Experiences of Students with Blindness and Visual Impairment in Online Learning Environments with regards to Instructional Media

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ABSTRACT

Accessibility is a very important criterion to make online learning inclusive to students with different abilities. According to Burgstahler, Corrigan and McCarter (2004) unless design of the courses are accessible to all students, including those with disabilities, the ultimate goal of distance learning to make education available to everyone cannot be accomplished. However, accessibility is rarely a priority for online course developers and students with disabilities are not considered as a large group (Treviranus & Roberts, 2006). This exploratory case study investigated the experiences of the students with visual impairment in online learning environments with regards to media used in their courses with the intent of providing suggestions for accessible media design. Media included text, visuals (pictures, diagrams, charts, and graphs), audio, and multimedia (video and animation) used in online learning environments. This study used a purposive sampling technique and participants who are visually impaired, who had an online course experience, and who are older than 18 years old were included in the study. A semi-structured interview protocol was developed and participants were asked about challenges they experienced and what worked well for them in terms of media in online learning environment. Because of the lack of scientific research examining design of online learning for students with visual impairment, this dissertation fills an important research gap and also makes contributions to the field of Instructional Design and Technology by providing students' perspectives and suggestions for accessible design.

Suggestions provided in this study is valuable in terms of designing accessible online courses and that there is a lack of information and guidance for answering the needs of students with visual impairment in online learning environments.

Keywords: Accessibility, Online Learning, Visual Impairment

Dedication

This dissertation is dedicated to

Anne Sullivan

and all the teachers around the world who bring light to their students life.

Image credit: Anne Sullivan Macy Museum, American Foundation for the Blind

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Chapter 1: Introduction and Need for the Study

Introduction

Distance education has its premise of providing instruction that students can access whenever and wherever they want. It is also aimed that with the help of distance learning programs, students who cannot attend formal education will have the opportunity to get their degrees. So, it can be said that the idea behind distance learning environments is providing accessible instruction to non-formal students. Nevertheless, the accessibility of distance learning environments for learners who have special needs is still questionable. According to Burgstahler, Corrigan and McCarter (2004) unless design of the courses are accessible to all students, including those with disabilities, the ultimate goal of distance learning to make education available to everyone cannot be accomplished. However, accessibility is rarely a priority for online course developers and students with disabilities are not considered as a large group (Treviranus & Roberts, 2006).

According to U.S. Census Bureau (2010), about 56.7 million people (19 percent of the population) had a disability in 2010, according to a broad definition of disability, with more than half of them reporting the disability was severe, according to a comprehensive report on this population. About 8.1 million people had difficulty seeing, including 2.0 million who were blind or unable to see. Eleven percent of undergraduates in 2011-2012 reported having a disability. Growing enrollments of students with disabilities in postsecondary education along with federal legislation have generated considerable need in research on accessibility of higher education for students with disabilities (Newman et al. 2010; Snyder & Dillow 2010).

Accessibility in the context of online learning means ensuring all learners can access technologies or the content and experience offered by technologies regardless of their disability (Seale & Cooper, 2010). The IMS Global Learning Consortium defined accessibility as:

> Accessibility is the ability of the learning environment to adjust to the needs of all learners. Accessibility is determined by the flexibility of the education environment (with respect to presentation, control methods, access modality, and learner supports) and the availability of adequate alternative-but-equivalent content and activities. The needs and preferences of a user may arise from the context or environment the user is in, the tools available (e.g., mobile devices, assistive technologies such as Braille devices, voice recognition systems, or alternative keyboards, etc.), their background, or a disability in the traditional sense. Accessible systems adjust the user interface of the learning environment, locate needed resources and adjust the properties of the resources to match the needs and preferences of the user. (IMS Global Learning Consortium, 2004)

IMS' definition (2004) highlights the adaptability and flexibility of the learning environments and meeting the students' needs. Nevertheless, the pedagogical context is usually ignored in accessibility studies (Seale & Cooper, 2010). According to Kelly, Phipps, and Swift (2004) although web accessibility guidelines can be used to ensure that online learning environments are accessible, this might not be preferable from a pedagogical standpoint and that there is a need for a wider perspective. Coombs (2010) maintained that despite the fact that providing accessible online education is mandated by

legislation and prevalence of web accessibility guidelines, it is difficult to claim that there is a successful implementation.

Problem Statement

There is a paucity of literature at the intersection of accessibility and online learning, which focuses on the pedagogical aspect of course design. Furthermore, only a few studies focus on a certain type of disability, for instance, students with visual disabilities (Suwannawut, 2013). The majority of the studies on designing accessible online learning have focused on technical considerations, omitting the pedagogical components (Kelly, Phipps, & Swift 2004; Arrigo, 2005; Burgstahler, Corrigan & McCarter, 2004; Permvattana, Armstrong, & Murray, 2013; Seale, & Cooper, 2010).

Web accessibility specifications have been studied and related guidelines have been developed over the past years. It is hard to say these guidelines solve all accessibility problems in all web contexts for all disability groups, but they offer a general framework that helps people with disabilities access the web. According to Arrigo (2005), although these guidelines should have a strong impact on the online learning development processes, it is necessary to have a broad perspective identifying limitations of these guidelines. For example, web accessibility guidelines for people with vision impairment are not specific enough to effectively design learning materials for this student group to understand the concepts being taught (Permvattana, Armstrong, & Murray, 2013).

In order to make people with disabilities effectively interact with the web more detailed guidelines are needed for specific target groups and web context. For online learning environments, apart from technical specifications that are valid for all web

contexts, learning process also need to be considered. According to Kelly, Phipps, and Swift (2004):

> At the heart of any e-learning experience is the pedagogy that drives it, the learning outcomes, the content, which illustrates those learning outcomes, the context in which the content is presented and the activities a student completes to aid his/her understanding of the learning outcomes. (p. 47)

Accessibility needs to be understood differently when it is being evaluated in the context of teaching and learning that needs of students with disabilities, learning in web environments, and appropriate media selection should be considered. Current accessibility guidelines fail to accomplish this premise and it is necessary to discuss what could be the further dimension in accessibility in online learning environments to create equal opportunities for students with disabilities.

Purpose of the Study

This exploratory case study aims to investigate the experiences of the students with visual impairment in online learning environments with regards to media used in their courses with the intent of providing suggestions for accessible media design. Media will include text, visuals (pictures, diagrams, charts, and graphs), audio, and multimedia (video and animation) used in online learning environments. The definition of Individuals with Disabilities Education Act (IDEA) for visual impairment is adopted for this study. Visual impairment is defined in IDEA (IDEA, 2004) as "visual impairment including blindness means an impairment in vision that, even with correction, adversely affects a child's educational performance. The term includes both partial sight and blindness" ("IDEA - Building The Legacy of IDEA 2004," n.d.).

Research Questions

In order to explore implications of accessible media design for students with visual impairment, this research study is guided by the following central research question: "What are the experiences of students with visual impairment in online learning environments with regards to media used in their courses?"

Based on the central research question, sub-questions of the study are formulated as below:

1. Which challenges do students with visual impairment identify in online learning environments with regards to media used in their courses?
2. What media design strategies work well for them?

Rationale for the Study

This study focuses on media design implications for students with visual impairment with the purpose of contributing to accessible design of online learning environments. Accessible online learning environments benefit students with disabilities and promote equality. Results of this study will cultivate the concept of inclusive design and support nondiscrimination based on different abilities. Also, designing accessible online learning environments is mandated by law. Americans with Disabilities Act (ADA), Rehabilitation Act of 1973 (Section 508 and Section 504), and Section 255 of the Telecommunication Act of 1996 require all federal, state, and local government entities to provide services, programs, and activities equally to everyone, regardless of disability. Students with disabilities should be able to participate in and benefit from higher education institutions. Moreover, accessible design of media potentially improves learning outcomes for all students. Providing multiple formats for presenting the content

answers the needs of students with different learning preferences (Burgstahler, Corrigan & McCarter, 2004). Lastly, people with visual impairment constitute the most disadvantaged group in terms of accessing and utilizing various educational technologies (Petty & Frieden 2012). Majority of online learning environments are designed for sighted students utilizing visual images and interactive features and do not incorporate considerations for students with visual impairment (Permvattana, Armstrong, & Murray, 2013). Revisions to online learning design principles and frameworks are necessary to prevent discrimination based on different abilities of the students.

Organization of the Study

Chapter 1 provides the background information of the study, the statement of the problem, the purpose statement, research questions, and rationale for the study.

Chapter 2 provides a review of the literature related to the topic of this research study. This chapter has two main sections. The first section focuses on students with visual impairment and the role of vision in development and learning. The second section focuses on students with visual impairment in online learning environment and accessibility of online platforms.

Chapter 3 provides information on the methodological approach that will be used to carry out this research study. It includes a description of the research design, research participants, data collection, data analysis procedures, and how the trustworthiness will be achieved.

Chapter 4 provides the results of the research findings. The chapter is organized according to the research questions. It first provides a description of the case and participants and discusses the issue being studied followed by the relevant literature. it

then provides the results for each research question.

Chapter 5 provides the discussion, implications for practice, and recommendations for future research.

Definitions

Accessibility. Accessibility has been defined by the ISO 9241-171 standard as the usability of a product, service, environment or facility by people with the widest range of capabilities. The concept of accessibility addresses the full range of user capabilities and is not limited to users who are formally recognized as having a disability ("ISO| Terms and Definitions," n.d.).

Accessible Learning Environment. The ability of the learning environment to adjust to the needs of all learners (IMS Global Learning Consortium, 2002).

Visual Impairment. Any chronic visual deficit that incapacitates everyday functioning and it cannot be corrected by ordinary eyeglasses or contact lenses ("APH: Blindness Basics," n.d.). Visual impairment is defined in Individuals with Disabilities Education Act (IDEA, 2004) as "visual impairment including blindness means an impairment in vision that, even with correction, adversely affects a child's educational performance. The term includes both partial sight and blindness" ("IDEA - Building The Legacy of IDEA 2004," n.d.).

Chapter 2 – Literature Review

A literature review was conducted to explore accessible online learning design and issues have been faced by students and instructional designers. This literature review consists of two main sections. The first section focuses on students with visual impairment and the role of vision in development and learning. The second section focuses on students with visual impairment in online learning environment and accessibility of online platforms.

Students with Visual Impairment

Definition of Visual Impairment

Prior to defining visual impairment, it is important to give definitions of impairment, disability, and handicap in order to have clear understanding of the borders of these terms. The World Health Organization (WHO) defines these three terms as below:

Impairment: any loss or abnormality of psychological, physiological or anatomical structure or function.

Disability: any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being.

Handicap: a disadvantage for a given individual, resulting from an impairment or disability, that limits or prevents the fulfillment of a role (depending on age, sex, social and cultural factors) (“WHO | Visual impairment and blindness,” n.d.).

Various degrees of a specific impairment would lead to different consequences in contrasting settings. For example, a child who has lost an eye following an accident would be categorized as impaired, but not as disabled since he will be able to participate fully in most school and family activities. On the other hand, if he was planning to be a police officer, an airline pilot, or a professional tennis player, then he would be considered as having a personal disadvantage or significant handicap (Webster & Roe, 1998).

Visual impairment is defined as any chronic visual deficit that incapacitates everyday functioning and it cannot be corrected by ordinary eyeglasses or contact lenses ("APH: Blindness Basics," n.d.). According to Holbrook (1996) visual impairment is a loss of vision that makes daily tasks harder or impossible to complete without specialized adaptation.

The classification of visual impairment involves measurement of visual acuity and visual field (Hollins, 1989). Visual acuity means sharpness of an individual's sight and visual field means the total area that can be seen without moving the eyes or head (Holbrook, 1996). Visual acuity is expressed as a fraction: the numerator indicates the maximum distance at which a person can stand and discriminate between two given objects, whereas the denominator refers to the usual distance at which a person with no visual deficits could discriminate between the same objects (Cattaneo & Vecchi, 2011). Visual field is expressed in terms of degrees and visual field of a person without any visual impairment is almost 180 degrees from side to side.

Classification. The World Health Organization's (WHO) International Statistical Classification of Diseases and Related Health Problems (ICD-10) classifies visual

impairments into four categories as mild visual impairment, moderate visual impairment, severe visual impairment, and blindness. WHO defines mild visual impairment as visual acuity of equal to or better than 6/18 in the better eye with the best possible correction. Moderate visual impairment is defined as visual acuity of less than 6/18 but equal to or better than 6/60 in the better eye with the best possible correction. Severe visual impairment is defined as visual acuity of less than 6/60 but equal to or better than 3/60 in the better eye with the best possible correction. Blindness is defined as visual acuity of less than 3/60 or corresponding visual field loss in the better eye with best possible correction ("ICD-10 Version:2010," n.d.).

Slightly different from WHO's classification, almost all U.S. government agencies have agreed on three categories of visual impairment. Categories that are used to determine eligibility for social security benefits are as below (Albrecht, 2006):

1. Totally blind
2. Legally blind (20/200 or less visual acuity in the best corrected eye)
3. Partially sighted (20/70 visual acuity in the best corrected eye)

The definition for eligibility for special education services because of a visual impairment is based on federal regulations in the educational system and these definitions may vary from state to state (Bradley-Johnson & Ekstrom, 1998). Visual impairment is defined in Individuals with Disabilities Education Act (IDEA, 2004) as "visual impairment including blindness means an impairment in vision that, even with correction, adversely affects a child's educational performance. The term includes both partial sight and blindness" ("IDEA - Building The Legacy of IDEA 2004," n.d.).

Blindness in an educational context is determined by student's need for educational materials that are not visually based. According to Bishop (2004) a definition of blindness for educational purposes implies the use of tactual and/or auditory channels for learning. This definition can be explained further that some educationally blind students have useful vision for mobility purposes and some students can see faces or outlines but they cannot read print of any size and will be actual/auditory learner. Webster and Roe's (1998) definition of educationally blind individual is very similar to Bishop's definition. They maintain that individuals who require non-visual means of accessing the curriculum are considered as educationally blind. Educationally blind children rely mostly on tactile and auditory information in order to learn. Halliday (1970) also shares the same view that an educationally blind child needs braille and related media without the use of vision.

Causes of Visual Impairment

The most common causes of blindness change according to age, socioeconomic status, and geographic location. According to the U.S. Centers for Disease Control and Prevention (CDC) many causes of visual impairment occur before birth and some conditions clear up over time. The leading causes of visual impairment among adults are age-related macular degeneration, glaucoma, diabetic retinopathy, cataracts, and optic nerve atrophy (Albrecht, 2006). Retinopathy of prematurity, deficits in the visual centers of the brain, and eye abnormalities like cataracts and retina abnormalities are the most common causes of visual impairments in infants and children ("APH: Blindness Basics," n.d.). Approximately two-thirds of the children with visual impairment also have at least

one other impairment. This might be because of the fact that visual impairment is the secondary effect of some diseases (Albrecht, 2006).

Demographics

WHO estimates that there are 285 million visually impaired people around the world, with 39 million are blind and 246 million have low vision. Approximately 90% of visually impaired people live in developing countries. About 65% of visually impaired people are 50 years old and older. More people will be at risk of age-related visual impairment due to increasing elderly population around the world. Approximately 19 million children are visually impaired. The number of visually impaired people from infectious diseases has reduced in the last two decades despite the increase in elderly population. According to WHO this decrease is the result of a concerted public health action ("WHO | Visual impairment and blindness," n.d.).

Twenty one point five million American adults ages 18 and older reported experiencing vision loss according to the provisional report for the 2010 National Health Interview Survey. Of these 21.5 million American adults, 12.7 million are women and 8.8 million are men. Six point one million are adults between the ages of 18 and 64 and 5.4 million are adults 65 years and older. Approximately 3.3 million people with vision loss live in the Northeast, 4.9 million live in the Midwest, 8.9 million live in the South, and 4.3 million live in the West. Of Americans who have vision loss and are 25 years of age and over, 4.3 million have less than a high school diploma, 5.9 million have a high school diploma, 65.8 million have some college education, and 3.7 million have a bachelor's degree or higher ("Facts and Figures on Adults with Vision Loss - American Foundation for the Blind," n.d.).

Although the numbers presented above represent the recent data for people with visual impairment, gathering the accurate data is problematic since people who begin to lose their vision as part of the aging process often do not register for social rehabilitation services (Albrecht, 2006). Also, Webster and Roe (1998) claimed that because of the wide variation in terminology found in different studies makes determining the incidence or prevalence of visual impairment in childhood problematic.

The Role of Vision in Development and Learning

Vision plays a primary role in development and learning as it is often accepted as mediator between all other sensory inputs (Barraga, 1980; Barraga & Erin, 2001). An infant with visual impairment may be able to identify objects and recognize some features that a sighted infant can recognize. The quality and quantity of the information will be limited for the infant with visual impairment since visual sense provides a greater quantity and more refined quality of information when compared with other senses (Best, 1992). Much of learning is incidental and most of what is learned incidentally is learned through the visual sense (Barraga & Erin, 2001). Many skills that sighted children learn incidentally may be delayed in children with visual impairment because they lack the visual abilities needed for observing and imitating (Bishop, 2004). For this reason it can be said that a child with visual impairment has a disadvantage in terms of exploring and interpreting his surroundings and incidental learning. Taylor (1973) also claimed that visual impairment causes a limitation interfering with incidental learning throughout the sense of vision.

According to Websters and Roe (1998) main areas that visual impairment has an effect on children's development are: (1) children's adaptation to the physical world

(learning the properties of objects, exploring space, and tactile and motor skills), (2) language and cognition (the intellectual tools for ordering and categorizing experience), and (3) social development (how children acquire the behaviors that permit appropriate social relationship and entry into the surrounding culture). They also claimed that these areas are interdependent and the effects of the visual impairment are cumulative. For example, an infant's early understanding of the physical world occurs in an environment in which social interaction is suffused with relevant language (Webster & Roe, 1998). Best (1992) also listed specific areas that visual impairment has an effect as motor development, language development, social skills and emotional development. He added that understanding relationships and gaining simulation from the environment are two areas that children with visual impairment have difficulty. He added that having problems in understanding relationships may have negative influence on cognitive development, mobility and orientation and gaining reassurance about events in the environment. Having problems in gaining simulation from the environment may affect incidental learning and lead to limited experiences and misunderstanding (Best, 1992).

Motor Development. In terms of motor development, Bishop (2004) maintained that for each successive step in motor development vision is key. Best (1992) maintained that a child with visual impairment cannot easily monitor his own movement and might have difficulty in understanding what happens when he moves. So, creating a mental map of his surroundings might be problematical in adapting to the physical world as Websters and Roe (1998) claimed. Barraga and Erin (2001) also highlighted that children with low vision have tended to function less efficiently in visual-motor and eye-hand coordination. In their study Berla, Rankin, and Willis (1980) worked with 112 students with low vision

ages 5 to 20 and found that the most frequently missed items on the Diagnostic Assessment Procedure (Barraga, 1980) were those requiring motor skills (Berla, Rankin, & Willis, 1980).

Cognitive Development. Getting past the concrete stage of development into the abstract stage is difficult for many children with visual impairment (Bishop, 2004). Cognitive development of children who are blind show some lag in various aspects of abstract thinking such as conservation, mental rotation, and reasoning. Spatial concepts and nominal realism are also areas in which blind students have problems (Anderson, 1984; Pereira, 1990). According to Bishop (2004) visual impairments impede acquisition of classification, conservation, and spatial imagery and without special instruction this situation can also delay the acquisition of reasoning skills and problem solving capabilities. Santin and Simmons (1977) maintained that students with severe visual impairments construct reality differently that sighted students because of limited visual input and this difference will affect problem solving and reasoning strategies.

Boldt (1969) found that although cognitive development of children who are blind developed similarly to that of sighted children, blind children's ability to process complex auditory material showed a tremendous lag until about age 16 or 18 and this situation makes them follow their sighted peers from several years behind (as cited in Barraga & Erin, 2001). Barraga and Erin (2001) claimed that this finding exemplifies the fact that hearing and verbalizing appropriate words does not always guarantee that the words are understood cognitively. Children who are blind are less able than their sighted peers in defining the meaning of vocabulary words on intelligence tests. Stephens, Simkins, and Wexler (1976) stated that children who are blind are unable to explain a

cause-effect relationship although they know and use a word. The reason might be being lack of a clear mental image to use as a referent.

Visual impairment has also negative effect on language development. Variety of test materials such as vocabulary tests, verbal reasoning and comprehension were used by many researchers to analyze effects of visual impairment on children's linguistic and conceptual abilities. It was found that visual impairment is impeding development of children with visual impairment in these areas when compared with sighted peers (Webster & Roe, 1998). Furthermore, several researchers have claimed that there may be difficulties in some areas of language use, such as questions, pronouns, echolalia, gesture, and in the appropriate use of words that have different meanings (Dunlea, 1989). Acquisition of the language depends on visual information in the immediate context and strategies that are visually based to gain and shape attention. Vision also has a role in the process of concept formation and generalization of language from one context to another (Mills, 1983).

Social Development. Social development is another area that children with visual impairment have problems. How children acquire the behaviors that allow them to have appropriate social relationship and entry into the surrounding culture is affected by visual input. Corn and Bishop (1985) found that adolescents with visual impairments performed poorly when compared with sighted peers in areas of professional, social, and occupational skills and knowledge. It can be explained that absence of non-verbal clues such as facial expressions in social interactions may cause children with visual impairment misinterpret the important factors about socially appropriate behaviors.

According to Bishop (2004) social skills that make children acceptable to each other must be taught intentionally.

It is obvious that all children do not learn in the same way but vision seems to have special place in many process of learning. Many of the process of learning that a visual impairment interferes with are interactive, involving other children, adults or environments.

It is important to mention that many educational researchers and medical specialist have shown that visual impairment does not give rise to poor learning automatically, it is ability of brain to process the visual information it receives that determines children's capability of functioning visually (Bateman and Weatherall, 1967; Faye, 1970, Barraga and Erin, 2001). Bishop (2004) maintained that visual impairment pushes other sensory channels to provide sensory data to the brain. Barraga (1980) elaborated this statement by adding if available senses are not developed, learning will probably be fragmented and inaccurate.

The aforementioned information does not mean that children with visual impairment cannot reach developmental stages as their sighted peers. According to Bishop (2004) children with visual impairments need more practice and appropriate intervention to reach developmental milestones. So, visual impairment impedes learning if methods of presenting information and instructional materials are not modified to answer specific needs of this special student group. It is not unrealistic to say that we live in a visual world that many systems / tools are designed with the assumption that all users have a fully functioning visual sense. It is also true that in educational systems many instructional materials are visually based (textbooks, pictures and drawings, maps, charts,

graphs, etc.) and it is assumed that students can see, can make visual comparison, have visual memory, and can use vision to expand knowledge (Bishop, 2014).

Students with Visual Impairment and Online Learning

Introduction

Online learning has its premise to provide instruction that students can access whenever and wherever they want. It is also aimed that with the help of online learning programs, students who cannot attend formal education will have the opportunity to get their degrees. So, it can be said that the idea behind online learning is providing accessible instruction to non-traditional students. Nevertheless, how accessible online learning platforms to learners who have special needs is still questionable.

According to U.S. Census Bureau (2010), about 56.7 million people (19 percent of the population) had a disability in 2010, according to a broad definition of disability, with more than half of them reporting the disability was severe, according to a comprehensive report on this population. About 8.1 million people had difficulty seeing, including 2.0 million who were blind or unable to see. Eleven percent of undergraduates in 2011-2012 reported having a disability. Growing enrollments of students with disabilities in postsecondary education along with federal legislation have generated considerable need in research on accessibility of higher education for students with disabilities (Newman et al. 2010; Snyder & Dillow 2010).

As such, this study reviews the experiences of students with visual impairment in online learning environments, the needs of this special student group, and considerations that should be addressed when answering those needs in terms of providing accessible online learning. But first, an explanation of web accessibility will be provided, including

the guidelines and federal regulations since it is the core underlying concept for the aforementioned issues.

Web Accessibility

Accessibility in a general sense means removing barriers for participating and engaging in online experiences (Seale, 2006). When defining the accessibility the main question that needs to be answered is "access by what or whom?" So, access by everyone regardless of disability is a crucial aspect ("Introduction to Web Accessibility," n.d.).

According to Web Accessibility Initiative (W3C), a leading organization for web accessibility, web accessibility means that "people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web" ("Introduction to Web Accessibility," n.d.). This is the most fundamental and simple definition of Web accessibility that is widely accepted.

After defining web accessibility, the next step is discussing how to achieve it which has given rise to several guidelines developed by different organizations and institutions over the time.

Web accessibility guidelines. There are various web accessibility guidelines developed by different institutions such as federal government, state governments, non-governmental institutions, organizations, and universities. The following three guidelines reflect different institutions' perspectives. The guidelines summarized here are Web Content Accessibility Guideline (WCAG), Section 508 Accessibility Guideline, and Web Accessibility Guideline of Commonwealth of Virginia. WCAG, the most well known guideline for the web accessibility, was developed by the Web Accessibility Initiative (WAI) and influenced other guidelines including the Section 508 Web Accessibility

Guideline. The Section 508 Web Accessibility Guideline can be considered as federal guideline for web accessibility and it was adapted from the first version of WCAG. Finally, the Web Accessibility Guideline of the Commonwealth of Virginia was developed for state agency web sites.

Web Content Accessibility Guideline (WCAG). WCAG was developed by Web Accessibility Initiative (WAI) that works under The World Wide Web Consortium (W3C). The current version of the guideline, WCAG 2.0, was published on December 11th 2008 and it explains making web content more accessible for people with disabilities. WCAG 2.0 covers wide range of issues but it does not address all types, degrees, and combinations of disabilities. It can be said that this guideline makes web sites more accessible for all types of users and improves usability for all users in general. WCAG 2.0 has four principles: perceivable, operable, understandable, and robust. In total twelve guidelines for design are listed under these four principles (see Appendix D for the guideline).

Section 508 of the Rehabilitation Act standards. Section 508 standards were written by the Architectural and Transportation Barriers Compliance Board, the federal agency that drafted the Americans with Disabilities Act (ADA). These standards are based on the W3C guidelines, but do not contain all the elements (see Appendix D for the guideline).

State Guideline of Commonwealth of Virginia. This guideline, with an official effective date of November 4, 2005, applies to all State Executive Branch agencies and institutions of higher education developing, managing, purchasing, and using information technology resources of Commonwealth of Virginia. Web sites, intranet, extranet sides,

and internal web-based applications of all agencies must comply with the accessibility requirements in this guideline. WCAG and Section 508 guidelines were used while developing this guideline ("Web Accessibility," n.d.) (see Appendix D for the guideline).

As it can clearly be seen, WCAG 2.0 has been very influential in development of the other guidelines. Also, the technical focus that all guidelines share is obvious. After explaining web accessibility guidelines providing road map to how to design accessible web sites, the next section presents federal legislation and regulations for web accessibility.

Federal legislation and regulations for web accessibility. In the U.S. specifications for accessible design have been mandated through legislation. Access to information technology has emerged as a civil right through the American disability rights tradition and while technology improves, federal law has established accessible design specifications for a wide range of information technology (Thatcher et al., 2007). Today, there are significant legal incentives to ensure accessibility of Information and Communication Technology (ICT) and the approaches these legislations have taken are different. Some of them focus on establishing a human or civil right to ICT; others highlight that any ICT purchased by government must be accessible; others concentrate on any ICT sold in a given market must be accessible ("WebAIM: United States Laws," n.d.).

Major legislation about web accessibility are The Americans with Disabilities Act of 1990 (ADA), Sections 504 and 508 of the Rehabilitation Act of 1973, and Section 255 of the Telecommunications Act of 1996. In the following section, these laws will be summarized.

Americans with Disabilities Act (ADA). American with Disabilities Act is a "civil rights law for persons with disabilities" which is governed by Department of Justice. The first version of this law is Americans with Disabilities Act of 1990 (ADA) and the ADA Amendments Act (ADAAA) enacted in 2008. The purpose of the ADA is to prohibit discrimination against people with disabilities in these five areas (a) employment, (b) state and local government, (c) public accommodations, (d) telecommunications, and (d) miscellaneous ("ADA Regulations and Technical Assistance Materials," n.d.). It is important to note that the ADA does not deal directly with the accessibility of web sites. Although there are many lawsuit cases that can be seen as examples of how ADA applies to web sites, there is no definite answer on the question of how the ADA applies to the Internet. Title II and Title III have been used in the past cases related to web accessibility, so it can be said that these laws provide the framework for web accessibility ("WebAIM: United States Laws - Overview of the American with Disabilities Act (ADA)," n.d.). Also, the Department of Justice issued a policy on September 9, 1996 mandating how ADA applies to the Internet, indicating that state and local government (ADA Title II), as well as public accommodations and commercial facilities (ADA Title III) must provide effective communication whenever they communicate through the Internet (Thatcher et al., 2007). These two titles are summarized as follows.

Title II: State and local government. Title II of the ADA mandates that "no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of a public entity, or be subjected to discrimination by any public entity" ("ADA Regulations and Technical Assistance Materials," n.d.).

Title III: Public accommodations. A public accommodation may not discriminate against an individual with a disability in the operation of a place of public accommodation. Individuals with disabilities may not be denied full and equal enjoyment of the goods, services, facilities, privileges, advantages, or accommodations offered by a place of public accommodation. The phrase goods, services, facilities, privileges, advantages, or accommodations applies to whatever type of good or service a public accommodation provides to its customers or clients. In other words, a public accommodation must ensure equal opportunity for individuals with disabilities ("ADA Regulations and Technical Assistance Materials," n.d.).

Many ADA accessible web complaints have been filed so far and some of these cases include educational environments. Furthermore, the Office of Civil Rights (OCR) and the U.S. Department of Education receive complaints claiming discriminations that prevent equal access to education (Thatcher et al., 2007). There are several cases that have impacted web accessibility of educational institutions and one example is summarized below:

> A student with a visual disability made a complaint that university failed to provide equivalent access to the Internet. The student was required to make appointments with personal reader attendants as the exclusive mechanism for access to the Internet. The University also failed to complete the "Self-Evaluation Plan" as required by ADA Title II. According to the finding:
>
> "The issue is not whether the student with the disability is merely provided with access, but rather the extent to which the communication is actually as effective as that provided to others. Title II of the ADA also strongly affirms the important role

> that computer technology is expected to play as an auxiliary aid by which communication is made effective for persons with disabilities. OCR notes that the "information superhighway" is fast becoming a fundamental tool in post-secondary research" ("OCR Case Re San Jose State - Docket Number 09-95-2206", nd).

Rehabilitation Act of 1973 (Section 508 and Section 504). The Rehabilitation Act of 1973 is administrated by The Rehabilitation Services Administration (RSA) and provides a wide range of services for people with physical and cognitive disabilities. It is important to note that this act was the first legislative effort to assure that individuals with disabilities have equal rights ("WebAIM: United States Laws," n.d.). Any discrimination based on "disability in Federal employment, in the employment practices of federal contractors, in programs conducted by Federal agencies, and in programs receiving Federal financial assistance is prohibited" by the Rehabilitation Act ("The Rehabilitation Act Amendments of 1973," n.d.). The Rehabilitation Act has been revised twice since its inception. The first revision was made in 1993 and the second one took place in 1998. Two sections within the Rehabilitation Act, as amended, have impact on web accessibility. These are Sections 508 and 504.

Section 508 of the Rehabilitation Act. Section 508 sets up requirements for electronic and information technology that is developed, maintained, procured, or used by the Federal government and The U.S. Department of Justice Office of Civil Rights is charged with enforcing Section 508. According to Section 508 Federal agencies must ensure that electronic and information technology is accessible to employees and members of the public with disabilities (Thatcher et al., 2007). An accessible information technology system is described as the one that can be operated in multiple ways and does

not rely on a single sense or ability of the user ("Disability Definitions," n.d.). Section 508 applies to Federal web sites, but it does not apply to web sites of private industry. The Board is responsible for developing accessibility standards for information technology and incorporating these guidelines into Federal procurement regulations ("The Rehabilitation Act," n.d.). Section 508 provisions directly affect federally owned educational institutions, but state and privately owned postsecondary institutions are not directly affected by Section 508.

Section 504 of the Rehabilitation Act. Section 508 of the act provides a framework for what is intended in Section 504. Thus, it can be said that Section 504 provides the context of the law and Section 508 provides the direction ("WebAIM: United States Laws," n.d.). Section 504 states that:

> "No otherwise qualified individual with a disability in the United States, shall, solely by reason of his or her disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance or under any program or activity conducted by any Executive agency or by the United States Postal Service." ("OASAM," n.d.).

It is obvious from this statement that programs receiving federal funds may not discriminate people based on their disability status. K-12 schools, state colleges, universities, and vocational training schools fall into this category.

Section 255 of the Telecommunication Act of 1996. Section 255 of the Telecommunication Act of 1996 is a comprehensive law that mandates telecommunication industry to design, develop, and produce accessible and usable

telecommunication equipment and customer premises equipment for individuals with disabilities unless it is not readily achievable ("The Telecommunications Act of 1996," n.d.). Readily achievable means easily accomplishable without difficulty or expense. Furthermore, manufacturers must design products to be compatible with assistive technology tools used by people with disabilities if they cannot make their products accessible ("ITTATC - Section 255," n.d.).

Although section 255 of the Telecommunication Act seems to have no connection with web accessibility, it should be kept in mind that the border between the Internet and the telecommunication industry is blurred and interactive voice responses (IVR) features on websites need to meet the accessibility requirements (Thatcher et al., 2007).

Accessibility in Online Learning Context

According to Seale (2006) how disability is defined has an important influence on the e-learning opportunities offered to students with disabilities and also attitudes of educators towards accessible e-learning. The term disability is perceived as a mismatch between the needs of the learner and the instruction offered in the educational context. From this perspective, disability is not an individual characteristic but a result of the interaction of the student and the learning environment. Then, accessibility is the capacity of the learning environment to adapt to the needs of all learners (IMS Global Learning Consortium, 2004a).

Coombs (2010) describes accessibility in online learning environments as effective usage of online course content by people who have visual, cognitive, physical, and mobility impairments. When the focus on accessibility is narrowed to online learning environments, it becomes apparent that researchers usually adapted the WCAG 2.0 and

have a technically oriented perspective, which does not address the pedagogical aspect sufficiently.

The Equal Access to Software and Information (EASI) organization defines accessible e-learning as follows:

> Accessible e-learning learning means courseware and content that is designed to be accessible to the widest possible variety of computer operating systems and specialized applications removing needless barriers for students with disabilities and providing a level playing field to let them work and learn like everyone else ("EASI", n.d.)

Burgstahler, Smith, and Coombs (2004) discuss three important issues in accessible distance education and listed their insights as direct accessibility of hardware and software, accessibility of content presentation and use, and education of those who use technology. For the accessibility of content presentation they maintain that design, layout, and delivery of the course have an impact on accessibility of the content and added that apart from the accessible technologies, the content itself must be presented in a way that is understandable to the learner (Burgstahler, Smith, and Coombs, 2004). There are two facets of accessibility in online learning environment. The first one is technical accessibility, which is the concept of web accessibility, and the second aspect is accessibility of the instructional content, which focuses on making the content understandable to the students with disabilities. Stone, Jarrett, Woodroffe, and Minocha (2005) also note that designing accessible online instruction requires an understanding of related ethical and legal issues, as well as knowledge of the technological and pedagogical issues associated with teaching a wide range of students.

Students with Visual Impairment in Online Learning Environments

According to Burgstahler (2006) the design of many online learning courses erects barriers to the full participation of students and instructors with some types of disabilities. Although there are many assistive technology tools available to help people with different disabilities to use computers and the Internet, these tools do not remove all access barriers. For example, people with visual impairments use screen reader programs to access the Internet. However, screen readers can narrate web sites correctly only if the web site is designed compatible with screen readers and this may not be the case for all web sites (Permvattana, Armstrong, & Murray, 2013).

It is not surprising that visual materials such as images, graphics, and videos create access challenges for students with visual impairments (Burgstahler, 2006). Text descriptions for all visual elements should be provided for attaining accessibility. The problem is the representativeness of the text description, the degree that the text description describes the visual element. Although it can be thought that videos including audio are accessible for students with visual impairments, an audio description should also be included. Concerning the fact that many web-based instructional environments use visual materials and video frequently, the importance of text equivalence becomes apparent. Apart from the pages that provide content, communication and interaction tools of the online learning environment, such as chat rooms, forums, and e-mails, should be compatible with screen reading programs so that educationally blind students can participate.

Coomb (2010) reported the outcomes of distance learning survey that the American Foundation of the Blind's (AFB) conducted in order to investigate experiences

of people with visual impairments in online learning platforms. Results indicate that important and necessary features of online educational tools present significant problems. These features are listed as assessments, assignments, attachments, real-time chat feature, color contrast, discussion board, documents, e-mail, graphic, maintenance, modifying text, navigation, recordings, security, technical support, time graded activities, training, and videos. Nearly one third of respondents who used assistive technology to access online educational tools reported their experiences as unreliable, inconsistent or no successful use/access.

Summary

The preceding literature review indicates that students with visual impairment need specific accommodations and are facing with various challenges in online learning platforms. Design of online learning environments is creating barriers for this student group due to inaccessible design. Furthermore, little research exists to help us understand the individual experiences of the students with visual impairment. There is little known about the student perspective. More research is necessary in order to understand experiences of this specific student group in online courses in order to design effective online learning environments.

Chapter 3 - Methodology

Introduction

This chapter expands upon the purpose and research questions and explains the methodology of the study. It includes a description of the significance of the study, research design, research participants, data collection, and data analysis procedures. How the trustworthiness was achieved is also discussed. Finally, the background of the researcher is provided under the reflexivity title.

Purpose of the Study and Research Questions

This exploratory case study aims to investigate the experiences of students with visual impairment in online learning environments with regards to media used in their courses with the intent of providing suggestions for accessible online course design. Media includes text, visuals (pictures, diagrams, charts, and graphs), audio, and multimedia (video and animation) used in online learning environments. The definition of Individuals with Disabilities Education Act (IDEA) for visual impairment is adopted for this study. Visual impairment is defined in IDEA (IDEA, 2004) as "visual impairment including blindness means an impairment in vision that, even with correction, adversely affects a child's educational performance. The term includes both partial sight and blindness" ("IDEA - Building The Legacy of IDEA 2004," n.d.).

In order to explore implications of accessible media design for students with visual impairment, this research study is guided by the following central research question: "What are the experiences of students with visual impairment in online learning environments with regards to media used in their courses?"

Based on the central research question, sub-questions of the study are formulated as below:

1. Which challenges do students with visual impairment identify in online learning environments with regards to media used in their courses?
2. What media design strategies work well for them?

Significance of the Study

Because of the lack of scientific research examining design of online learning for students with visual impairment, this dissertation will fill an important research gap and also make contributions to the field of Instructional Design and Technology by providing students' perspectives and suggestions for accessible design. This will advance the field of Instructional Design and Technology as the information that will be provided in this dissertation may inform instructional designers who develop online courses and researchers who study accessibility in educational context.

Research Design

This qualitative study employed a case study approach utilizing semi-structured interviews. According to Van Maanen (1979):

> Qualitative research is an umbrella term covering an array of interpretive techniques which seek to describe, decode, translate, and come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world (as cited in Merriam, 2009, p.13).

A goal of qualitative researchers is to gain insight about human behavior and experience (Bogdan & Biklen, 2003). How people interpret their experiences, how they build their worlds, and what meaning they assign to their experiences are the main questions that

qualitative researchers aim to investigate (Merriam, 2009). Bogdan and Biklen (2003) describe meaning as the sense people make out of their lives. So, qualitative methods help to know people individually as they are constructing their own interpretation of the world (Bogdan & Taylor, 1975).

A case study is a detailed examination of one setting, or a single subject, a single depository of documents, or one particular event (Merriam, 1988; Yin, 1989). Yin (2009) defines case study as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are nor clearly evident" (p.18). Case studies seek to understand the larger phenomenon through close examination of a specific case and therefore focus on the particular (Rossman & Rallis, 2003). Most case studies are descriptive and exploratory; that is, they depict events, processes, and perspectives as they unfold the "real-life context" and often build an explanation for those events or outcomes (Yin, 1994). Because of their particularistic focus, case studies are "an especially good design for practical problems, situations, or puzzling occurrences arising from everyday practice" (Merriam, 1998, p.11). This study adopted an exploratory case study approach to investigate accessible instructional media in a real-life context and depict perspectives of students with visual impairment. A multiple-case study method was utilized and each individual was investigated as a case hence individual person constituted unit of analysis.

Interview as a data collection method has been used in qualitative research with the purpose of entering into another person's perspective and gathering stories (Patton, 2002). Morgan (1988) defined interview as a purposeful conversation between two people that is conducted by one with the purpose of getting information from the other.

Patton (2002) maintained that the major purpose of an interview is to obtain a special kind of information. DeMarrais and Lapan (2004) explained that researcher communicates with participants focusing on research questions of the study s/he is conducting. Interviews are used in two ways in qualitative research: (1) they may be the main strategy for data collection, or (2) they may be used together with other techniques such as participant observation and document analysis (Bogdan & Biklen, 2003). This study utilized interviews as the dominant strategy for gathering data.

Research Participants

This study used a purposive sampling technique, where the participants were selected based on the degree of their visual impairment, experience with online learning, and age. The main assumption behind the purposeful sampling is a researcher selects a sample from which he can learn most since his aim is to uncover, comprehend, and gain insight (Merriam, 2009). Patton (2002) argued that:

> The logic and power of purposeful sampling lies in selecting information-rich cases for study in dept. Information-rich cases are those from which one can learn a great deal about the issues of central importance to the purpose of the inquiry, thus the term purposeful sampling. (p.230)

As stated above, participants were selected based on their visual impairment, experiences with online learning, and their age. Participants who are visually impaired, who had an online course experience, and who are older than 18 years old were included in the study. The definition of Individuals with Disabilities Education Act (IDEA, 2004) was used for determining visual impairment. IDEA defines visual impairment as "visual impairment including blindness means an impairment in vision that, even with correction,

adversely affects a child's educational performance. The term includes both partial sight and blindness" ("IDEA - Building The Legacy of IDEA 2004," n.d.). An age criterion was determined as 18 with the purpose of including college level or older students. Also, sensitivity of collecting data from younger students with visual impairment was considered. No other criteria were used in the selection process. Virginia Department for the Blind and Vision Impaired (DBVI) and National Federation of the Blind (NFB) were contacted as formal gatekeepers. Bogdan and Taylor (1975) defined gatekeepers as those who have the power to grant access. Mission of the DBVI is stated as " to provide services and resources which empower individuals who are blind, vision impaired or deafblind to achieve their desired levels of employment, education, and personal independence" ("DBVI | About DBVI," n.d.). DBVI is providing employment, education, and personal independence services to Virginia's citizens. Purpose of the NFB is:

> to help blind persons achieve self-confidence and self-respect and to act as a vehicle for collective self-expression by the blind. By providing public education about blindness, information and referral services, scholarships, literature and publications about blindness, aids and appliances and other adaptive equipment for the blind, advocacy services and protection of civil rights, development and evaluation of technology, and support for blind persons and their families, members of the NFB strive to educate the public that the blind are normal individuals who can compete on terms of equality (Nfb.org, 2015).

NFB is a nation wide organization whose members are spread all over the USA and its listservs have been used by many people with blindness.

How many participants to interview is a question that many authors answered, as

it depends on the research study (Patton, 2002; Seidman, 2006; Merriam, 2009). Lincoln and Guba (1985) claimed that

> In purposeful sampling the size of the sample is determined by information considerations. If the purpose is to maximize information, the sampling is terminated when no new information id forthcoming from new sampled units; thus redundancy is the primary criterion. (as cited in Merriam, 2009, p. 80)

According to Seidman (2006), sufficiency and saturation of information are two criteria for deciding what is enough in terms of number of interviews. Sufficiency is having enough number of participants to reflect the population and saturation of information is a point in a study at which researcher starts hearing the same information from interviewees (Seidman, 2006). Seidman also mentioned that although sufficiency and saturation are helpful when used as criteria, especially in doctoral research, practical demands of time, money, and other resources also play a role. Furthermore, Patton (2002) recommended determining a minimum sample size "based on expected reasonable coverage of the phenomenon given the purpose of the study" (p.246).

Similarly, in a case study making representative case selection is very important (Stake, 1995). Patton (1990) maintained that attaining the better understanding of the phenomena relies on choosing the case well. Also, case studies incline to be selective, focusing on one or two issues that are elemental to comprehend the system being examined (Yin, 2009). Multiple-case studies bring the question of how many cases are sufficient for your study. Yin (2009) responds this question by explaining that sampling logic should not be used in case study and that the number of case replications necessary for the study should be considered. He added that deciding the number of replications

relies on the certainty a researcher wants to have in results; two or three literal replication is enough if theory used in a research is not complicated and a case does not require excessive degree of certainty (Yin, 2009). It is common for case studies either employ one person as a single case or two or three people as multiple cases (Stake, 1995). The simplest multi-case design is the selection of two or more cases that are literal replications (Yin, 2009). In the light of the information summarized above, I decided to interview two participants.

Interview Format

A semi-structured interview protocol was developed in order to explore experiences of students with visual impairment in online learning environments in terms of media. A semi-structured interview is largely guided by a list of questions to be explored and questions are flexibly worded. The researcher can respond to any situation that emerges, revealed worldviews of the respondent, and different ideas on the subject (Merriam, 2009).

In order to have comprehensive understanding of experiences of students with visual impairment in online learning environment, the interview protocol included questions addressing the research questions of the study. Participants were asked about challenges they experienced and what worked well for them in terms of media in online learning environment. The interview questions are directly related to the two research questions of the study. The interview protocol was divided into three sections: (a) a section for demographic information; (b) a section on experiences in terms of media; (c) section that allows participants to provide additional comments on their experiences which is constructed as overarching questions.

Interviews were conducted as real time online interviews. According to O'Connor, Madge, Shaw, and Wellens (2008), advancement of Voice Over Internet Protocol technologies, such as Skype, has important implications for the future of social research since they allow researchers to communicate via computers with the advantage of seeing and hearing one another. They also added that researchers should decide whether online interview is appropriate or not based on the pros and cons in relation to their research topic (O'Connor et al., 2008). I chose to have online interviews with the purpose of accessing more participants. The number of students with visual impairment who have online learning experience was limited in Blacksburg, but with the help of DBVI and the NFB, there was a high possibility to access more students. From this perspective, online interviews seemed to be the most appropriate choice.

Data Collection

After getting the IRB approval, an e-mail including a brief description of the study and an invitation was sent to Virginia Department for the Blind and Vision Impaired (DBVI) and the National Federation of the Blind (NFB). DBVI and the NFB were asked to send this e-mail to its members. The invitation e-mail was sent to the members of the NFB and DBVI and I started getting responses from people who volunteered to join the study. I chose the first two participants who answered the invitation email. I asked them to sign an online IRB consent form prior to the interview. According to O'Connor et al. (2008) it is necessary to decide how to inform research subject about the interview procedure. In addition to providing a short introduction to the goals of the interview, types of questions, and explanation of how participants can contribute to an online discussion might be provided (O'Connor et al., 2008). I sent a

brief description of the study and aims of the interview to the participants who volunteered to participate. Also, I sent my interview questions seven days prior to the scheduled interview date so participants go back to their online courses, refresh their memories about their experiences, and provide more useful data. The interviews were conducted online and Skype video conferencing software was used. I used a digital voice recorder and a GoPro camera to record the interviews. Each interview lasted approximately 80 minutes. I asked participants to share their screen with me and visit their online course while answering questions. In this way I could see specific examples of the media that participants have experienced in order to have a better understanding of the context. Recordings of the interviews were saved in a flash drive and the flash drive was locked in a cabinet in my office. I was the only person accessing the recordings in order to ensure anonymity and confidentiality.

Data Analysis

"Data analysis is the process of making sense out of the data. And making sense out of the data involves consolidating, reducing, and interpreting what people have said and what the researcher has seen and read" (Merriam, 2009, pp.175-176). Similar to Merriam, Bogdan and Taylor (1975) also defined the data analysis as techniques used to make sense out of and learn from the data. According to Bogdan and Biklen (2003) data analysis includes working with the data, coding and synthesizing them, and looking for patterns. In the next section, three aspects of data analysis are described as transcribing, coding, and management of the data.

Transcribing. According to Bogdan and Biklen (2003) transcripts are the main data of many interview studies and it holds true for my research. The interviews were

video-recorded with the permission of the participant. The recorded interviews were transcribed using the Olympus AS-2400 Transcription Kit and the Dragon Dictation Software. I was wearing headphones with microphones attached to the laptop, listening to an interview via Olympus AS-2400 Transcription Kit software and speaking what I hear into Dragon Dictation. Dragon Dictation typed the transcripts into Microsoft Word. Each transcript was labeled with a participant number. After finishing the transcription process, transcribed interviews were returned to the participants within one week to allow participants to make any changes or adjustments.

Coding. According to Creswell (2009), there are several steps involved in coding process:

1. Organize and prepare the data for analysis.
2. Read through all the data to get a general sense of the information and reflect on its overall meaning.
3. Begin detailed analysis with a coding process.
4. Use the coding process to generate a description of the setting or people as well as categories or themes for analysis.
5. Advance how the description and themes will be represented in the qualitative narrative.
6. Make an interpretation or meaning of the data. Ask, “what were the lessons learned?” (P.185-190).

Transcribed interviews were coded for categories and themes following Creswell’s (2009) steps. I coded each transcript two times in order to identify categories and themes. I used NVivo software for coding. According to Merriam (2009) data

collection and data analysis should be a concurrent process in qualitative research, so I started analyzing my data while I continue conducting interviews.

Management of the Data. Conducting a qualitative research study requires the researcher be careful while dealing with the data. According to Merriam (2009) a system for arranging and managing data should be planned in advanced and added that creating an inventory of the entire data set is necessary. Bogdan and Biklen (2003) also suggested keeping data physically well-organized, typing transcripts via word processing program and storing via filling system, and having hard copy of what is in the computer. Furthermore, keeping the record of the daily activities such as date, time, place, event, and participants was suggested by Rossman and Rallis (2003).

I used MS Word for Mac 2011 for typing my transcripts. I printed out each transcript to have a hard copy. As stated before, recordings of the interviews were saved in a flash drive and the flash drive was locked in a cabinet in my office. I was the only person accessing the recordings in order to ensure anonymity and confidentiality. I kept an audit trail daily events and decisions I made.

Trustworthiness of the Study

Trustworthiness in a qualitative study means providing the reader with enough detail to show that the researcher's conclusion makes sense (Merriam, 2009). Trustworthiness in qualitative research corresponds to validity and reliability in quantitative research. Validity is called as credibility and reliability is called as consistency and there are different procedures to ensure the credibility and consistency of the study. In the next section, I explain which procedure I used to establish credibility and consistency in my study.

Credibility or Internal Validity. The question of how research findings match reality is the focus of internal validity. Internal validity is ensured with consistency of the findings with the reality and capturing what is really there (Merriam, 2009). Procedures I used to establish credibility are member checks, peer examination, and reflexivity.

1. *Member checking:* Member checking, is also called respondent validation, means gathering feedback from participants on interview transcripts and emerging findings (Merriam, 2009). I transcribed each interview recording and then shared that analysis with the participants in order to allow them the make changes they want.
2. *Peer examination:* Peer examination or peer review is asking a colleague to scan some of the raw data and evaluate if the findings are reasonable based on the data (Merriam, 2009). I shared analyzed data with the two graduate students who have qualitative research experience and use their feedback to reduce the chance of researcher bias and clarify any misunderstanding.
3. *Reflexivity or clarification of researcher bias:* This is the process of reflecting critically on the self as a researcher. According to Merriam (2009) researcher needs to explain his assumptions, dispositions, and biases related with the research he is conducting. I described the factors affecting researcher bias and the actions taken to prevent them. This information can be found under "Related Background of the Researcher" section of this chapter.

Consistency or Reliability. Consistency in qualitative research means whether the results are consistent with the data collected. In qualitative research instead of getting the same results from repetitive studies, researcher interested in how results make sense

given the data collected (Merriam, 2009). Procedures I used to establish consistency were peer examination, reflexivity, and an audit trail. Since peer examination and reflexivity are previously explained, I explain audit trail as follows.

Audit trail: How data were collected, how categories were developed, and how decisions were made are described in detail as an audit trail in a qualitative research (Merriam, 2009). I kept an audit trail to keep track of decision-making process and actions taken during the study.

Related Background of the Researcher

In qualitative research studies, the researcher is the primary instrument for data collection and analysis (Patton, 2002). So, it is important to identify how the researcher's experiences, values, and biases may affect interpretation of the data. I will provide my background, relevant experiences, and personal beliefs in this section as a way to strengthen trustworthiness.

Before I started my PhD, I was interested in usability of user interfaces and conducted usability tests for several applications for my master thesis and job. While dealing with usability and user interface design principles, I learned about the term accessibility and started reading about it. The more I learned about accessibility, more I realized how important it is and how limited are sources for building a conceptual framework and effective guidelines. While I was doing my masters degree and working as a research assistant, I volunteered for college students with visually impairment in order to help their reading assignments and had a chance to observe problems they had in terms of accessing written information. I was also able to observe them while they were using assistive technologies and computer for their learning and daily activities. This

experience made me aware that there are a lot to investigate accessibility in the context of learning.

Through my doctoral education, I continued focusing on accessibility, specifically designing educational interfaces for students with disabilities and I was able to construct my experiences around this focus. I took and audited several courses to learn more about disability, accessibility, and user centered design. My aim has always been studying accessibility in the instructional design and technology (IDT) context. The more I learned about the concept of accessibility, the more I became aware that serving students with special needs has not been fully addressed in some principles and frameworks in IDT.

I have worked with the Assistive Technology Lab as a graduate research assistant and involved in a research project aimed to develop a reading tool for users with visual impairments. My major responsibilities were conducting data collection sessions, analyzing qualitative data, and writing reports. This position allowed me to have first hand experience with people with visual impairments who are older and how they use digital interfaces. I also learned more about how software engineering discipline approaches to accessibility.

I am a strong supporter of the accessibility and I believe it makes changes in lives of people with disabilities. Throughout my involvement with accessibility, I always thought that it should be redefined for instructional context. There are many technical guides available but these guidelines help providing the same input to the people with disabilities, which does not guarantee whether this input easy to learn. I also think that frameworks and principles in IDT related with screen design should be revised in order to

address needs of students with special needs. Therefore, I am examining accessible instructional media in online learning environments.

Although I believe the importance of accessibility in instructional context, I did not have any presumption about how to make an online instructional media accessible for students with visual impairment. I know how to make a web site accessible for visually impaired users from a technical perspective and I know how students with visual impairments learn, but there is limited information on intersection of accessibility and learning in the literature so I do not have any assumptions on my research questions. As a conclusion, being aware of my personal beliefs and importance of objectivity of the researcher in qualitative studies, I will attempt to remain neutral and unbiased throughout the study.

Summary

This chapter outlines the methodology I used to conduct this research study. Research design, research participants, data collection, and data analysis procedures were included. How the trustworthiness was achieved was also provided.

Chapter Four – Findings

The purpose of this study was to examine the experiences of the students with visual impairment in online learning environments with regards to media used in their courses with the intent of providing suggestions for accessible media design. This examination was accomplished by interviewing two participants who are visually impaired and who has online learning experience. This chapter presents the findings from these interviews and provides a description of the research study participants' experiences. During the data analysis process, explanation building in narrative form was utilized. A description of the case and the research study participants are presented in this chapter along with an analysis of the findings as they relate to the following research questions.

In order to explore implications of accessible media design for students with visual impairment, this research study is guided by the following central research question: "What are the experiences of students with visual impairment in online learning environments with regards to media used in their courses?"

Based on the central research question, sub-questions of the study are formulated as below:

1. Which challenges do students with visual impairments identify in online learning environments with regards to media used in their courses?
2. What media design strategies work well for them?

Description of the Case

According to Stake (1995) each case is similar to other people and programs in many ways and unique in many ways and researchers are interested in them for both their uniqueness and commonality. He added that:

> "The case could be a child, a classroom of children, or a particular mobilization of professionals to study a childhood condition. The case is one among others. In any given study, we will concentrate on the one. The time we spend concentrating on the one may be a day or a year, but while we so concentrate we are engaged in case study" (P.2).

Smith (1978) defined the case as a bounded system highlight the fact that it is an object rather than a process. According to him the study must be concerned with a larger phenomenon that can be observed within a specific frame (Smith, 1978). Merriam (1988) maintained that the specific case becomes known as the "unit of analysis".

The larger phenomenon this study examines is experiences of students with visual impairment in online courses with the media used and the unit of analysis, the case, is a student with visual impairment who has taken online course(s).

Description of Participants

Ann Garcia

The first participant was Ann Garcia. She is 34 years old and at the time of the study was not employed. She is legally blind and she had lost her vision in progress of time due to optical nerve damage. She became legally blind at the age of 25. She is 20/400 on her right eye and she is 20/800 on her left eye. She had her GED when she was 17 years old and she decided to work with children while she was working at early

learning center for children. After loosing her vision she took her time to get rehabilitated and learn mobility, assistive technologies, and how to use computer again. She went to her local college and graduated with associates of human service. Currently she is a student at a university and majoring in Psychology. She has been taken all of her courses online for her degree and she had taken 15 courses in total. She is planning to be a school counselor. She uses the Internet on a daily basis; she uses email, social media, and news web sites. She believes that her life would be difficult without the Internet. She also uses different assistive technologies such as JAWS screen reader and speech synthesizers.

Some of the courses she has taken were foreign policy, Chinese century, executive woman, psychology of the body, memory and cognition. Some of the courses were provided through learning management system (Blackboard) and some of the courses were provided through email correspondence with teachers. She considers her performance as successful as she got high grades from those courses. But she added that her experience was a struggle.

She responded the email I have sent and she after getting the details and the interview questions, she confirmed that she was willing to participate and share her experiences.

Tina Conner

The second participant was Tina Conner. She is a recent graduate from a university with a B.S. in Physics and she was about to start her graduate school at the time of the study. She has taken one fully online course and couple blended courses throughout her undergraduate education. She is 23 years old and has couple internship experiences as an accessibility tester. She is congenitally blind which means she was born

blind. She has light perception in one eye. She uses the Internet daily basis for email, web browsing, listening podcasts, streaming things, ordering groceries, and for many other things. She describes herself as someone who is always online and she has skillful in using assistive technologies.

Her online course was World Region that was offered from History department. It was provided through learning management system (Moodle) and she was successfully passed the course.

She responded the email I have sent and she after getting the details and the interview questions, she confirmed that she was willing to participate and share her experiences.

Description of the Issue Being Studied with the Relevant Literature

Accessibility in online platforms has been discussed and several problems have been presented over the years (Burgstahler, Smith, and Coombs, 2004; Stone, Jarrett, Woodroffe, and Minocha, 2005; Burgstahler, 2006; Coombs, 2010). Among this literature, the ones that focusing on online blind learners has been reviewed below.

The American Foundation for the Blind (AFB) conducted a survey with 100 students with disabilities on their online learning experiment. The survey was weighted heavily toward students who had limited vision or were blind. The results showed that participants found that most features of online educational tools created significant problems for them especially when using assistive technology such as screen reading or screen magnification software. Nearly one-third of respondents who use assistive technology reported the experiences as being “unreliable”, “inconsistent”, or “unsuccessful”. Participants reported that graphics, color contrast, modifying text, and

videos were problematical features of online educational tools (American Foundation for the Blind, 2008). The use of HTML content, when written with proper structure, was the only item that was not mentioned as a problematical feature.

Kinash (2004) interviewed eight students with blindness about being an online blind learner. Her approach is more on the phenomenological aspect of the situation yet still she also asked about inaccessible course components. Results of her study showed that some course components (text, printed text, and bulletin board) had been found inaccessible by participants but they evaluated their online learning experience as positive.

Babu (2011) conducted a study to investigate accessibility and usability problems students with blindness and visual impairment face in online environment when accomplishing academic tasks. Results of his study showed that online environments had many components violating WCAG's accessibility standards and participants faced many problems. Babu (2011) summarized these problems under six items as (1) confusion while navigating across WEI environment due to its frame-based page structure without unique frame names; (2) susceptibility to submitting incomplete work when a new question page does not provide location and contextual information; (3) difficulty understanding how to submit work when the selection controls for multiple option questions lack a consistent keyboard navigation procedure; (4) inability to negotiate security information pop-up when the WEI environment uses an alert dialogue box; (5) ambiguity in essay-type question page that lack meaningful labels for interface objects, including text area and text formatting toolbar; (6) vulnerability of losing work when Backspace behaves as browser's Back button inside text area.

Siu and Lam (2012) conducted a case study to review the design of computer assisted learning (CAL) facilities for students with visual impairment. They found that students with visual impairment face more barriers than others in CAL environment. They proposed key directions for design of CAL by applying the universal design principles. Hartley (2003) examined designing of instructional and informational text and maintained that text large prints should be used for visually impaired people with acknowledging the fact that there have been few actual studies of designing printed instructional and informational texts for the partially sighted.

It is necessary to note that number of studies focusing on accessibility of online learning platforms is limited. Furthermore, this number gets even smaller when a specific disability, such as visual impairment, is chosen. It is easy to see from the studies summarized above that they took broader approach and look at overall accessibility problems of the platforms. In this current study on the other hand, the focus is on the media used in online courses. Participants explained their experiences with different types of media (text, picture, graph, diagram, video, animation, and audio) and provided suggestions for accessible course design. Below, the results of the study are provided.

Research questions and Corresponding Interview Questions

Research questions and corresponding interview questions are given in table 1. Apart from the background questions, there are 10 interview questions focusing on challenges encountered with and best examples of text, visual, audio, and multimedia used in online courses.

Table 1: *Research questions and corresponding interview questions*

Research Questions	Corresponding Interview Questions
R.Q.1. Which challenges do students with visual impairments identify in online learning environments with regards to media used in their courses?	**I.Q.1.** Considering your learning process, what are challenges you have encountered with text in online learning environments? Could you please provide examples? **I.Q.3.** What are challenges you have encountered with visuals (pictures, diagrams, charts, and graphs) in online learning environments? Could you please provide examples? **I.Q.5.** What are challenges you have encountered with audio in online learning environments? Could you please provide examples? **I.Q.7.** What are challenges you have encountered with multimedia (video and animation) in online learning environments? Could you please provide examples? **I.Q.9.** Considering your overall online learning experience, what do you think the greatest challenge you encountered in terms of accessibility? It can be any of challenges you mentioned or an additional one.
R.Q.2. What media design strategies work well for them?	**I.Q.2.** What worked well for you in terms of the text? Could you please provide examples? **I.Q.4.** What worked well for you in terms of the visuals (pictures, diagrams, charts, and graphs)? Could you please provide examples? **I.Q.6.** What worked well for you in terms of the audio? Could you please provide examples? **I.Q.8.** What worked well for you in terms of the multimedia (video and animation)? Could you please provide examples? **I.Q.10.** What would be a successful strategy for establishing accessibility for online courses?

Findings for Research Question 1: Challenges

The first research question is as follows: "Which challenges do students with visual impairments identify in online learning environments with regards to media used in their courses?"

In order to investigate the first research question, five interview questions (interview questions 1, 3, 5, 7, 9) were asked to participants. Findings are provided as follows.

Challenges with Text.

The first interview question was asking participants challenges they encountered with text in online learning environments.

Ann described problems she had with text in online courses as screen reader not picking up the text correctly all the time, not being able to adjust the screen to the text, and handwriting prints. The biggest problem she had was the screen reader she use (JAWS) not always reading the text correctly. She believes that it is a technical issue and sometimes she switches between the cursors (JAWS versus PC) and that solves the issue. She added that cursor jumped over the different parts of the screen time to time and she did not know where exactly the cursor was.

Tina also mentioned about the same issue that screen reader not picking the text. She also added that big tables created challenge for her. Whenever a page includes a big table, she says, screen reader usually does not read it correctly. Ann mentioned that not being able to adjust the screen to the text was challenging for her. She said she did not need to make the text extra big because she was not able to see it anyway but when the text fitted the screen, she had better results with the screen reader.

Ann had experienced issues with course materials that were in handwritten format. She mentioned that some of her instructors were not aware that she could not read the handwritten materials and/or screen readers cannot read them. So, whenever she had a handwritten text, she had to ask for a typed version of the same content. Also, she added that whenever she got the feedback in handwritten format (instructor handwriting on her paper and scanning it back to her), she got the same problem. So, she prefers getting feedback in typed format. Lastly, Ann explained that bullet list did not help her while reading the content since the screen reader says "bullet item" for each list item and it distracted her.

Challenges with Visuals.

The third interview question was asking participants challenges they encountered with visuals in online learning environments.

Ann indicated that visuals constituted the biggest problem for her for her online courses and added that all of her online courses included pictures, charts, diagrams, and graphs. The first problem she mentioned was pictures without labels. In her online courses, most of the images were not labeled or were not properly labeled. She had to have an assistant, usually her husband, describing the visuals to her since screen readers do not describe the visuals; they just read the labels for the visuals. She indicated that math and biology courses were especially difficult because they were heavily based on visuals. She had to ask for accommodations and that was time consuming for her. She sometimes got help from her counselor at the university or student accommodation center. But even this help was not very helpful for her since people trying to help her did not know how to describe visuals to a blind person. Labeled pictures on the other hand,

she said, did not help her to get a sense what the image really looked like. The example she gave was a picture of a specific flower from a biology class. The label was only saying “this is a picture of Daffodil” and this did not help her to understand what daffodil really looked like.

Ann repeated over and over again that she generally did not get a sense of what the image really looked like. When asked about her preferred method for describing pictures, she explained it as “starting from one side continuing to other side of the picture (it might be top to bottom or right to left) so I have a better clarification of where the objects are located in the picture as well as colors”. Her preferred way for describing graphs and charts is “a detailed description of what the graph is about, what type of graph it is, and information that entails the graph”. She does not mind reading detailed paragraph for a description of a visual. She also added that she enjoyed hand held things for the visuals. She would like to have 3D printed objects for the visuals she had in online courses to better understand the content. Ann stated that she learns tactilely and any tactile input along with a description would help her to learn. During the interview, Ann visited one of her online courses and found a page with a visual. Screen reader said, “there is a graphic” when the page was loaded but it did not say what type of graphic it was or where it was. She concluded that this happens her a lot.

Tina started answering this question as explaining the core of the issue as representation of the data. In her World Regions course there were many visuals (pictures, maps, charts, and graphs) and quizzes were based on those visuals. Physics and astronomy courses were also heavily visual based. She stated one of her biggest problem as having visuals without labels, similar to Ann. She also said that she could not figure it

out what the visual was about unless someone was sitting next to her and describing visuals to her. She continued that labeled visuals were not descriptive enough; there were not enough content in the text. Similar to Ann, Tina also mentioned some of the visuals were inessential for the class and having them created extra difficulty for her. She added that some of the visuals were so complex that even the labeling did not help her to understand them. Similar to Ann, Tina also mentioned having problems with screenshots. She said those visuals were usually used for explaining how to use a system, a tool, or a specific system capability but without having a proper definition, so she could not understand what those screenshots were telling. Tina concluded that while using help pages, by the time she figured it out what she wanted to do, she usually has forgotten what button she needed to push.

Challenges with Audio.

The fifth interview question was asking participants challenges they encountered with audio in online learning environments.

Ann answered this question under three titles as audiobooks, audio lectures, and short audio embedded in the course pages. Audiobooks were more beneficial for her, she said, and she liked them. She prefers audiobooks over pdf files and the biggest problem she has with them is that there are not many books are offered on audio. She explained she gets them through Learning Ally (a company provides audio books to visually impaired users) and although she could bookmark and highlight them, it was still hard for her to navigate through the audiobook. She usually accesses audiobooks via her computer and she had to be very focused to stay on track. She added that sometimes she gets audio books on CDs and those are harder to navigate because she cannot bookmark and/or

highlight them. She stated that she also had audio lectures in her online courses. She mentioned accessing audio files via screen reader was difficult and she needed someone else to access those files for her. She also stated that she could not use control tabs to play/stop/rewind. Apart from accessing an audio file and controlling the stream, she also had difficulty in terms of understanding lectures since usually instructor or narrator mention visuals (that were in the course book) during the lecture and they did not describe what those visuals looked like. She said they usually said, "okay, see this diagram…" or "as you can see in the diagram on the page 28…". So, she indicated that teachers and narrators need to be more descriptive when they use visuals in their audio lectures and they need to explain in detail what the visual looks like along with what information it entails without assuming students have an easy access to those visuals. Lastly, she talked about short audio embedded in the course pages. According to Ann, those audio files are for general public not for her since they include a lot of visual references. She concluded that she did not find those short audio segments included in her online courses helpful for her.

Tina started answering this question explaining the core of the issue was having control over the audio files. She stated that it is not always easy to control online audio files. Tina also mentioned that some of the audio files played automatically and she could not hear the screen reader. Similar to Ann, Tina also uses audiobooks she gets from Learning Ally. She thinks audiobooks are good for general source of information and she does not prefer them for her academic courses. The problem Tina had with audiobooks was having different readers for the same book or chapter. So, she found it a little distracting since every person had a different reading style and she needed to adjust

herself each time they switch readers. She described her way of listening audio as "explorer" which basically means that she stops the audio when she hears a term that she does not know and searches for that term online and then goes back to audio again. She also maintained that having no control over the speed of the audio was problematical for her since she can listen audio information faster than the normal speed because she uses screen reader all the time. Lastly, Tina mentioned that she could not play some of the audio files with the web browser she used to access her course so she had to close the window and open the course in a different browser. She said sometimes the LMS she was using (Moodle) did not work well with the audio files.

Challenges with Multimedia.

The seventh interview question was asking participants challenges they encountered with multimedia in online learning environments.

Ann stated that in many courses she has taken, instructors provided links for videos to watch and she had difficulties with those videos. She said that videos were all visual and there was not any description. She had to go with what she heard without totally understanding the whole picture. Again, she had to ask someone else to describe her what was happening in the video, basically what visuals they were showing on the screen. She had the same problem with animations and she gave example from her biology course, which included many animations. For example, she said an animation for the transmission of the neurons had no audio and no description. So, she had no other option but ask someone to help her understand what was going on inside the animation.

Tina explained that controlling videos was problematical for her. Similar to audio files, she said, she found it hard to control video stream. Also, she mentioned that she

usually did not know how long a video was before going into it. She added that she found video harder to control compared to audio. Similar to Ann, Tina also stated that instructors usually do not know or remember that all types of people will be watching those videos. She explained further that instructors showing visuals or writing on the board (especially in math courses) saying "as you can see here…" She also added that some of the instructors did a great job in terms of explaining everything they were doing in the video. In the World Region course she took, she explained that whenever the instructor used a map she felt like she really had to have someone to explain what was going on. She usually used her previous knowledge to make sense of what she heard. Similar to Ann, Tina also highlighted the importance of describing in video lectures. She also had some lectures described (by the teaching assistant of the course) but she felt that the instructor and the narrator was not on the same page al the time. So, she claimed that having the instructor describing what s/he is doing while teaching the course is better since instructor is the person who knows what points to get across.

The Greatest Challenge.

The ninth interview question was asking participants the greatest challenges they encountered in terms of accessibility.

Ann took her time to think before answering this question and came up with three main challenges she experienced in her online courses. These challenges are (1) Visuals and multimedia that were not descriptive, (2) interactive labs, and (3) course platform (LMS) being incompatible with the assistive technology. She has already described the issues she had with visuals in her online courses and she repeated that many of her courses included visuals and multimedia. Those media were not labeled and were not

described and she had to ask for accommodations, which made her spend more time and feel frustrated. Interactive labs, she had them in her psychology course, were online basic psychology experiments (such as memory and perception tests) she needed to conduct by herself. Since they were all visuals (for example showing flash cards and asking user to remember what it was) she could not complete them. She, again, had to ask for accommodations. She noted that she usually had difficulties whenever instructors used new tools (especially interactive ones) without realizing there was a blind student in the class. She said she couldn't use those tools (interactive experiments, online portfolios, interactive chats) since they usually did not work well with the screen reader or any other assistive technology. Which is the similar situation for the course platform (LMS). Her LMS was Blackboard and she declared that it did not work well with the assistive technology she used to access the class. She described her experience as random that sometimes she had an issue she has not have before and she had no idea what was happening. As a researcher I also witnessed her cursor jumping around on the welcome page of her Blackboard account and screen reader did not help her to get out of the situation.

Tina mentioned a new problem when asked this question. She explained that having math and science content is very problematical. She stated that it requires a lot of work and adjustments. Markup language for math content is a very specialized one and many people do not know it. Having this complexity for presenting the content online and having less people skilled in the area is causing a lot of problems in terms of availability and this, she believes, discourages many students to go forward with math and science courses.

Findings for Research Question 2: Design Strategies

The second research question is as follows: "*What media design strategies work well for students with visual impairment in online learning environments?"*

In order to investigate the second research question, five interview questions (interview questions 2, 4, 6, 8, 10) were asked to participants. Findings are provided as follows.

Best Practices for Text.

The second interview question was asking participants what worked best form them in terms of text.

Ann stated that plain text without the graphics worked best for her. She likes having only plain text for her course content eliminating unnecessary graphics as mush as possible. For organization of the text, she stated that she used all different types of organizations (including one bulk text, lists, bullets, paragraphs, etc.) and plain paragraph form with just titles and/or headlines for each paragraph helped her the most.

Tina maintained that organization of the text is very important for her and added that if the text was set up in a logical way by different pages or by headings, it worked out well for her. Tina also liked to have description for the visuals embedded and/or spread out in a text so she understood what the content was about easier. She also emphasized that she enjoys having links in the text for more detailed information or further explanation. She said this is what she has been doing with her online learning; she searched for the term or the phenomena to have a better understanding.

Best Practices for Visuals.

The fourth interview question was asking participants what worked best form them in terms of visuals (*pictures, diagrams, charts, and graphs).*

Ann started answering this question as "I don't really have a good example", and after thinking a while she said having someone explaining what the visual was about helped her so far. She repeated that either her husband or her counselor from her school helped her to understand the visuals. She repeated that she would like to have 3D printed objects sent to her in the beginning of the semester for all the visuals her course includes.

Tina explained proper tags helped her to understand the content. She added that using links to refer more detailed information was also very beneficial to her. She likes taking advantage of the information available online. When asked what strategy worked for her in terms of describing visuals, she answered that first explaining the general trend of the image and then filling the details helped her. She needs to know why the image is there in the first place and the description should include what important thing she needs to know about the image. She also stated that she is dealing with a lot of visuals since her major is physics and she wants descriptions get to the point quickly so she can start with an idea. Tina concluded her comments related with describing visuals saying she is okay as long as she knows what the visual is supposed to telling her. Furthermore, Tina mentioned that she found audiobooks tricky for the visuals because they used top to bottom approach for describing and she usually forgets what was on the top by the time narrator was describing the bottom part. She noted that it was a logical approach but that she found it tricky. Similar to Ann, Tina also mentioned she liked 3D printed objects. She had a real experience with them in one of her math classes. She also emphasized that she

learns tactilely and translating visuals into 3D models would be very helpful for her. She added that those models are faster than visuals in terms of conveying the information.

Best Practices for Audio.

The sixth interview question was asking participants what worked best form them in terms of audio.

Ann answered this question by giving an example from one of her online courses. She had a physiology of psychology course she enjoyed a lot; she actually described it as one of her best classes. This course included a lot of audio but the instructor was doing a great job in terms of explaining everything in detail. The instructor first was going over the course material briefly and then he was going back and explaining the content in more detail. In the first round, he was using the terminology of the discipline and in the second round, while he was providing detailed explanation while he was using daily English. Ann maintained that this helped her a lot. She said she is aware of the fact that as a psychology major she needs to get acquainted with the terminology but being a person with a visual impairment, it is difficult for her since she does not have the visual aspect of the content. So, getting the big picture first and then getting the details helped her a lot. When asked about what would be the best strategy she would recommend, she said breaking the content in to simple chunks, going back and iterating in simple terms, and explaining everything would be her suggestion to instructors.

Tina stated that she would like to have control over audio files as much as she wants (in terms of playing, stopping, rewinding, and arranging the speed). She also stated she liked being able to download and play audio files in different platforms such as her smart phone or her tablet PC.

Best Practices for Multimedia.

The eighth interview question was asking participants what worked best form them in terms of multimedia (video and animation).

Ann mentioned that it helped her if they were talking and explaining at the same time in the videos. So, she said just assuming your audiences cannot see what you are doing and embedding the explanation while you are lecturing is a great strategy. She also mentioned audio description (visual description of what is happening in the scenes) helped her a lot. She had couple educational videos audio described and she enjoyed them. But she stated that they are not widely available. She would like to have them in her online courses but she does not expect it happening soon. Ann noted that even for the movies (which is the main target of the audio description movement) she had limited options but she is still happy with the ones she watched; in other words audio description strategies for the movies worked well for her. She also mentioned she enjoyed TED talks (TED (Technology, Entertainment, Design) is a global set of conferences run by the private non-profit Sapling Foundation, under the slogan "Ideas Worth Spreading"). She used them for her classes and found them very helpful mostly because they did not include visuals and speakers usually described any visual they show.

Tina stated that she likes taking videos anywhere (different platforms) to watch and being able to control them. She believes that if done correctly, videos are very helpful to learn the content because she can listen them whenever and wherever she wants. She provided an example from her online course that the instructor was distributed them widely so she did not have to use one specific web site to watch them. She thinks having this freedom is very important.

Successful Strategy for Establishing Accessibility.

The tenth interview question was asking participants about a successful strategy for establishing accessibility for online courses.

Ann listed her suggestions as: (1) using plain text without unnecessary graphics, (2) adding very descriptive labels to visuals, (3) using a LMS compatible with assistive technology, (4) being able to adjust text size and contrast, (5) not having a lot of information on one page and breaking it down to several pages, (6) adding audio to "help" and "how to" pages, and finally (7) training online teachers about overall spectrum of disabilities.

Tina listed her suggestions as: (1) providing multiple ways to complete the course, (2) providing multiple modes of access, and (3) providing independent study as an option. For her first suggestion she gave her world region course as an example. In that course the instructor provided different options for students. Students could have watched all the videos and took quizzes, or they could have read the course material only, or they could have participated in class lectures. She highlighted that she would like to have more courses taking this approach. For her second suggestion she explained that having different types of media for the same information would be very helpful. She repeated that having 3D models would be included in this suggestion. Finally, in her last suggestion she explained that one of her best classes was the independent ones and it was very effective for her to have one on one session with her instructor.

Chapter 5 – Summary, Discussion, and Conclusions

This chapter reviews the study as a whole by summarizing and discussing the results and providing implications for practice. Limitations of the study and recommendations for future research are also provided in this chapter.

Review of the Study

The research presented in this study investigated the experiences of students with visual impairment in online learning environments with regards to media used in their courses with the intent of providing suggestions for accessible media design. Media included text, visuals (pictures, diagrams, charts, and graphs), audio, and multimedia (video and animation) used in online learning environments.

In order to explore implications of accessible media design for students with visual impairment, this research study was guided by the following central research question: "What are the experiences of students with visual impairment in online learning environments with regards to media used in their courses?"

Based on the central research question, sub-questions of the study were formulated as below:

1. Which challenges do students with visual impairments identify in online learning environments with regards to media used in their courses?
2. What media design strategies work well for them?

An exploratory case study approached utilized in this study and semi-structured interviews were conducted with two visually impaired students who had online learning experience.

Review of the Case and the Participants

The larger phenomenon this study examines is experiences of students with visual impairment in online courses with the media used and the unit of analysis, the case, is a student with visual impairment who has taken online course(s).

Two participants of the study were Ann Garcia and Tina Conner. Tina is 34 years old and at the time of the study was not employed. She is legally blind and she had lost her vision in progress of time due to optical nerve damage. She became legally blind at the age of 25. She is 20/400 on her right eye and she is 20/800 on her left eye. She had her GED when she was 17 years old and she decided to work with children while she was working at early learning center for children. After loosing her vision she took her time to get rehabilitated and learn mobility, assistive technologies, and how to use computer again. She went to her local college and graduated with associates of human service. Currently she is a student at a university and majoring in Psychology. She has been taken all of her courses online for her degree and she had taken 15 courses in total. She is planning to be a school counselor. She uses the Internet on a daily basis; she uses email, social media, and news web sites. She believes that her life would be difficult without the Internet. She also uses different assistive technologies such as JAWS screen reader and speech synthesizers. Tine is a recent graduate from a university with a B.S. in Physics and she was about to start her graduate school at the time of the study. She has taken one fully online course and couple blended courses throughout her undergraduate education. She is 23 years old and has couple internship experiences as an accessibility tester. She is congenitally blind which means she was born blind. She has light perception in one eye. She uses the Internet daily basis for email, web browsing, listening podcasts, streaming

things, ordering groceries, and for many other things. She describes herself as someone who is always online and she has skillful in using assistive technologies.

Summary and Discussion of the Results

The results are summarized and discussed per media (text, visual, audio, multimedia) under this section. Also, the most challenging experiences of the participants and their suggestions for more accessible online courses are outlined.

Results Related with Text

Challenges with text. Text constituted the core of the media used in the participants' online courses. They both access text through screen readers (both use JAWS) and the major problem related with the text was screen reader's incapability of picking everything correctly. Of course this is more of a technical issue and instructional designers and online teachers have limited control over it but being aware of this problem is also very important. Being aware of the fact that screen readers might not be working well with the platform (LMS) being used for online course may lead testing the course in advance; communicating with LMS provider or responsible technical office (many of the screen reader problems are avoidable), or providing content of the course in more accessible platform.

The other problem related with text was not being able to adjust the screen to the text. This problem is especially important for students who, although very little, have vision. Since, students with visual impairment prefer to use whatever vision they have instead of depending on only screen readers. So, being able to adjust the screen to the text is very important for them to be more independent. The solution to this problem is using "responsive design" strategies. Responsive design is a term coined by Marcotte (2015)

and it highlights designing optimal viewing experience by embedding standards-based technologies into design to make it more flexible, more adaptive to the media that renders it. Again, online teacher might be not skilled in terms of designing the platforms, but instructional designers should be knowledgeable to avoid this specific problem.

The next problem was handwritten text in online courses. Students with visual impairment do not have any technology, including the screen readers, to read any handwritten text. So, online teachers should avoid providing this type of text considering it is not accessible for all.

The other problem was using big tables in online course pages. Big tables are usually tricky in terms of accessing via screen readers. Online teachers and instructional designers should avoid using them as much as possible.

The final problem that this study revealed was using "bullets" for lists since screen readers say "bullet item" for each item in the list. Non-ordered list can be provided as plain text with commas.

Best Practices for Text. Not surprisingly, a plain text avoiding unnecessary visuals worked best for the participants. Both participants agreed on having paragraphs with heading and subtitles for each paragraph and not having too long pages.

Also, embedding descriptions for the visuals in the text was another best practice. So, instead of creating very short labels for visuals, more detailed descriptions can be inserted into the content of the course.

Providing a link for more detailed information for a new terms used was another suggestion. Considering the fact that most of the students with visual impairment do not have any visual reference while learning, this might be a very effective solution.

Providing an external link for a new or a complex term, which takes student to a new page including further explanation might be very helpful for student with visual impairment.

Results Related with Visuals

Challenges with visuals. It is not surprising that visuals constituted the biggest problem for the study participants. Both participants stated that their online courses included a lot of pictures, charts, diagrams, and graphs.

The major problem related with visuals was having no labels for them or having not proper labels. Although it is mandated through law and web accessibility guidelines (WCAG 2.0; Section 508) have made it clear that any visual item should be accommodated with a non-visual equivalent, participants of the study have encountered many visuals without proper labels. Math and science courses were especially difficult for this reason. Even with labels, participants stated, they did not get a sense of what image really looked like because labels were not descriptive enough. So, it is very important to add descriptive labels for any visual used in an online course.

Both of the participants highlighted problems they experienced with screenshots on the help pages. Screenshots for how to use a system, a tool, or a specific system capability usually do it without providing explanations for visuals, which creates challenges for users without vision. Using screenshots for help pages are very common but having text to explain what is in the pictures are not. Considering the fact that screen readers cannot describe visuals, it is very important for instructional designers to add proper descriptions for screenshots in the help pages.

Best Practices for Visuals. The best strategies for describing visuals were slightly different for the study participants. While Ann prefers top to bottom or left to right approach for describing visuals, Tina was more interested in knowing the essential information about visuals first and then listening the details. They both agreed on learning what the visual is about, what type of visual it is, and information that entails the visual.

The study participants also provided insights about 3D printed objects without specifically being asked about it. Both participants stated that they learn tactilely and enjoyed 3D printed models for understanding visuals. Their suggestion was having 3D printed models mailed them in the beginning of the semester for all the visual their online courses include. This request may look unrealistic for now, as many of the institutions may not have sources to produce 3D printed instructional materials. But 3D printing gaining popularity in many different areas including medicine, construction, and material science and it could be also used in instructional material development in the near future.

Results Related with Audio

Challenges with Audio. The main problem with audio in online courses was accessing and controlling audio files. Both participants maintained that audio files were difficult to access while using screen reader. Also controlling (play, stop, rewind) audio files was problematic for the study participants. Having no control over the speed of the audio was found to be challenging. Students with visual impairment can listen to audio faster than normal speed since they use screen readers on a daily basis. Furthermore, participants mentioned that the LMS they were using for their online course (Blackboard and Moodle) did not work well with audio files. These problems can be avoided by

testing the audio players used in the online course with different screen readers. Some audio players are more compatible with screen readers and choosing those players to use in online courses could be very helpful.

Another issue emerged related with audio was using a visual language. Both participants agreed that in many audio lectures instructors mentioned visuals without describing what they really look like. It is very important to remember most of the students with visual impairment do not have frame of reference for visuals so they need more detailed explanation for a new term, object, and subject introduced.

Best Practices for Audio. The study participants suggested providing access to control over audio files in terms of playing, stopping, rewinding, and controlling the speed. Making audio files downloadable for students so they can listen to it from different platforms was also suggested.

In terms of how to talk for audio lectures, a best practice suggested was providing the big picture first, and then explaining the details by breaking the content into small chunks. Both participants agreed on providing an explanation of new terminology avoiding visual references as much as possible.

Results Related to Multimedia

Challenges with Multimedia. Similar to visuals, videos and animations without descriptions created challenges for the participants. Video description is available for some entertainment movies, but it is not widely used in instructional videos. Describing a video requires knowledge and time, but there are online sources for instructors and instructional designers to make this process easier. Instructional videos should be selected and created carefully and all the scenes in the video described to make it accessible.

Similar to audio, participants mentioned that in their online courses instructors usually showed content without providing a proper explanation. They heard what the instructor was saying but they could not see and understand what s/he was holding, showing, or writing. Providing a detailed explanation for all the actions taken during video lectures would be very helpful for students with visual impairment.

Lastly, using control buttons for the videos created difficulty for the participants because they use screen readers. Choosing video formats and video players carefully while considering assistive technology compatibility is important to avoid this problem.

Best Practices for Multimedia. The study participants agreed on producing more descriptive instructional videos. The strategy suggested for this end was assuming the audience cannot see the video and embedding the explanation of what it shows (an object, writing on a board, etc.) and visuals you are using while you are lecturing. It was also suggested to have the instructor of the course describe his/her actions and visuals instead of an external narrator for the sake of more accurate information.

Also, making videos downloadable for students to use them on any device and platform was suggested.

The Greatest Challenges in terms of Accessibility

The study participants stated their greatest challenges as: (1) visuals and multimedia that were not descriptive, (2) interactive learning environments, (3) course platform (LMS) being incompatible with the assistive technology, and (4) accessing math and science content.

Suggestions For More Accessible Online Courses

The study participants listed their suggestions as: (1) using plain text without unnecessary graphics, (2) adding very descriptive labels to visuals, (3) using a LMS compatible with assistive technology, (4) being able to adjust text size and contrast, (5) not having a lot of information on one page and breaking it down to several pages, (6) adding audio to "help" and "how to" pages, (7) training online teachers about overall spectrum of disabilities, (8) providing multiple ways to complete the course, (9) providing multiple modes of access including 3D models, and (10) providing independent study as an option.

Comparison Between the Participants and the Case for Visual Impairment Variation

As it can bee seen from the results, there were similarities and differences between the challenges participants of the study reported. The similar challenges were screen reader problems, visuals without descriptions, visuals with inadequate labels, help pages including screenshots, accessing control panels of audio and video players, and videos without audio descriptions. Both participants experienced challenges with these accessibility issues. The differences, on the other hand, were mainly about level of detail each participant needs for visuals and videos. It was apparent that the participant who had vision beforehand needed more detailed information for describing visuals and videos and also she had requested more accommodations throughout her online courses. The other participant, on the other hand, needed less detailed descriptions for visuals and videos and she was looking for getting the main idea as quickly as possible.

Differences in online learning experiences are expected since the participants have different vision impairment conditions. Ann lost her vision in progress of time and Tina is congenitally blind. So, differences in vision impairment condition also have an effect on needs of the students and necessary accessibility specifications to support their learning in online platforms.

Implications for Practice

This study analyzed experiences of students with visual impairment and blindness in online learning environments with regards to media used. One of the goals of this research was to provide recommendations to instructional designers about how to design, develop, or select more accessible educational media. At the end, the results of this study can serve different populations. Instructional designers who design and develop online courses, instructors who teach online courses, and accessibility specialists who work in higher education can benefit from this study. Challenges participants experienced can be avoided and what worked well for the participants can be used in future online course design. Also, suggestions for more accessible course design can be taken into consideration.

Suggestions derived from interview data are listed below for each medium. These suggestions should be taken into consideration while designing instructional messages and online learning platforms for students with visual impairment.

Suggestions for Text.

- Avoid handwritten text
- Avoid big tables
- Avoid bullet lists

- Use plain text avoiding unnecessary visuals
- Use paragraphs with heading and subtitles for each paragraph
- Avoid long pages
- Embed descriptions for the visuals in the text
- Provide a link for more detailed information for a new terms used
- Use responsive design strategies
- Test the course in advance for accessibility
- Communicate with LMS provider or responsible technical office for accessibility problems
- Provide content of the course in more accessible platform if possible

Suggestions for Visuals.

- Add descriptive labels for any visual used
- Add proper descriptions for screenshots in the help pages
- Provide following information for describing visuals:
    - what the visual is about
    - what type of visual it is
    - information that entails the visual
- Use 3D printed learning materials for visuals when possible

Suggestions for Audio.

- Provide the big picture first, and then explain the details by breaking the content into small chunks in audio lectures
- Provide more detailed explanation for a new term, object, and subject introduced

- Test the audio players used in the online course with different screen readers and choose more accessible audio players
- Provide access to control over audio files in terms of playing, stopping, rewinding, and controlling the speed
- Make audio files downloadable for students so they can listen to it from different platforms

Suggestions for Multimedia.

- Add audio description
- Provide detailed explanations for all the actions taken during video lectures
- Assume the audience cannot see the video and embed the explanation of what it shows (an object, writing on a board, etc.) and visuals you are using while you are lecturing
- Have instructor of the course describe his/her actions
- Make videos downloadable
- Choose video formats and video players carefully while considering assistive technology compatibility

Intended Contribution of the Research Study to the Field of Instructional Design and Technology

This study extends the current literature base by discussing accessible media in online learning. A review of the literature revealed that there is paucity in empirical studies exploring this phenomenon. The literature on instructional media and instructional message design has to a great extent ignored the accessibility and student with disabilities.

According to Reiser and Gagne (1983) choosing the appropriate medium is an essential step in the instructional design and development process and almost all instructional design models have a step for selecting media.

Instructional message design was defined by Fleming and Levie (1978) as "the process of manipulating, or planning to manipulation of, a pattern of signs and symbols that may provide the conditions for learning"(Fleming & Levie, 1978, p.xi). A pattern of signs and symbols such as words, pictures, and gestures were defined as a message and design was explained as intentional process of analysis and synthesis for creating concrete plan for solution of an instructional problem (Fleming et al.,1993).

Good message design is effectively communicating clear thinking either through text, visuals, or aural media or designing a message that attract to any or all the human senses (Lockee, & Larson, 2014). According to Berry (1995) message design requires comprehensive understanding of how people learn and capabilities of technological tools in other words medium. Message design can be accepted as an activity in which instructional designers are trying to answer how they can structure the content to promote optimum learning (Berry, 1995).

Lockee and Larson (2014) highlighted that message design and delivery is not afterthought rather it is a process that should start from the beginning of an instructional project. And added that visual design aspect of the message design is the focus of many message design efforts. Bishop (2000) also highlighted the same situation and maintained that interface and instructional design guides ignore sound and instructional uses of sound are left largely unexplored.

It can be clearly seen from the studies summarized above that choosing instructional media and designing instructional messages are part of the instructional design process and instructional designers should consciously making decisions from the beginning of an instructional project. Unfortunately visual media is the main focus of many instructional design projects and other types of media is used less frequently. The assumption behind overly using visuals is that all students can see those visuals. This brings the main issue related with instructional design projects which is accessibility is ignored. Students with different abilities are not targeted in most of the instructional modules and necessary design requirements are not taken into consideration. Lockee and Larson (2014) maintained that:

> The first stage in effective message design is ensuring that the content and activities are accessible to the learner. When instruction is accessible, the learner can access it technically, physically, and cognitively. To access instruction physically and cognitively, the learner must be able to perceive the instructional message so that it can be processed (P. 208).

It is very important to discuss the concept of universal design as it relates to this current research. The main idea behind implementing universal design to instruction is that "anticipating and planning for the diverse needs of potential users during the design process, the resulting product or outcome will better suit the needs of all users" (Scott, McGuire & Foley, 2003). It is aimed that with the universally design instruction "only a small minority of students will need "special" accommodations - those who cannot use even universally designed instruction" (Bowe, 2000, p. 2). This notion represents a

practical shift away from traditional processes in which students with exceptionalities were supported by special accommodations toward a system that is designed from its planning stages to address multiple learning styles, ability levels, interest areas and assessment practices (Kirby, 2009). Universal design principles have been adapted to education through a number of models that emerged in the last decade. These frameworks share the same aim that is creating an inclusive instruction that every student can benefit by implementing universal design principles to educational environment. One of the well-known frameworks, Universal Design for Learning (UDL), was developed by Center for Applied Special Technology (CAST) with the purpose of creating a flexible approach to curriculum design that offers all learners equal opportunities to learn (Coombs, 2010). UDL describes three principles that help instructors create a flexible curriculum, a curriculum that uses multiple ways to provide instruction, gather what students learned, and enable student motivation and engagement. It uses inclusive instructional strategies that benefit a broad range of learners.

Universal design of learning environment is very important to make instruction accessible for each student. The idea behind it is designing instruction and learning materials in a way to support most of the students' needs at the front so minimum adjustment is necessary during the instruction. The IDT filed has not paid enough attention to UDL in terms of evaluating its effectiveness or investigating its applications to different learning environments. The UDL framework can be extended with the help of IDT knowledge base and research.

It was discussed in the Chapter 1 that accessibility needs to be understood differently when it is being evaluated in the context of teaching and learning that needs of

students with disabilities, learning in web environments, and appropriate media selection should be considered. This study investigated what could be the further dimension in accessibility in online learning environments to create equal opportunities for students with disabilities with the purpose of contributing development of the concept of Pedagogical Accessibility. This concept is fairly new and mainly focuses on accessibility of digitized learning platforms while considering learning process. This is an area that deserves attention of IDT researchers, as there are limited number of people who understand cognitive learning process, interface design of learning platforms, and instructional design.

This study attempts to fill the gap in the IDT field by investigating experiences of students with visual impairment in online learning environments with regards to media used and providing suggestions for how to select more accessible media and how to design more accessible instructional messages. Accessibility should be part of any instructional design project and needs of the students with different abilities should be answered. Suggestions provided in this study is valuable in terms of designing accessible online courses and that there is a lack of information and guidance for answering the needs of students with visual impairment in online learning environments. It is very important that IDT field is acknowledging and highlighting this gap. More research on accessibility in online courses should be conducted for diverse student ability groups.

Study Limitations

It should be noted that this particular research study had two limitations with respect to the number study the participants and visual impairment status of the participants.

The first limitation is this was a small case study of two participants. To enhance the possibility that this study may be informative in similar contexts, I attempted to provide rich descriptions of the participants' experiences and attempted to provide descriptions of how each participant compared with the other within the study (Merriam, 1998).

The second limitation to this study is that both participants had similar visual impairment (they both cannot use their vision for leaning purposes) although they are classified as blind and legally blind. This study could have been strengthened by including another participant who has some useful vision for learning purposes to get an additional perspective.

Recommendations for Future Research

Based on the study's findings and limitations, several recommendations for further research can be made. First of all, the same study can be repeated with students who have diverse vision impairment to provide more inclusive implications. Secondly, as participants of the study highlighted, 3D printed instructional models for students with visual impairment can be studied further to see how they may help students. Thirdly, this study did not differentiate course content and provided a broader view. Future research can especially focus on accessible math and science content since these are the courses students had the biggest challenges for the visually impaired learners. Lastly, message design research can focus on accessibility specifications for diverse student groups. For the instructional message design, Fleming and Levie (Fleming et al., 1993) maintained that their principles were written with the intent of being widely applicable across subject matters and learners so specificity of the principles is limited. It can be said that there are

many principles that are applicable to all of the students regardless of the disability status but there are some principles that may not work with students who have specific disability. So, working on specifications of accessible instructional messaged design for online learning environment would benefit the field.

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Appendix A: Interview Protocol

Interview Protocol for study on
Online Instructional Media for Students with Visual Impairment

Interviewer: _____
Participant pseudonym: _____
Time: _____
Date: _____

Consent form
The participant has received an electronic copy of the consent form and signed it before scheduling the interview.

Introduction
Overview of project: I am conducting a research study entitled "Online Instructional Media for Students with Visual Impairment". The purpose of this study is to explore the experiences of the students with visual impairment in online courses with regards to instructional media with the intent of providing suggestions for accessible instructional media design. You are one of the three participants in this study and I will ask questions about your experiences with text, visuals, audio, and multimedia used in your online course.

Begin video recording

- Ask the participant if he or she has any questions before the interview commences.
- Inform the participant that the study will begin when starting the recording.

Begin with Interview Questions:

Background information

1. Your age
2. Your visual impairment status
3. Your education level
4. Your program of study
5. Your online learning experience
    a. How many courses have you taken online?
    b. What was/were the name/s of the course/s?
    c. How the course was offered? Which platform was used?

   d. Could you please describe your performance? Were you successful? Did you struggle?
   e. How long it has been since you have taken an online course?
2. Can you explain your Internet usage?
   a. How frequently you use the internet?
   b. For what purposes you use the internet?

Experiences with instructional media in online course

- Ask participant to share his/her screen with you and visit online course web site while answering the questions.

3. Considering your learning process, what are challenges you have encountered with text in online learning environments? Could you please provide examples?
4. What worked well for you in terms of the text? Could you please provide examples?
5. What are challenges you have encountered with visuals (pictures, diagrams, charts, and graphs) in online learning environments? Could you please provide examples?
6. What worked well for you in terms of the visuals? Could you please provide examples?
7. What are challenges you have encountered with audio in online learning environments? Could you please provide examples?
8. What worked well for you in terms of the audio? Could you please provide examples?
9. What are challenges you have encountered with multimedia (video and animation) in online learning environments? Could you please provide examples?
10. What worked well for you in terms of the multimedia? Could you please provide examples?

Overarching questions

11. Considering your overall online learning experience, what do you think the greatest challenge you encountered in terms of accessibility? It can be any of challenges you mentioned or an additional one.
12. What would be a successful strategy for establishing accessibility for online courses?

Stop recording and thank the participant for participating.

Appendix B: Recruitment Letter

Greetings!

My name is Zerrin Ondin and I am a Ph.D. candidate at Virginia Tech. I am conducting a research entitled "Online Instructional Media for Students with Visual Impairment". The purpose of his study is to investigate the experiences of the students with visual impairment in online learning environment with regards to instructional media (text, visual, audio, and multimedia) with the purpose of developing suggestions for accessible online course design. To this end I am looking for subjects to participate in my study.

If you agree to be in this study, I will conduct an online interview with you. The interview will be conducted at your convenience. The interview will include questions about your experiences in online courses with regards to instructional media. The interview will take approximately 60 minutes to complete and will be video-recorded.

Rest assured that all of your answers will be confidential and I will make sure your name will not be revealed in any report related to this study. The study will conform to the policies regarding human subjects' research as mandated by the Institutional Review Board of Virginia Tech.

I am looking for subjects:

- Who are older than 18 years old
- Who are visually impaired
- Who have taken online course/s

I encourage people of all genders and ethnicities to participate. You don't have to be a student currently. If you are interested in participation in this study, please reply to this email for further information such as interview scheduling or any additional information that may aid you in making a decision about participating.

Additionally, if you know of other individuals fitting the criteria of joining the study, please forward this email to them. If you would prefer to discuss the study and/or your participation on the telephone, please call Zerrin Ondin (540-642-9047).

Sincerely,
Zerrin Ondin
Instructional Design and Technology
Virginia Tech
zerrin@vt.edu

Appendix C: IRB Approval

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE:	July 27, 2015
TO:	Barbara B Lockee, Zerrin Ondin
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)
PROTOCOL TITLE:	Online Instructional Media for Students with Visual Impairment
IRB NUMBER:	15-739

Effective July 27, 2015, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 6,7**
Protocol Approval Date:	**July 27, 2015**
Protocol Expiration Date:	**July 26, 2016**
Continuing Review Due Date*:	**July 12, 2016**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Appendix D: Accessibility Guideliness

WCAG 2.0 Guideline

Principle 1 - Perceivable: Information and user interface components must be presentable to users in ways they can perceive. *Guideline 1.1 Text Alternatives:* Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language. *Guideline 1.2 Time-based Media:* Provide alternatives for time-based media. *Guideline 1.3 Adaptable:* Create content that can be presented in different ways (for example simpler layout) without losing information or structure. *Guideline 1.4 Distinguishable:* Make it easier for users to see and hear content including separating foreground from background.
Principle 2 – Operable: User interface components and navigation must be operable. *Guideline 2.1 Keyboard Accessible:* Make all functionality available from a keyboard. *Guideline 2.2 Enough Time:* Provide users enough time to read and use content. *Guideline 2.3 Seizures:* Do not design content in a way that is known to cause seizures. *Guideline 2.4 Navigable:* Provide ways to help users navigate, find content, and determine where they are.
Principle 3 – Understandable: Information and the operation of user interface must be understandable. *Guideline 3.1 Readable:* Make text content readable and understandable. *Guideline 3.2 Predictable:* Make Web pages appear and operate in predictable ways. *Guideline 3.3 Input Assistance:* Help users avoid and correct mistakes.
Principle 4 – Robust: Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. *Guideline 4.1 Compatible:* Maximize compatibility with current and future user agents, including assistive technologies.

Section 508 of the Rehabilitation Act standards

1194.22 Web-based intranet and internet information and applications
(a) A text equivalent for every non-text element shall be provided (e.g., via "alt", "longdesc", or in element content).
(b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.
(c) Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.
(d) Documents shall be organized so they are readable without requiring an associated style sheet.
(e) Redundant text links shall be provided for each active region of a server-side image map.
(f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.
(g) Row and column headers shall be identified for data tables.
(h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.
(i) Frames shall be titled with text that facilitates frame identification and navigation.
(j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.
(k) A text-only page, with equivalent information or functionality, shall be provided to make a web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.
(l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology.
(m) When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l) (http://www.section508.gov/index.cfm?fuseAction=stdsdoc#Software).
(n) When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.
(o) A method shall be provided that permits users to skip repetitive navigation links.
(p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.

State Guideline of Commonwealth of Virginia Web Accessibility Standards

(a) A Web site procured in accordance with the Virginia Public Procurement Act (§ 2.2-4300 et seq.), must adhere to, but is not required to exceed, the Federal Section 508's rules for Web-based intranet and Internet information and applications.
(b) A Web site shall ensure that foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits or when viewed on a black and white screen.
(c) The opening of new browser windows should only be done if the user is warned that a new window will open and there may be a possibility of functional difficulties.
(d) Use style sheets to control layout whenever possible. Do not use tables for layout unless the table makes sense when linearized. If the table does not make sense, provide an alternative equivalent, which may be a linearized version.
(e) Font sizes should be percentage based instead of fixed.
(f) A method shall be provided that permits users to skip repetitive navigation links .
(g) Content headers shall use the Heading Element (H1 through H6) hierarchy, although style sheets may be used to modify the size and other characteristics of that text.
(h) The requirements of this Standard apply to all Agency Web sites, with the following exceptions: (i.) Downloadable documents (e.g. Word document, PowerPoint presentation, etc.) per se are exempted, although accessible and equivalent versions of the content must be available. (ii.) Sites external to the Executive Branch. (iii.) HTML frames are forbidden when in the visual template. An Agency exempt from using the visual template and that uses frames must: • Provide alternative, equivalent content since many screen readers can not access or follow frames. • Title the frames with text that facilitates frame identification and navigation.