?

3. How does the delivery of the course affect your need for accommodations? (for example: do you need accommodation in face-to-face more than in online? Or when the delivery is text you don’t need more accommodations than when the course materials are audio?)

4. How has accommodation and assistive technology helped you to overcome challenges in your online courses? What were these challenges?

5. Which types of accommodations and assistive technologies could contribute better to your engagement, participation and learning of the content of your online courses?

6. With respect to your engagement in the courses, Do you think receiving accommodations has motivated you to be engaged in the online course’s environment?
   a. Did it impact in a positive way?
   b. Please describe the accommodations that were impacted in a positive way
   c. Please describe the accommodations that were impacted in a negative way
   d. What accommodation can help you to be more engaged in the future?

7. According to your experience, what accommodations in online courses were helpful to you and how were they helpful (to navigate the online courses, to better understand online instruction and/or to complete online activities??
a. What accommodations did you need in online courses but did not get to help you understand the material?
b. What kind of visual information were you looking for in online courses?
c. What kind of auditory information were you looking for in online courses?

8. What is your wish list regarding accommodations you’d prefer in an online course? Can you describe a specific experience where you felt like you didn’t have access to services or accommodations that you thought would be helpful in your education?

9. I’m curious about your experience with getting approved for accommodations and then not using one or more of those accommodations. Can you describe this experience for me?

10. Is there anything else you would like the researchers to know about your online course experience regarding your low-vision?

11. What question should I have asked, but didn’t?
APPENDIX D

EMAIL ASSOCIATE PROFESSORS IN THE SPECIAL AND EARLY EDUCATION DEPARTMENT (SEED)
Dear Dr.
My name is Asma Marghalani, and I am a doctoral candidate in the ETRA program at Northern Illinois University. I am currently conducting research to better understand students with low vision perception of accommodations in online courses. I am writing to ask for your permission with distributing the survey in one of your online courses. In this email you are receiving an online questionnaire. This questionnaire contains a consent form as well as 21 straight-forward questions. The questionnaire should take less than 20 minutes to complete.
I realize that this is a very busy time of year for many of us; therefore, your help will be deeply appreciated.
(Questionnaire Link)

Sincerely,
Asma Marghalani
APPENDIX E

EMAIL TO DRC DIRECTOR
Dear Debra,
I am Asma Marghalani, a doctoral candidate in the ETRA program. My research has been approved by the IRB. Per our discussion, I would like your help in distributing the survey to collect the data for the study. I am currently conducting research to better understand students’ with low vision perception of accommodations in online courses. The research project titled “A Case Study: Examining Perceptions of Students With Low vision in Online Courses”

I am writing to ask for your help to distribute the survey link below to the students who identify as having low vision and are registered with the DRC. The online survey contains 25 questions and should take less than 15 minutes to complete.

I realize that this is a very busy time of year for many of us; therefore, your help with the distribution is deeply appreciated.

[Survey Link]

Sincerely,
Asma Marghalani
APPENDIX F

PARTICIPANTS’ INVITATION EMAIL
Dear Sir or Madam,

My name is Asma Marghalani, and I am a doctoral candidate in the educational technology research and assessment (ETRA) program at Northern Illinois University. I am currently conducting research to better understand students with low vision perception of receiving accommodations in online courses. The research project titled “A Case Study: Examining Perceptions of Students With Low vision in Online Courses.”

I am writing to ask for your help with this study. In this email you are receiving an online survey. This survey contains a consent form as well as 25 straight-forward questions. The survey should take less than 15 minutes to complete. Would you please take a few minutes to answer these questions survey by December 30? Your voluntary participation will help the researcher better understand how to assist students with low vision in online courses.

If you have any additional questions concerning this study, you may contact Asma Marghalani at [z1757975@students.niu.edu](mailto:z1757975@students.niu.edu), or Cindy York Ph.D. (NIU faculty advisor) at [cindy.york@niu.edu](mailto:cindy.york@niu.edu) or [815-753-8193](tel:815-753-8193).

I realize that this is a break time of year for us; therefore, your participation will be deeply appreciated.

Sincerely,

Asma Marghalani
APPENDIX G

CONSENT TO PARTICIPATE IN AN INDIVIDUAL INTERVIEW
I ____________________________ agree to participate in the research project titled *A Case Study: Examining Perceptions of Students With Low vision in Online Courses* that is being conducted by Asma Marghalani, who a doctoral candidate at Northern Illinois University.

I have been informed that the purpose of the study is to explore helpful accommodations for postsecondary students with low vision who have an online course experience as well as the barriers they face to succeed.

I understand that if I agree to participate in this study. I will be interviewed to respond to in-depth open-ended questions regarding my online course experience, knowledge and opinions regarding accommodations.

I am aware that my participation is voluntary and may be withdrawn at any time without penalty or prejudice and that if I have any additional questions concerning this study, I may contact Asma Marghalani at z1757975@students.niu.edu or Cindy York Ph.D. (NIU faculty advisor) at ___________________________. I understand that if I wish further information regarding my rights as a research subject, I may contact the Office of Research Compliance at Northern Illinois University at (815) 753-8588.

I realize that Northern Illinois policy does not provide for compensation nor does the University carry insurance to cover injury or illness incurred as a result of participation in University sponsored research projects.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I have received a copy of this consent form.

Signature of Participant Date

I understand that this interview will be recorded either in person or over the telephone. I do hereby grant Asma Marghalani permission to record my voice for the purposes of this study.

Signature of Participant Date
APPENDIX H

IRB APPROVAL
10-Dec-2019
Asma Marghalani
Educational Technology, Research and Assessment

RE: Protocol # HS20-0154 "A case study: Examining perceptions of students with low vision in online courses"

Dear Asma Marghalani,

This is to inform you that your request for approval of modifications to the above named project was reviewed on 10-Dec-2019 and it was determined that the modifications you propose do not change the exempt categorization of the project.

Although this research is exempt, you have responsibilities for the ethical conduct of the research and must comply with the following:

Amendments: You are responsible for reporting any amendments or changes to your research protocol that may affect the determination of exemption and/or the specific category. This may result in your research no longer being eligible for the exemption that has been granted.

Record Keeping: You are responsible for maintaining a copy of all research related records in a secure location, in the event future verification is necessary. At a minimum these documents include: the research protocol, all questionnaires, survey instruments, interview questions and/or data collection instruments associated with this research protocol, recruiting or advertising materials, any consent forms or information sheets given to participants, all correspondence to or from the IRB, and any other pertinent documents.

Please include the protocol number (HS20-0154) on any documents or correspondence sent to the IRB about this study.

If you have questions or need additional information, please contact the Office of Research Compliance, Integrity, and Safety at 815-753-8588.
APPENDIX I

DATA ANALYSIS SHEET
<table>
<thead>
<tr>
<th>Theoretical Constructs</th>
<th>Key Word/Terms</th>
<th>Key Phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representation</td>
<td>ID-Information delivery methods</td>
<td>Creating preliminary codebook</td>
</tr>
<tr>
<td></td>
<td>HA-Helpful Accommodations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AA-Accessibility Accommodations</td>
<td></td>
</tr>
<tr>
<td>Action and Expression</td>
<td>AT-Assistive Technology</td>
<td></td>
</tr>
<tr>
<td>Engagement</td>
<td>WLA-wish list of the students</td>
<td></td>
</tr>
<tr>
<td>Representation</td>
<td>ID-Information delivery methods</td>
<td>Open coding</td>
</tr>
<tr>
<td></td>
<td>Ruby “I’d say they’re pretty much the same.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Karen “I wouldn’t personally add more accommodations in online course than face-to-face.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ruby “Then I think I would need more accommodation because it has more images and graphics,” and “the class if it’s like a class that has to do with a lot of reading articles and research, I don’t think I need as much support.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ruby “I prefer mostly face-to-face classes, but I do like online classes for synchronous sessions as face-to-face interaction.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sarah “I would prefer face-to-face when the professor understands that I have issues. Which means when we have a test and he wants us to do it in five minutes, he has to give me 10.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Karen “I just feel like I learn better face-to-face versus when it’s online, you can’t ask. You don’t get direct feedback from questions and things like that.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ruby “To explain to professors what I need. If they can like see me. And we can actually talk in person.”</td>
<td></td>
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<tr>
<td></td>
<td>Sarah “well, I have to take myself online because I live in the suburbs. I can’t drive out to campus.”</td>
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<td>Ruby “So I would like to see and read text materials.”</td>
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<td>Karen “I usually prefer just text by itself.”</td>
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<td>Sarah “I prefer audio 100%.”</td>
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AA-Accessibility Accommodations
Ruby “Word document and RTF are the most beneficial types of alternative formats for textual online materials.”
Ruby “having formats like word documents or RTF are super helpful to access the text and use Read Aloud feature when I need it.”
Sarah “I avoided reading. I avoided doing anything that wasn’t just hands-on like the building because I’m actually in the construction trades.”
Sarah “sometimes I get notes, teacher’s notes and I actually have to change the font to just an Arial font because the New Times Roman is hard for me to read. Yeah, it has too many like little curves in it and the letters are too close.”
Karen:
I would like to see that used more and more like accessible PDF documents instead of just like taking a picture. I think it’s just giving me more access. For example, being able to look at like a PowerPoint in an accessible format. I can use it more easily to take notes and to keep track of information instead of having to like struggle through the slide.

The online survey responses:
• “alternative text format is the most often requested accommodation that I know of for myself or anyone else with a visual impairment.”
• “For me, the majority of accommodations for online classes are alternative text and video/image descriptions.”
• “Enlarged text. And using my computer.”
Ruby “I’d say like headings having a lot of headings in the works it looks at, usually that we get from sections having things split into sections.”
Sarah
one of the classes I have now, he has a lecture, it’s short, it’s a simple lecture. But then he has a PowerPoint and that does not have any audio to it and it’s kind of a struggle for me to read through that. It’s actually on the university [brand]; the background is red with the black and the gray and that’s actually hard to read. I think that’s hard to read.

Sarah said, “I’d say more ideal description from videos” would help students with low vision understand what is happening in the video.
<table>
<thead>
<tr>
<th>Action and Expression</th>
<th>AT-Assistive Technology</th>
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<td>Ruby:</td>
<td>And so being able to have, like for example, the articles that we had to read were in two formats. They were in like a scanned in PDF and they were in like a word document. And so I was able to use my screen reader to read the word document and I had access to the course material without having to ask somebody to help me read it or help me scan it and to be able to change the scanned document.</td>
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<td>The survey responses</td>
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<td>• “books in the library going text to speech helped me access the materials for my class”</td>
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<td>• “Text to speech software tends to work very well”</td>
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<td>• “Using screen reader for PDFs that are tagged for accessibility or alternative materials that have embedded video players are visible to the screen-reading software.”</td>
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<td>Karen said, “Being able to have that assistive technology … gives me access to the course and it allows me to be able to do as many things, but without having live help, as possible.” Ruby” I feel more comfortable and engaged when I receive the extended time [her accommodation].”</td>
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<td>Karen “Sometimes just it’s the timing of when I take a test. Sometimes people have to read it to me.” Online accommodations would be time and a half for exams and in any class and the ability to record lectures … So when I didn’t have that, it was always harder to complete all of the questions on the exams. So I’d say it helped me in that sense.</td>
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<td>Sarah “I take mainly online classes. Everything needs to be read to me, [I] ask someone to read the online quiz questions for me.” The online survey responses:</td>
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<td>• “extended time on quizzes and tests … allows me to recheck my work over and over as I make many mistakes due to vision.”</td>
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<td>• “I usually get longer time to finish the test and I ask for extended time to check my answers.”</td>
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<td>• “Time and a half for test and projects”</td>
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<td>Engagement</td>
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<td>Sarah</td>
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<td>Sarah:</td>
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• Assistive Technology |
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</table>
| Representation        | • Information Delivery Methods to answer RQ 1.  
• Accessibility to answer RQ2. |
| Action and Expression | • Most Helpful Accommodations to answer RQ2.  
• Assistive Technology to answer RQ2. |
| Engagement            | • Wish List for Students with Low Vision in Online Courses to answer RQ3. |

The themes in relation to each research question.