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How People With Multiple Sclerosis Experience Web-Based Instructional Technologies

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This is to certify that the doctoral dissertation by

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Abstract

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Dissertation Submitted in Partial Fulfillment

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Abstract

People with the autoimmune disease multiple sclerosis (MS) have few options for educational activities. Although web-based instruction may be a viable option, little is known about how people with MS perceive this form of learning. The purpose of this qualitative study was to understand the experiences of people with MS regarding web-based instruction. The 3 learning structures--differentiated instruction, collaborative learning, and assistive technology--provided the conceptual framework for this research. Nine volunteers from the Pacific Northwest area of the United States who have MS were individually interviewed for this basic qualitative study. Transcripts were analyzed using open, axial, and selective coding. The results indicated that all participants found personal and professional benefits of their experience with web-based instruction and used course management systems to successfully communicate with instructors or peers. Participants also noted that these management systems did not directly aggravate their MS disease symptoms. Findings from the study may be useful information to individuals with MS for effectively managing their educational choices. This study's results could also be used by learning institutions to improve the access to education and allow individuals with MS to more fully participate in training opportunities.

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Dedication

This research is dedicated to all persons who have contracted and managed life with multiple sclerosis. Heroes include organizations such as the National Multiple Sclerosis Society and research individuals who have been working tirelessly to find a cure for this disease. Other individuals have helped organize self-help groups so that people with MS have a place to receive assistance in managing this disease’s symptoms.

Acknowledgments

I would like to thank the people who supported and encouraged the completion of this research: Dr. Carol Watson, Dr. Gary Lacy, and Dr. Paula Dawidowicz. Their support and encouragement have given me the science and tools necessary to bring web-based learning experiences for people with MS to the public.

I would like to thank my wife, Dr. Jan DeRoest, for her loving support and the many hours spent transcribing recorded interviews. This project could not have been completed without her support, love, and encouragement.

I also need to thank the nine interviewees. Their willingness to spend time with me, share their stories, and patiently wait for this document is appreciated. I have learned a lot from you and appreciate your time.

I need to thank my parents, Gary and Della, for their lifelong support and encouragement that fostered my interest in educational research and improving classrooms everywhere. I thank Leslie & Norman, David & Patrice, and Mike & Rachelle, for demonstrating daily the love of our heavenly Father.

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Chapter 1: Introduction to the Study

The autoimmune disorder multiple sclerosis (MS) affects a significant number of persons worldwide. Because there is no list of people who have MS, and doctors and individuals are not required to disclose patient health issues, it is difficult to estimate the number of people who have MS. Longstanding statistics indicate that about 400,000 people in the United States and 2.5 million worldwide have MS (Bagheri et al., 2014; Smith et al., 2012). However, at the MSParis2017 event, the number of people in the United States with MS was estimated to be 974,000 (MSParis2017, 2017), which is more than double the previous estimate. This statistic is under peer review and may be published later in 2019. If confirmed, it would also change global estimates of persons with MS.

This chapter includes the background for the study, the problem statement, the purpose of the study, and the theoretical foundation and nature of the study, followed by key definitions. The assumptions, scope and delimitations, limitations, and significance of the study are then discussed. The chapter ends with a summary and transition section.

Background

Software developers often design software for general use without considering its application to specific populations (V, & Sadashivappa, 2015). For example, Schmiliat, & Anton, (2019) indicated that use of mobile devices and applications by people with disabilities is a research need in the United States. Although persons with certain disabilities are not always representative of the general population’s desires for technology, they can provide critical feedback for developers and those who work with marginalized communities. For example, people with MS can be challenged by symptoms such as double vision, muscle weakness, lack of balance and coordination, partial or complete paralysis, numbness, fatigue, pain, and loss of sensation (O'Connor, 2014; Schwartz et al., 1999; Swann, 2006). Any one of these symptoms can create a barrier to the use of traditional learning environments. The use of particular technologies can help people with disabilities to communicate and learn. For example, a person with vision difficulty may use text-to-speech software on their computer to listen to educational material. However, Haase, Schultheiss, Kempoke, Thomas, & Ziemssen, (2012) indicate that while about 45% of people with MS would like to use web-based information sources to help their therapy, only about 5% currently use them. Rezeau (2000) indicated that many resources are released annually in the United States to support people with MS. Many of these resources, however, are not utilized to support the educational needs of people with MS (Fogarty, Walsh, McGuigan, Barry, & Tubridy, n.d.).

Furthermore, little is known about how people with MS perceive and experience web-based educational technologies. Not knowing the perceptions and experiences of people with MS regarding such web-based educational opportunities prevents the effective use of these educational resources. This study should benefit people with MS looking for accessible learning environments and offer ideas to learning institutions trying to build educational resources that are available to all learners, including those experiencing disabilities.

MS affects mainly adults, with less than 5% of children contracting the disease (Till et al.; Yeh, 2012). Because a high percentage of people with MS are adults, I assumed that many are high school completers and perhaps college completers. The U.S. Department of Education (2014) indicated that 90% of people aged 25-29 years in the United States have a high school diploma or equivalent. The U.S. Department of Education also reported about 34% of people in this age range have a bachelor's degree or better (Snyder, Dillow, & National Center for Education Statistics, 2013). For this study, I posited that the U.S. population affected by MS reflects this breakdown.

When a person with academic or work goals is forced to rethink objectives due to a developed disability such as MS, she or he may turn to educational structures for learning new skills or expanding her or his knowledge base. These people may also look at non-traditional educational resources such as web-based instruction. Reevaluating such goals can be difficult but lead to productive outcomes (Levack et al., 2015).

Because of the variety of symptoms associated with MS, it is difficult to predict how sufferers may use various learning accommodations. Little research is available on people with MS and their use of specific learning technologies, such as web-based instruction, according to my review of the literature. However, research about diseases with similar symptoms may also apply to people with MS. For example, persons with traumatic brain injuries have been shown to benefit from access to appropriate education resources (Hux et al., 2010). This and other research can provide information about the benefits of education to people with MS. Physical and mental disabilities might lead people, in general, to avoid traditional educational structures. Likewise, people with MS are sometimes unable to participate in college classes and educational activities with the same ease and regularity as healthy students (Johnson, Bamer, Yorkton, & Amtmann, 2009).

Robbie and Zeeng (2008) indicated that web-based social technologies could motivate student learning. Tools such as YouTube, Flicker, and weblogs can have educational value for college students. These and other learning resources could also be useful for people with MS. Goverover, Basso, Wood, Chiaravalloti, and DeLuca (2011) indicated that two learning techniques had a positive effect on memory for people with MS: spaced learning and self-generation. Spaced learning repeats learning material three times, 10-minutes apart (Mulligan & Peterson, 2014). Self-generation has a learner creating objects from learned content (Sanchez-Elez et al., 2014). Both techniques can be implemented with or without technological assistance (Vlach, 2014). Findings showed that these two practices helped people with MS to remember names, appointments, and object locations (Vlach, 2014). These skills serve people not only in academia but also in the workplace. For example, many people with MS struggle with employment difficulties due to memory trouble, executive function deviations, and physical limitations (van der Hiele et al., 2015), so mastering memory techniques can positively affect their success.

Strober et al. (2012) indicated that unemployment affects many individuals with MS. They specified that 70-80% of adults with MS became unemployed within five years of their diagnosis. Work is important because “employment is critical for a sense of identity, self-esteem, social contact, and overall mental and physical health” (Strober et al., 2012, p. 647). Being unemployed can exacerbate feelings of depression and lower self-esteem, as well as place extra burdens on limited personal and public resources (Wiberg, et al., 2015). Being jobless might also mean living in poverty, experiencing homelessness, or facing declining health (Wilberg, Marklund & Alexnderson, 2017). Techniques such as spaced learning or self-generation have been shown to help MS sufferers to learn new skills and broaden their knowledge so as to become and remain employed (Ibrahim, Boerhannoeddin, & Bakare, 2017).

People have different access to technology and communication preferences, and these factors influence their ability and desire to participate in web-based learning. Baylor, Yorkston, Bamer, Britton, and Amtmann (2010) identified several variables that affect the communicative participation of people with MS. In their study, participants had the option to take the survey online or on paper. While the study did not report the number of participants in respective modes, this research would seem to indicate that some people with MS do have access to technological resources. However, simply answering questions on a computer does not indicate a person's access to learning resources that meet her or his specific interests. Individual desires and level of disability influence the choice to participate in online learning activities as well.

Haase, Schultheiss, Kempcke, Thomas, and Ziemssen (2012) created a questionnaire to collect data regarding the use of technology tools by people with MS.

Surveying about 600 people with MS in Germany, they found that about 90% used a personal computer and accessed the Internet at least once a week, about 87% used e-mail, and about 85% used a mobile phone. Their study reveals that most people with MS (at least in Germany) have the necessary tools and skills to be able to participate in web-based educational programs. The 2014 Census report indicates that at that time, 83.8% of people in the United States had home access to computers and 73.4% had Internet access (File & Ryan, 2014). In addition to at-home Internet resources, the American Library Association reports that 98% of libraries provide access to Internet-enabled computers (American Library Association, n.d.).

A student with MS may have similar learning capabilities as a healthy student. However, she or he is likely to have physical, mental, and emotional disabilities that can reduce success in a specific educational venue (Chiaravalloti, Stojanovic-Radic, & DeLuca, 2013; Goverover, Hillary, Chiaravalloti, Arango-Lasprilla, & DeLuca, 2009; Tomassini et al., 2011). People with MS can learn new information or skills in specific situations using various instruction and memory aids, as discussed previously (Johnson et al., 2009). A web-based learning format lessens the fatigue that is generated by traveling to and from a classroom. Online learning structures can also aid individuals with MS who have vision or memory problems, as current technologies can record and translate written words into audible messages. The web-based instructional curriculum can be recorded, capturing visual and audio content so that it can be repeated. Many instructors have found value in providing a video or audio recorded lecture that students can interact with

(Dunn, McDonald, & Loch, 2015; Hahn, 2012; Nast, Schäfer-Hesterberg, Zielke, Sterry, & Rzany, 2009; Wieling & Hofman, 2010). A web-based course could result in a more positive learning experiences for those with MS (Şahin & Kişla, 2016). A person who is shy or withdrawn in a traditional class, or one with a disability, might become more participatory when face-to-face contact decreases (Kim, 2014).

In one survey of people with MS, 397 (27.3% of 1,456 responses) participants identified stressful or traumatic events as a reason for the recurrence of their MS symptoms (Simmons, Ponsonby, van der Mei, & Sheridan, 2004). Stress is defined here as any environmental or psychological stimulus that promotes change from a person's homeostasis due to varying circumstances, whether those conditions are actual or perceived, affirmative or adverse (Rumrill, Roessler, & Fitzgerald, 2004). Stress is also a common condition reportedly experienced by college learners (Guo, Wang, Johnson, & Diaz, 2011; Watson, 2012). Stress might exacerbate the onset or recurrence of MS indications, making it difficult for those students to remain in school.

Many researchers have explored the use of web-based technologies with young and special populations (Campbell & Jane, 2012; Dan, Simona, Alexandru, & Adrian, 2015; Ferreira, Travassos, Sampaio, & Pereira-Guizzo, 2013; Gillis, Luthin, Parette, & Blum, 2012; Ploog, Scharf, Nelson, & Brooks, 2013), but few have investigated adults with multiple sclerosis and how they use web-based technologies to improve their skills or learn new trades. This research provides the information needed to start a conversation about how web-based technologies may help or challenge the lives of people with MS.

Problem Statement

The problem is that neither researchers nor professionals know the ways in which people with MS use web-based learning technologies. Despite extensive literature reviews, little or no information was discovered regarding web-based instructional modalities and how people with MS use them. Findings from this study may be useful to educational technologists in developing better educational offerings for learners with MS. Practices that are having a positive influence on people's lives can be improved, and new technologies developed, to assist people with MS as well as the general population.

Individuals with MS could make more effective and confident decisions regarding their academic pursuits, given increased support and broader educational opportunities (see Doogan, & Playford, 2014). Moreover, learning institutions could provide better tools to support people with MS. This original research reveals how people with MS can apply technology to make a positive change for themselves, their caregivers, and the learning systems of which they are a part.

Purpose of the Study

The purpose of this study was to determine the ways in which people with MS use web-based learning technologies. Some people with MS, accept these new technologies and use them to communicate with friends, family, medical professionals, or learning groups, while others may not (Camlek, 2015). While web-based instruction may be used with healthy people, my literature review discovered few research studies that examined their use with people with MS. It is important to talk to people with MS to determine if and how they are using these systems. It is also crucial to determine the influence of these tools on users possessing disabilities.

Research Question

The study had two overarching research questions:

Research Question 1: What web-based technologies do people with MS use for learning?

Research Question 2: How do people with MS interact with the web-based learning technologies they use?

I asked participating individuals with MS about the web-based technologies they have used in the past and what characteristics were beneficial or challenging for learning. Participants also were asked to state the characteristics they look for in web-based technology.

Conceptual Framework

Classroom environments can either encourage learning or discourage the work of students. Students with different abilities or specific learning proficiencies will thrive educationally in some environments and be challenged in others (Dosch & Zidon, 2014). There are three learning structures that have established benefits in classroom environments where students experience learning challenges: Differentiated instruction, constructive learning, and assistive technology.

Differentiated instruction (DI) is a teaching technique that provides flexible instruction and evaluation structures to meet students at their unique learning potentials

(Darrow, 2015). Dosch and Zidon (2014) indicated that DI students performed better on assignment completion and test performance than a traditional lecture class. In the DI group, several teaching methods were implemented including (a) student note review, (b) question and answer sessions, (c) calling on students, (d) rapid writing, (e) written student responses to questions posed at the end of a class or learning activity, (f) thumbs up/thumbs down, (g) watching completed activities, and (h) small cluster performance activities.

This method benefits learners and instructors in pre-collegiate and post-secondary educational environments (Chamberlin & Powers, 2010; Dosh & Zidon, 2015; Monk et al., 2014; Santangelo & Tomlinson, 2008). De Jesus (2012) indicated that DI could involve cooperative learning, project-based learning, and multiple intelligences. It is also known to benefit students with physical and mental disabilities (McKenna, Shin, & Ciullo, 2015).

In constructivist systems, learners build meaningful knowledge and understanding of their environment through educational experiences and reflection about their interaction with them. Dewey (1938), Piaget (1952), Bruner (1960), and Gardner (2011) have described constructivist models where student actions support learning. These models describe learning in face-to-face environments. These systems may also support web-based learning. If students implement self-generation in their learning, then they are constructing their understanding of class concepts.

Assistive technology (AT) provides tools that help people perform cognitive, physical, communicative, and other activities (Wästlund, Sponseller, Pettersson, & Bared, 2015). Legislation that supports the use of AT for people is called the Individuals with Disabilities Education Act (IDEA, 2004). This Federal law also supports state and local assistance for learners with disabilities in the United States (Peterson-Karlan, 2015). AT is “any item, piece of equipment or product system, whether acquired commercially or customized after purchase, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (Americans With Disabilities Act of 1990). Web-based instruction can be considered AT, as can a wheelchair, smart pen, note taker, computer, text-to-speech software, or other assistive devices (Balaji, et al., 2015; Fichten et al., 2009). Individual traits, environmental features, and personal preferences can influence the use of DI, CL, and AT. These concepts will be developed further in Chapter 2.

Nature of the Study

This study was one of the first to investigate the web-based technology learning experiences for adults (18-72 years) with MS, according to my review of the literature. Research regarding educational modalities for MS sufferers is sparse. Strokes are often mistaken for MS and there is some research available on stroke (Orenstein, 2016). Therefore, much of the background data for this research relied on data collected and analyzed, both for healthy individuals and people experiencing a stroke (Rasura et al., 2014). The use of stroke research will help narrow, though not replace, the knowledge gap surrounding people with MS.

To gain the necessary information, this study utilized a specialized version of a qualitative case study known as an interview study (Merriam & Tisdell, 2016). Interviews were conducted with eight to ten individuals from the local area who have MS, and have taken a course with web-based instruction. Interviews are a way of gathering qualitative data (Hatch, 2002; Merriam & Tisdell, 2016. According to Merriam and Tisdell (2016), "Interviewing is necessary when we cannot observe behavior, feelings, or how people interpret the world around them. It is also necessary to interview when we are interested in past events that are impossible to replicate" (pg. 108). Interviews were conducted to gather deep, rich data that cannot be as effectively obtained through any other method,

Through shared communication with the researcher, participants can clarify our understanding of web-based educational experiences of persons with MS. The meaningful descriptions of participant's individual experiences helped generate credibility and transferability. The shared experiences of individuals and this analysis created invaluable insight and knowledge.

Definitions

Autoimmune diseases (ADs): A group of 81 disorders, many of which are rare. ADs contain two of the following five criteria: (a) explicit modifying immunologic response is focused on the diseased anatomy, (b) T cells and/or specific microbes that have an immune response and exist in the diseased body, (c) T cells and/or specific microbes can move the infection to healthy people or creatures, (d) vaccination with the autoantigen encourages the disease in animals, and (e) removal or suppression of the autoimmune reply blocks disorder advancement or even alleviates its appearance (Hayter & Cook, 2012; see also “Medical Definition of Autoimmune Disease,” n.d.).

Burst design: Repeated assessments across and within study visits (Holtzer et al., 2013).

Central nervous system (CNS): “That part of the nervous system that consists of the brain and spinal cord” (“Medical Definition of Central Nervous System (CNS),” n.d.).

Demyelination: A “process that erodes away the myelin sheath that normally protects nerve fibers” (“Medical Definition of Demyelination,” n.d.).

Immune system: “An intelligent self-organizing and adaptive system, which has a variety of immune cells with different types of immune mechanisms” (Gong, Cao, & Xiong, 2015, p. 293).

Multiple sclerosis: “A degenerative disease of the central nervous system, primarily affecting the brain and the spinal cord” (Rumrill, 2009, p. 75).

Social learning systems: Environment where “learners collaborate, problem-solve, and share knowledge together among peers in what is sometimes an ill-structured, open-ended situated learning context” (Reynolds, & Caperton, 2011, p. 287).

Web-based learning: “Web based learning environments combine multiple forms of representation such as texts, images, and static or animated graphics, transforming learning into an active process where users can interact with dynamic content and immediately check their knowledge” (Pando Cerra, Suárez González, Busto Parra, Rodríguez Ortiz, Álvarez Peñín, 2014, p. 398).

Assumptions

I assumed that interviewees would respond truthfully. The people interviewed were expected to communicate their experiences with web-based instruction in English, verbally or in writing. I took measures to prevent my personal values, beliefs, and biases from influencing this report (see Chapter 3).

Scope and Delimitations

MS is a disease that is experienced by 2.5 million people worldwide (National Multiple Sclerosis Society [NMSS], 2015). Adults with this disease need accessible educational structures to train or retrain for jobs and enrich personal activities that promote a feeling of self-worth and well-being (Bøe Lunde, et al., 2014).

The participants in this study were MS sufferers between 18 and 72 years of age who had taken a web-based class in the time since their initial MS diagnosis. The aforementioned online learning activity may have been a for-credit course; a CEU-bearing class; or a time-specific, none evaluated class taken solely for personal enrichment. Finally, the participants were required to be able to read and understand standard U.S. English.

Limitations

While this convenience sample was relatively easy to gather, it took 6 months to find and recruit nine participants who met the study's requirements. This study cannot provide generalizable results. The individual participants in the sample did not represent the population of people with MS and did not have to verify their MS diagnosis or symptoms. Disclosure of the diagnosis of MS might have proven uncomfortable for some. I may have inadvertently excluded people struggling with disease acceptance from this study. I was not seeking external confirmation of the disease, but I assumed that if participants stated that they were suffering from MS, they were being truthful. I asked clarifying questions in order to determine whether participant information was relevant to this research and conducted a careful review of the final report to avoid researcher bias. I have MS and must take care to report participants' responses accurately from their points of view. I did not seek to collect any data that might have been influenced by other severe health conditions. Therefore, people with other major disorders were excluded.

All interviews were recorded and transcribed by a person without MS. The interviewee received a copy of her or his transcribed interview to correct, update, and clarify answers to questions. Participants did not receive copies of the actual analysis for review, as analysis of the given information was the task of the researcher alone.

I am a teacher at a local community college and a board director for the state's education association. As these roles may have interfered with gathering unbiased data from interview subjects, students from the community college and members of the state's education association were disqualified from participation. I did not interview professional subordinates.

My MS diagnosis provided a unique opportunity for understanding what interviewees were likely to discuss. There was also a risk of researcher bias. It was with this concern in mind that I employed specific interviewing protocols to help alleviate such bias (see Chapter 3).

Significance

There is a dearth of literature focusing on people with MS and how they use web-based instruction. This study researched and reported information that will help individuals, institutions, and professionals in the field to better utilize educational resources and supported those with MS, thereby contributing to social progress. Qualitative research explores the socially constructed meaning of our interaction with our world. Individual attitudes can change over time and our knowledge of these feelings can deepen our understanding of their effects on people with MS. New technologies affect our experience of the world. People with disabilities may use such technologies to more successfully interact with their environment and learn from their experiences. This study helped identify these technologies as well as their effects on the lives of people with multiple sclerosis.

Information gained from this research should help medical professionals, families, and other supporters of people with MS to make positive decisions regarding the use of technology to gain essential educational experience. Since the quality of life experienced by people with MS often improves with the correct treatment, it is critical to learn more about social technology's benefits and challenges for both current and future MS patients and their caregivers. This understanding contributes to appropriate decision-making by people with this disease, as well as the professionals providing their care.

More accessible learning environments could be created in institutions of higher education. Results from a study by Scarpazza et al. (2013) suggested that participation in higher education slows or counteracts cognitive impairments related to MS. In their research, MS-diagnosed students with less education did worse on a Paced Auditory Serial Addition Test (PASAT), while students with MS and more education performed at the same level as healthy control subjects. If schools can make learning opportunities more accessible to people with MS, the education they provide may lessen students' MS symptoms. Even so, a person's educational attainment is the consequence of many individual choices and environmental factors, which may also modify and be modified by specific MS symptoms.

Educational theorists need to develop structures that support disabled learners. Not long ago, most people thought that MS did not affect the language centers of the brain. Today, studies report different experiences with the disease. Barwood and Murdoch (2013) suggest that linguistic dysfunction may exist in some people with MS. They conducted tests on fifteen people with relapsing-remitting MS and sixteen control subjects. Subjects were tested on the Test of Language Competence: Expanded (TLC-E); selected subtests of the Western Aphasia Battery-Revised (WAB-R); The Word Test-Revised (TWT-R) and the Boston Naming Test (BNT). These researchers reported lower scores for oral communication related to duplicating sentences; semantic illogicalities; listening, understanding, and creating inferences; and definitions. Students lacking these skills may benefit from web-based instruction environments.

A positive social change could occur by making educational systems more accessible for people with MS and other disabled learners. Since many people do not have access to traditional brick-and-mortar classrooms, web-based technologies can provide educational opportunities to more learners.

Summary

Multiple sclerosis is primarily an adult disease that has many symptoms and can affect individuals differently. These adults may have been trained for one career but find that their MS symptoms do not allow continuation of that vocation. People with MS need appropriate retraining opportunities to become productive people in society. Though the disease may limit the choices sufferers have, using web-based technologies significantly increase available learning opportunities. Returning to work can bolster self-esteem and help individuals feel connected to a group, while simultaneously serving that group's members (Strober et al., 2012, p. 647). This research determines what features of a web-based class are most desirable to people with MS and identify potential problems that may need to be changed. As shown in Chapter 2, much is known about MS symptoms. However, little is known about how people with MS use, and are affected by, web-based learning environments. This research helps clarify the needs for this population and fills a gap in the literature.

Chapter 2: Literature Review

Introduction

The purpose of this study was to clarify how web-based learning technologies are used by people with MS. Previous research has elucidated the various symptoms that MS can manifest in a person (see Daly, Gibson, & Dewing, 2019). It has also provided extensive information about how assistive technology, differentiated instruction, and constructive learning has assisted physically and mentally disabled people (see Iranmanesh, Tirgari, Tofighi, & Azizzadeh Forouzi, 2014; Morgan, 2014; Squires, Williams, & Morrison, 2019)

In this literature review I examine the physical and psychosocial symptoms experienced by people with MS; the potential uses of assistive technology, differentiated instruction, or constructive learning in educational, professional, or personal contexts; and how healthy persons, as well as individuals with MS and similar diseases, are using web-based technologies to enhance their learning environments. This chapter develops a conceptual lens through which readers can filter and understand first-hand anecdotal evidence from people with MS about their experiences in web-based learning. The chapter begins with an overview of the literature search strategy and conceptual foundation, which is followed by the literature review; the chapter concludes with a summary.

Literature Search Strategy

I conducted this literature review search using scholarly databases from university, national, state, and local sources. These resources provided peer-reviewed documents related to relevant research terms. For example, the query using the search term *multiple sclerosis* within the education category yielded limited results. Expanding the search to include all databases and diseases with similar symptoms as MS produced a reasonable number of references. Diseases that have similar symptoms as MS include lupus, stroke, fibromyalgia, Sjogren's syndrome, vasculitis, myasthenia gravis, sarcoidosis, and acute disseminated encephalomyelitis (Orenstein, 2016).

I used these diseases as additional query key words. Another disease, Parkinson’s disease, has different symptoms than MS but was also used as a database search term for the purpose of comparison. Each disease was searched independently and with the following secondary and tertiary search terms: *web-based*, *online*, *Internet*, *e-mail*, *learn*, *work*, *employ*, *train*, *virtual*, *Facebook*, *social technology*, *assistive technology*, *differentiated instruction*, *constructive*, *wired*, *pain*, *education*, and *stress*. These and similar queries provided references that described various MS symptoms. I organized the query results into five categories -- physical symptoms, psychosocial environments, living and working environments, web-based learning, and learning strategies -- which I used to structure the literature review.

Conceptual Framework

Many philosophers have discussed the learning environments for those with disabilities. For example, Silvers (2000) described the thoughts of philosophers regarding individuals with a physical and mental disability, specifically those with limited visual perception. These discussions focus on the perceived limitations of both healthy people and those with disabilities. Although reduced visual acuity is a common symptom among people with MS (Martínez-Lapiscina et al., 2014), Silvers did not specifically discuss the other challenges people with MS experience or the resulting physical, emotional, psychosocial, or learning restrictions.

Another philosopher, Fitch (2009), agreed with Silvers' philosophy that disability, not ability, should frame social experiences. Silvers stated that people with cognitive or physical disabilities are not missing aptitude, but their symptoms limit the ways they express their skills. Fitch also warned that disabilities have also been used to justify discrimination of marginalized people (p. 167). Support for and discrimination against people with disabilities can be encouraged by local social standards and laws.

Recently, Serdyukov (2015) proposed that modern learning structures such as web-based instruction might require a different paradigm. Web-based technologies are very experimental and do not have the theoretical foundations that support face-to-face and other learning environments. Some still believe that stimulus and response are the best way to provide education to children and adults (Lozano, Hernández, Rubio, & Santacreu, 2011; Rosales, & Rehfeldt, 2007). Cannell (2016) and Dewey (1938) espoused a framework of teaching and learning that promoted life-long scholarship. Educational experiences should positively influence a person's participation in continuing learning practices. It is possible that assistive technology, differentiated instruction, and constructivist structures can be used in web-based educational environments, which could augment the learning of people with MS.

Some philosophers, including John Dewey, have discussed the different ways learning environments for children and adults are accessed and used (Bruner, 1960; Dewey, 1981; Piaget, 1952; Serdyukov, 2015). Dewey (1981) stated

> The democratic faith in human equality is [the] belief that every human being, independent of the quantity or range of his personal endowment, has the right to equal opportunity with every other person for [the] development of whatever gifts he has. (p. 229)

This idea influenced the creation of laws around the world to protect the rights of those with disabilities. The Americans with Disabilities Act in the United States was enacted in 1990 (Americans With Disabilities Act of 1990). Other laws such as the Equity Act of 2010 protect disabled people in the UK and disabled people in France by the *law on the equal rights and opportunities, the participation and the citizenship of disabled persons,* which was enacted in 2005 (Vinance, Ville, & Ravaud, 2007). Even the United Nations has adopted the Convention on Rights of Persons With Disabilities in 2006 and its ratification by 160 countries bring issues of living with disabilities to the International stage (Kanter, 2015).

Many countries have laws to protect the rights of challenged people; however, the enforcement of these laws varies. Jakovljevic and Buckley (2011) studied the use of assistive technology with workers at two companies based in Johannesburg, South

Africa. They found that these businesses have very few workers with disabilities and that laws to protect them were not acknowledged or enforced. In the United States, as well, access to and use of assistive technology fails to meet the needs of those with disabilities. Asselin (2014) stated that less than 25% of people with disabilities sought and used assistive technology. Asselin also indicated that the access to web-based learning opportunities might assist students, but training for the appropriate use of these assistive technologies is significantly lower in postsecondary venues. Also, support for these tools is often different at private institutions of higher education than for the general public (Asselin, 2014).

Some countries, such as Turkey, have changing standards regarding people with disabilities. Arslan, Inan, Ozel, and Wells (2007) showed that in Turkey, disabilities in students is an ignored social condition. In the 2000 census, Turkey asked about citizen disability for the first time. Providing statistics on assistive technology use is made more difficult when some governments refuse to acknowledge the prevalence of disabilities in their country.

Although Dewey (1938) did not specifically address the learning issues of people with MS, he discussed an ideal framework which applies to all learners. Dewey explained that teachers in an educational community serve as leaders to the groups that produce individual learning and social meaning. His educational framework supports the compromise between the power to intelligently direct one’s movement and the self-control to temper one’s actions out of respect for another’s similar freedom. When cooperative social intelligence determines the purpose of education, then teaching becomes a continuous process of reconstruction, intelligent observations, reflective experiences, and cooperative interaction.

Assistive technology (AT), differentiated instruction (DI) and constructive learning (CL) can help provide access to supportive educational environments for people with MS and other disabilities. AT can help individuals interact with educational environments. Crutches, glasses, and social learning tools support access to learning opportunities for those with disabilities. Unassisted, a physically disabled person may fall often. Mobility devices can decrease the number of falls, but training, type of assistive device, individual strength, and usability issues can influence the device’s effectiveness (Bradley, 2011).

Not only do the social standards of a country effect the use of assistive technology, but individual perceptions and institution support can affect reporting and use of appropriate assistive technologies. Nguyen, et al. (2013) found that in one English and two French community colleges, over 4% of students self-reported their learning disabilities. However, only 59% of these students were registered to receive support (Nguyen, et al., 2013). These statistics illustrate the difficulty of gathering reliable information on people with disabilities and MS specifically and the learning modalities they use.

Wheelchairs can provide mobility assistance. Verza, Battaglia, and Uccelli, (2010) reported that literature identifies four patterns for propelling a manual wheelchair with your hands: arcing, semicircular, single looping over propulsion (SLOP), and double looping over propulsion (DLOP). Arcing is used by 90% of people with MS and is the least efficient method for propelling the wheelchair. Fatigue, upper body and limb weakness, and limited coordination may make manual wheelchairs inappropriate for some people with MS.

According to Finlayson, Peterson, and Asano (2014), who studied 353 adults with MS (age $\geqq 55$), the use of multiple mobility devices can increase a person's incidence of falling compared with a healthy person. Since study volunteers came from a patient registry, bias cannot be determined. This research indicated that use of a single mobility device by people with MS could also increase their likelihood of falling compared to healthy people. These statistics did not compare the number of falls by people with physical challenges not using mobility devices, to those that used them. Giannì, Prosperini, Jonsdottir, and Cattaneo, (2014) performed a literature review regarding factors in people with MS who reported falling. These researchers found that people with MS were more likely to fall, but criticized the study protocols of 12 of 15 articles, because participant reports of falls were used, rather than researcher verification. This indicates that this research might have introduced recall bias. Also, Gianni et al. may not have identified duplicate involvement by individuals in all 15 studies. They indicated that the length of disease history, progressive disease manifestation, overall disability level, and slower walking speed affect fall frequency. Appropriate use of assistive technologies can minimize some of these challenges. Nilsagård, Denison, Gunnarsson, and Boström

(2009) interviewed 12 people with MS living near Orebro University Hospital to identify several other factors that increase the likelihood of falling. These include fatigue or heat sensitivity, reduced muscular endurance, divided attention, proper architectural design (environment and device), and indoor climate.

Lack of access to and improper use of mobility devices can limit a person's ability to succeed in traditional educational environments. Souza, Kelleher, Cooper, Iezzoni, and Collins (2010) found that the use of mobility assistive technology (MAT) helped an estimated 80% of people with MS that developed balance and gait difficulties. This study did not research the use of assistive technology to interact with brick-and-mortar or web-based learning environments. They did, however, identify challenges in finding MAT devices that meet a person's degree of fatigue, their activity level, the context of use, funding limitations, and user acceptance.

Finlayson, Peterson, and Asano (2014) indicated similar results. However, their study only reported on falling. Their study did not compare the act of falling to the amount of time that the person was walking or standing. If a person is working strenuously for 8 hours and falls once, this is very different than someone who is sitting most of the day and falls every time they begin to move around. Similarly, tripping over one's own feet on smooth flooring should be evaluated differently than a person stumbling over a rocky trail.

Beyond manual assistive devices, differentiated instruction (DI) is a teaching technique that is proven to help all students, including those with disabilities (Chamberlin

& Powers, 2010; De Jesus, 2012; Dosch & Zidon, 2014; Kappler & Weckstein, 2012; Milman, 2014; Santangelo & Tomlinson, 2008). DI creates a conducive educational environment for pre-collegiate and collegiate students of varying skills. Darrow (2015) stated that DI requires working with groups of students and adapting programs for each individual learner. Santangelo and Tomlinson (2008) indicated that DI could positively affect college students' learning. Students reporting their experiences stated that they were appropriately challenged and found importance in their accomplishments. This study indicates that college students have different ways of acquiring new information; diverse personal experiences; and varied skills, interests, and ambitions.

As with everyone, individuals with MS have some skills in which they excel and others that they find challenging. DI may provide environments that support student learning and mitigate their disease symptoms. However, the DI framework focuses on the instructor, while CL environments focus on the learner. Little research is available on how DI affects people with MS in particular. However, the guiding principles of DI include: a concentration on critical concepts and activities in a content area, instructional practices that meet the unique skills of the learner, incorporating various frameworks for teaching and evaluation, and a continuing alteration of process, content, and products to meet each student's needs (Demos & Foshay, 2009). These same principles describe the student-focused framework of constructivist learning.

Constructivist learning is a methodology supported by Bruner (1960), Dewey (1938), and Piaget (1952), and discussed by Ruey (2010) when describing web-based training for healthy people. The theory of constructivist learning and Ruey's research suggest positive outcomes for individuals involved in web-based training.

Dewey (1938) supported educational systems that provide both experiential and constructivist activities. In constructivist systems, learners build meaningful knowledge and understanding of their environment through educational experiences and reflection about their interaction with them. Traditional educators may have students memorize the Bill of Rights and test them, whereas constructivist educators may ask students to instead research the Bill of Rights. Students could pick a bill that they have an interest in then put together a 10-minute presentation utilizing two of Gardner's Multiple Intelligences (Gardner, 2011; Sherman, 2014), examining how and from whom support was garnered for its eventual inclusion in the Bill of Rights. In the first example, students might remember the Bill of Rights long enough to pass a test on the topic, while in the second, students may retain the knowledge of their research for an extended period of time.

Piaget (1952) also described constructivist systems, but with the addition of processes called assimilation and accommodation. Assimilation described a person's ability to incorporate new learning into their experiences without re-framing that learning. Accommodation referred to a person's ability to experience learning that conflicted with previous knowledge, but reframe and absorb this new experience into his or her behavior. These two processes work together to determine how new learning integrates with previous knowledge. A learner will interact with his or her physical environment and personal attributes to create new knowledge. In some cases, people with disabilities can learn to change the development progress of their particular disease symptoms.

Bruner (1960) promoted a concept similar to assimilation (p. 7). He argued that students would be more accepting of new information if they understood how it related to previous knowledge. Bruner also stated that students could understand ideas and skills better through practice and application. He believed that concepts are linked to each other. Students who can understand these connections are more likely to assimilate new learning. He did not agree, however, with the accommodation framework of Piaget. Instead, Bruner (1960) suggested that students learn by transferring existing principles and attitudes to new situations (p. 17). Students who are happy and fruitful in their academic progress will continue their educative experiences. Bruner supported schools that helped students develop social and emotional skills as well as intellectual abilities.

A stroke is a neurological event that has similar symptoms to MS (Orenstein, 2015). Best et al. (2012) indicated that exercise activity had positive results when stroke victims could use the web to report physical activity. While MS can produce a multitude of symptoms, sufferers may continue with their educational and employment experiences. Also, Scarpazza et al. (2013) proposed that people with MS who had higher educational attainment also had fewer symptoms and disabilities than people with lower education levels.

Other research shows that face-to-face instruction provide improved learning over web-based learning. Wang and Newlin (2000) and Waschull (2001) described research showing that learners performed better in face-to-face learning environments as opposed to web-based ones. It appears that face-to-face classrooms provide stronger social connections between students and instructors. Unfortunately, many students choose not to participate in traditional educative experiences because the symptoms of MS can make face-to-face educational environments difficult.

MS restricts the way people can interact with their environments and society. Alternate communication technologies may improve these relationships (see Baylor, Yorkston, Bamer, Britton, and Amtmann (2010). For example, text-to-speech, gesture technology, and assistive pointing devices may help communicating to and with computer technologies (Feennaughty, Tjaden, Weinstock-Guttman, & Benedict, n.d.). In this study I investigated the quality of academic life experience for people with MS and how assistive technology, differentiated instruction, and constructivist learning frameworks can change a person's educational experience.

Literature Review Related to Key Variables and/or Concepts

Multiple sclerosis (MS) is a disease that affects people worldwide in many different ways. It is an autoimmune disease that degrades the myelin sheaths that protect the pathways that make up the central nervous system (Roessler, Gitchel, & Bishop; 2013). Depending on the location and extent of the damage, messages from the brain can be disrupted so that they do not reach their intended receptors (Langkamp et al, 2009). Depending on the place and severity of demyelination, a person can have different disease types: relapsing-remitting (the most common), primary-progressive, secondary-progressive, and progressive relapsing (National MS Society, 2015). Each of these types has differing life cycles, and each affects the activities, employment, and education of people coping with the disease. Little research exists exploring how people with MS interact with web-based educational environments. This literature review will explain the physical symptoms of MS and how assistive technology, differentiated instruction, and constructive learning in a web-based medium may support educational success for people with MS. The conclusion will discuss remaining questions and how this research will address them.

Physical Symptoms of MS

The physical symptoms of MS vary. These symptoms include fatigue, pain, touch dysfunctions, balance abnormalities, vision difficulties, and bladder and bowel dysfunctions. Such symptoms can affect a person's physical environment, emotional state, and ability to succeed in various learning environments.

Fatigue. Fatigue is the most common complaint of people with MS. A search of the terms “multiple sclerosis” and “fatigue” yielded 1,630 peer reviewed articles. These resources showed that there is confusion in defining and measuring this self-reported symptom (Warner, 2012). The MS Society’s website explains that fatigue occurs in 80% of people with MS, but without a clear definition for the symptom. Measurements and tests exist, but they often provide conflicting results (Mills & Young, 2011). The NMSS website indicates that fatigue:

- Occurs on an everyday basis

- May happen first in the day, even after a good sleep
- Is typically aggravated throughout the day
- Tends to be worse with humidity and high temperatures
- Advances both slowly and swiftly
- Is usually more intense than typical fatigue
- Is more likely to hinder everyday tasks

Fatigue can limit work, activities, social interaction, and play. It can also affect cognitive functioning and have a negative impact on a person's educational pursuits (Bol, Duits, Hupperts, Verlinden, & Verhey, 2010). Appropriate use of assistive technologies can reduce fatigue symptoms, and web-based learning environments limit the physical and cognitive fatigue caused by traveling to and from class.

Ghahari, Packer, and Passmore (2010) researched a system for managing fatigue in adults with a variety of neurological dysfunctions. They used 95 persons, 20 years of age or older, with multiple sclerosis, Parkinson's disease, and post-polio syndrome in a randomized controlled trial. The researchers used pretest questionnaires to garner consent and blind facilitators for study groups to lessen bias. A doctor's confirmation was not used to validate status in this study. Participants were required to have Internet access and a score of four or above on the Fatigue Severity Scale (Amtmann et al., 2012). People with moderate or severe mental dysfunction were ineligible. Also, a score of nine was compulsory on the Memory Orientation Concentration Test (Vlaar & Wade, 2003).

Ghahari, Packer, and Passmore (2010) evaluated the fatigue perceived by three groups of participants: a group receiving a web-based self-management program, a group receiving web-based information-only for fatigue management, and a control group that had neither support structure. All participant groups showed some fatigue improvement over time. Surprisingly, people in the information-only and control groups experienced improved scores on the Personal Wellbeing Index, where the fatigue self-management group did not. This research indicates that fatigue resulting from polio, MS, and Parkinson's disease might not be manageable in the ways tested. The researchers also raised questions regarding the study design and data evaluation methods. Chapman and Joines (2017) specifically looked at end-of-course evaluations for Web-based classes. This research brings to light further concerns about the effectiveness of web-based fatigue reduction programs. The researchers reported that scores on depression, anxiety, and stress indexes did not change in the course of this study and probably did not influence the research findings.

Fatigue can vary over time and affect other MS symptoms. Gianni, Prosperini, Jonsdottir, and Cattaneo (2014) indicated that fear of falling could lessen physical activity, which can increase fatigue and other symptoms. This article investigated previous research regarding people with MS and their incidence of falling. The researchers found that the progressive nature of MS, loss of balance, and changes in cognition all increased the rate of falling. This study did not compare similarly aged people, leaving the role of age in fall frequency unclear. However, Finlayson, Peterson, and Asano (2014) indicated that the chance of falling increased with each type of assistive technology used.

Cognitive fatigue can limit access to educational environments for the learner with MS. Holtzer, et al., (2013) researched how cognitive fatigue affects people with MS. They selected 30 people with Relapsing and Remitting MS (RRMS) and 30 individuals to act as controls. RRMS is described by plainly defined incidents of new or cumulative neurologic indications. These occurrences, also called relapses or exacerbations, are followed by fractional or whole recovery remissions (National MS Society, 2016).

The researchers then tested memory using repeated assessments across multiple office visits. They determined that the burst design was well-suited to the study of learning and cognitive fatigue. Participants with RRMS demonstrated reduced learning compared with healthy controls. Therefore, cognitive fatigue may provide learning challenges for people with MS. Even so, a comprehensive comparison of cognitive fatigue between those taking web-based and face-to-face classes has not been performed.

Though assistive technologies, such as web-based instruction, are unlikely to change the fatigue felt by people with MS, the physical activity needed to attend and participate in a traditional face-to-face learning environment impacts their decisions and opportunities. Web-based instruction might provide an environment in which students can interact and learn but more easily manage their physical fatigue.

Pain. Multiple sclerosis is the most devastating nervous disease for early adults (Murray, 2006). Research by Calabresi (2004) investigated the sensation of pain from optical neuritis in people with MS. This occurs when nerve strands that communicate visual data from the eye to the brain become infected, causing pain and visual dysfunction (pg. 1935). Calabresi's paper indicated several treatment options for individuals with MS experiencing pain but most treatment options presented possible side effects.

Pain can also affect a person's ability to concentrate and learn new concepts. Smith and Ayres (2013) studied the effect of pain on learning. They determined that people experiencing pain for at least 6 months performed significantly lower than healthy people on retention and transfer tests. Fifty-eight teachers from New South Wales (Australia) schools served as participants in this study. Instruction delivered via multimedia rather than text-based resources provided learning benefits for both pain and pain-free participants.

While this research did not study MS, it did indicate that in industrialized countries, one in five people possess persistent pain. Jawahar, Oh, Yang, and Lapane (2013) indicated that 83% of MS patients have pain symptoms occurring in different parts of their bodies. The FDA has approved several medications for combating pain and other MS symptoms (Weiner, 2005). Despite this, managing pain from MS and other diseases can make both traditional and web-based learning environments challenging.

Touch. Touch can also be a limiting dysfunction for many with MS (Guclu-Gunduz, Citaker, Nazliel, & Irkec, 2012). Kalron, Greenberg-Abrahami, Gelav, and Achiron (2013) designed a re-education program for people with MS, but their research showed that it did not improve participants' dexterity. While exercise appears not to have affected the level of sensory input in the hand, it may lead to new neural pathway generation.

Hand-eye coordination supports employment opportunities and maintaining quality of life. People with MS who experience touch disabilities might find alternative writing implements or similar assistive technologies helpful. Lancioni et al. (2007) performed research on people with MS who experienced spasticity in their hands. They found that participants could use assistive technologies such as optic sensors and tongue or eye response technologies with writing tools when unable to use traditional computer keyboards. This study did not investigate other DI technologies or surroundings.

Balance. Jenkins (2007) indicated that 30 of 137 persons with MS identified balance as a physical concern. Balance issues can originate from sensorimotor abnormalities. Movements such as stepping down from a curb, navigating stairs, or driving a car are common areas of concern, and stumbling and falling often pose safety worries for patients with MS. Cameron and Huisinga (2013) indicated that persons with MS become aware of these balance issues when involved in physical activities (p. 1,401). This loss of balance can also result in less control of one's body and feelings of fear and frustration.

Assistive technology, as indicated before, creates new problems and may increase a person’s episodes of falling. The personal and social stigma regarding the use of these aids may also limit their effective use. Lund and Nygård (2003) indicated that self-image and others opinions were major impediments to the use of assistive technologies in public and private. They argued that people were reluctant to use appropriate assistive technologies in part due to personal and sociocultural meanings thereof. This study interviewed 17 independent-living, Swedish, physically disabled users of assistive technology. After the interviews, participants were organized into three groups: pragmatic, ambivalent, and reluctant assistive technology users. The study showed that the subjective experience of the disabled participants differed significantly from the medical perspective. People may be unwilling to try new technologies because of the cultural stigmas and feelings of embarrassment.

In a traditional learning environment where one must negotiate stairs, step over curbs, sit down and rise frequently, or stand up for extended periods, balance challenges may cause a student with MS to give up on her or his education. A person participating in web-based instruction can be spared these hardships and avoid places where advanced balance and body control are required. According to Onambélé and Degens (2006), a 63-year-old male MS patient improved his stability with a 16-week period of strength and balance training. This work will not regenerate lost myelin, but instead retrain the body to use different neural pathways. While such training might be helpful to individuals suffering from MS, the constant fear of fall or injury may still cause affected students to avoid traditional learning environments.

Vision. MS can cause vision difficulties and even blindness, affecting all facets of life. Martínez-Lapiscina et al. (2014) indicated that lack of color vision is often present in sufferers of severe MS. Considering the color of traffic lights and warning signs, it is clear that color acuity is an important safety concern. Double vision and blindness can limit the use of a vehicle or other pieces of equipment at work and home. In addition, vision problems can increase dependence on caregivers and create a feeling of isolation from others.

Assistive technology such as text-to-speech or voice recognition software helps some vision-impaired learners, but can be a source of frustration for others (Van Schyndel, Furgoch, Previl, & Martini, 2014). In a study by Tjaden, Sussman, & Wilding (2014), participants included 78 speakers: ten men (25–70 years, M = 56), and 22 women (27–77 years, M = 57). The study involved speakers with a medical diagnosis of idiopathic PD (n = 16): eight men (55–78 years, M = 67) and eight women (48–78 years, M= 69). The study also integrated speakers diagnosed with MS (n = 30): ten men (29–60 years, M= 51), and 20 women (27–66 years, M= 50). The participant selection criteria did not recognize that more women have MS than men (Finlayson, Peterson, & Asano, 2014; Iranmanesh, Tirgari, Tofighi, & Forouzi, 2014). These speakers were each asked to read sections of text aloud.

The participants, 100 listeners, were screened and ranged in age from 18 to 30 years. They were native English speakers from the US, had a high school credential or equivalent; reported no history of speech, language, or hearing problems; and were unfamiliar with speech disorders. Listeners were recruited using flyers posted at the University of Buffalo and received a modest participation stipend.

This research classified speaking samples as habitual, clear, loud, and slow. The research analysis saw improved intelligibility for clear and loud conditions. Slow samples had similar intelligibility ratings as the habitual examples. Listeners given the loud samples showed a significant improvement in understanding over those hearing the habitual samples, especially those provided by people with MS. This indicates that increased volume is better for producing intelligible speech. Several other variables could have affected this study's results. Though many speakers and listeners participated, the pitch and characteristics of an individual voice may have influenced the audience's perception of spoken samples. A similar follow-up study could confirm the findings seen here.

Vision dysfunction for people with MS can also affect access to traditional educational environments. Many traditional learning settings are not suitable for people with vision problems, despite the development of technologies to assist learners. I have instructed blind and color-blind individuals in the classroom. Physically challenged students required materials prepared with attention to their specific needs. In order to meet these needs, written documents were re-published as audio files and one had to keep in mind that text characteristics such as boldfacing, underlining, or font changes may or may not convert well. Computers can read text aloud and translate visual content to other suitable frameworks (Argyropoulos & Thymakis, 2014; Swann, 2008). Also, sight-challenged students may require recorded classroom material, instructions, and discussions.

Bladder and bowel symptoms. Another debilitating symptom of MS is urinary and bowel dysfunction and infections, which can lead to the need for medication and the loss of personal dignity. Ghezzi et al. (2011) stated that urinary disorders are less common during early disease progression but increase with disease maturation (p. 1223). Khan, Pallant, Shea, and Whishaw (2009) indicated that out of 73 people with MS (27% male), over half were knowledgeable of possible urinary dysfunctions with others describing instances of incontinence. Urinary difficulties influenced emotional well-being (31%), ability to complete domestic tasks (22%), and disrupted recreational activities (28%). The needs for catheterization or protective clothing can be cost prohibitive and negatively affect a person's quality of life, and can sometimes lead to the need for caregiver assistance. Lorback (2015) indicated that bowel disabilities could be physically and emotionally debilitating.

Norton and Chelvanayagam (2010) showed that many people with MS have bowel difficulties. In a survey of individuals with MS in the UK, 29-43% indicated constipation and fecal incontinence affecting over 50% of the responders. Participants included 155 members of the MS Society. Forty-seven people also submitted a postal questionnaire. Some responders, 34%, stated that they spend half an hour a day controlling their bowel symptoms. Among other parts of life, these bladder and bowel problems affect the use of traditional learning environments.

Phé et al. (2016) performed a literature review from articles involving multiple sclerosis and urinary tract infections. Their article provided diagnosis, treatment, and prevention strategies for people with MS. It also presented common treatment options for overactive bladder symptoms, including oral anti-muscarinic agents, injections of intradet-rusor botulinum toxin A, stimulation of the tibial nerve, and sacral neuromodulation. Natural treatments, including cranberry and D-Mannose (a food supplement), vary in efficacy.

Soe, Kopsky, Jongen, de Vet, and Oei-Tan (2009) indicated a possible assistive technology, electro-acupuncture (EA), for patients that cannot use medicine or self-catheterization treatment. EA has been shown to reduce voiding symptoms for persons with MS. Other management options can be found online and through discussions with doctors.

However, even with a reduction of symptoms, individuals might face daunting social pressure and constraints when attempting to navigate a traditional college or university experience. These feelings explain why some students with MS avoid traditional learning environments.

Effect of physical symptoms on learning. MS limits a person's interactions with the world, as well as educational environments. For those with MS, the instructional level of an individual may also affect symptom severity. Scarpazza et al. (2013) suggest that educational attainment may influence symptomology in people with MS. This study recruited 50 participants from Bufalini Hospital (Cesena, Italy) and Spedali Civili of Brescia (Brescia, Italy). The participants also a) had the relapsing remitting form of MS, b) had no exacerbations the month previous to the study, c) did not have a history of psychiatric or neurological disease other than MS, d) scored 26 or higher on the Mini-

Mental State Examination, and e) were not taking glucocorticosteroid, a glucose metabolizing agent. The findings indicated that individuals with a lower education level were more affected by fatigue and other MS symptoms. The researchers also found that highly educated people with MS exhibited cognitive function similar to the healthy control group.

Rebuilding a person's damaged myelin is currently impossible. Future research might find ways to regenerate damaged myelin and ways to mitigate damage done by MS (Azin, Mirnajafi-Zadeh, & Mohammad, 2015; Natarajan, Yao, & Sriram, 2016). Research to retrain the body to use alternative pathways has provided limited improvement. Nilsagård, Forsberg, and von Koch, (2013) tried to improve the balance in people with MS by using a Nintendo Wii® Fit exercise regimen. Their research, however, reflected no statistically significant differences between the group that used the program and the one that did not.

The physical symptoms of MS can be debilitating and their effects can also limit access to traditional learning environments. While web-based environments are unlikely to change a person’s symptoms, they can provide access to educational options. Web-based environments can make bathroom facilities easier to access than face-to-face classrooms. When working online, a student is free to participate in learning when fatigue and pain subside. Web-based environments provide flexibility to allow learning when a student is receptive to it, by allowing active response to her or his fluctuating symptoms. In addition, learning environments that reduce travel make managing balance and fatigue symptoms easier.

Psychological and Social Symptoms of MS

People with MS may have difficulty interacting with friends, family, and co-workers because of damage to brain-situated myelin. This damage can lead to general and specific cognitive dysfunction (Llufriu et al., 2014; Reuter et al., 2011; Weier et al., 2014), stress (Patten, Williams, Lavorato, Berzins, Metz, & Bulloch, 2012), and depression (Feinstein, 2011). Such difficulties can also affect how a person learns (Holtzer, Foley, D'Orio, Spat, Shuman, & Wang, 2013). This section will address aspects of MS disability related to cognition, stress, and depression, and how these conditions affect learning.

Cognitive. Llufriu et al. (2014) indicated that MS could deteriorate communication skills by attacking the gray matter of the brain. This and other studies show that gray matter is important for muscle control, self-control, sensory perception, memory, and decision-making. Damasceno, Damasceno, and Cendes (2014) concluded that gray matter damage happens in both cortical and subcortical structures (p. 1). If the gray matter in the spine is also affected, damage expands. These influences can affect the quality of life for those living with MS. Although the gray matter has been the primary focus of previous research, recent discoveries have prompted researchers to reconsider white matter as the initial source of dysfunction. Currently, some researchers believe that gray matter is the origination point of MS (Schutzer et al., 2013).

Holtzer, Foley, D’Orio, Spat, Shuman, and Wang (2013) studied 30 people with

MS, aged 25 to 55 years old, and 30 healthy controls that did not demonstrate psychological disorders. This study determined that patients with RRMS showed lesser learning within and throughout study visits, whereas healthy controls performed better. In another study, Chiaravalloti, Stojanovic-Radic, and DeLuca, (2013) indicated that the speed of information processing in people with MS affected new learning. Their study compared 51 people with MS and 68 healthy controls that were of similar ages and education level. These researchers determined that the participants with MS showed mild to moderate reduction of new learning abilities and processing speed. They also indicated that participants who took the WMS-III Logical Memory Total Recall test had scores that were within reasonable limits, suggesting that memory dysfunction is less affected by speed of information.

Stress. While the definition of stress has been problematic for researchers and caregivers, there seems to be widespread agreement that MS both creates and may be caused by stress. In a biological or medical environment, stress is a psychological, bodily, or emotional trait that creates physical or mental tension ("Medical Definition of Stress," n.d.). Artemiadis, Anagnostouli, and Alexopoulos (2011) attempted to connect stress with MS onset and progression through analysis of 17 longitudinal studies. While anxiety appears to have a relationship to the onset and progress of MS, details are currently unknown.

Selye (1955) indicated that personal health problems could develop due to ineffective stress management and nonspecific treatments, such as those concerning colloidal metal, foreign proteins, exposure to heat and cold, and shock therapy. Current research into stress management focuses primarily on modification of the body’s production of corticoids (Morale et al., 2001). This research could benefit people who develop MS or other neurological diseases.

A study by Guo, Wang, Johnson, and Diaz (2011) found that students feel increased economic stress as they approach college graduation. The researchers surveyed 560 undergraduate college students of both genders and found increased stress related to work conditions, economic viewpoint, and financial worry. Since stress affects development of MS, it is important to understand which activities could increase risk of disease.

The research by Bland, Melton, Welle, and Bigham, (2012) identified stress-reducing habits and self-management mechanisms in college students. Student participants completed the Stress Tolerance Questionnaire and researchers identified techniques for reducing stress in their responses. The study also showed that some college students have low-stress tolerance, or are unsuccessful at relieving stress. Some participants’ low-stress thresholds might explain why college stress affects MS onset or recurrence for some people more than others.

Patten, Williams, Lavorato, Berzins, Metz, and Bulloch (2012) surveyed people in Canada regarding the effects of stress on their lives. Of the 28,640 respondents, 245 people reported having MS. The researchers found that respondents with MS reported lower health and more impairment than people with other disabling conditions. They also tended to report slightly higher health scores for family and friends than those without MS.

Various technologies can affect a person's level of stress in different learning environments, and technology might limit the adverse effects of physical or mental disability. Reis et al. (2010) indicated that modern technologies could provide accessible educational environments for children with cerebral palsy. This study provides some information about the ways adults with MS could benefit or be challenged by various web-based learning technologies. Even so, more research is needed to connect college, workplace, and personal stress levels to the management of diseases such as multiple sclerosis.

Depression. Depression is a consequence for many inflicted with chronic diseases such as MS (Gaskill, Foley, Kolzet, & Picone, 2011; Hind et al., 2014). Feinstein (2011) stated that depression for people with MS “may further compromise cognitive function, can lead to suicidal intent and suicide itself, often impairs relationships and reduces compliance with disease modifying treatments” (p. 1,276). Comedian Robin Williams indicated that he received treatment for depression and early stages of Parkinson’s disease before his suicide (James, 2015). While depression is treatable, its management is difficult and can negatively affect quality of life.

Furthermore, depression is often spurred by physical symptoms of MS. Amtmann et al. (2015) collected survey data as part of a longitudinal study on quality of life indicators for people with MS. A total of 1,271 people with MS returned surveys. While telephone calls were made in an attempt to collect incomplete information, 26 people were not contacted and this analysis excluded partial information. This study showed that pain, anxiety, fatigue, and loss of sleep indirectly affect levels of depression in persons with MS.

Although diagnosing and treating depression in people with MS can be difficult, two tools are available to help: The Hospital Anxiety and Depression Scale and the Beck Fast Screen for Depression (Feinstein, 2011). Feinstein (2002) indicated that significant depression, abuse of alcohol, and social separation sometimes occur in people with MS. This research also found that depression affects people with cerebral and spinal cord diseases. In their study, Aşiret, Özdemir, and Maraşlıoğlu (2014) indicated that half of the 65 participants with MS showed severe depressive feelings. This study's researcher-designed inventory device found that people with MS suffered from hopelessness and lower life satisfaction.

Effect of psychological and social symptoms on learning. MS affects not only individuals, but also their interaction with friends, medical professionals, family, caregivers, and others. Many elements of MS change the way a person interacts with his or her environment. Those suffering one or more of the aforementioned symptoms might find traditional educational environments, which require social interactions to be uncomfortable or intolerable. It is important to note, people with MS can interact with other people and their environment, but their method for this interaction may require support. Students who are affected by MS-related bowel or bladder conditions, for instance, can read educational content on a computer in their homes, just steps away from their restrooms. These students can feel less stress when granted a learning environment that better supports their disabilities. A person struggling with depression can find solace in web-based instruction, which provides an accessible way to interact with others and be a productive member of society. Yen, Yen, Chen, Wang, Chang, and Ko (2012) found that 2,282 Taiwanese college students who interacted in a web-based environment felt less social anxiety than a control group who interacted in person.

People with MS who want to learn new workplace or life skills rely heavily on cognitive functions. Because MS is diagnosed in adulthood, some people develop MS after finishing a successful college or post-secondary education. The physical and psychological conditions of MS may require changes in living and employment environments. A productive person may feel less depressed and require fewer support services.

Reduced cognitive function, stress, and depression can disrupt the traditional educational environment for learners with MS. These conditions might also interfere with the success of web-based students. In either case, increased access to educational structures can lessen stress and depression, as well as increase social activity and work productivity.

Effects on Living and Working Environments

MS can strain activities at home and in the workplace. This section will first review available research about living and working with the disease. It will also summarize the available research focusing on employment concerns of people with MS.

Home and lifestyle changes. Roessler, Gitchel, and Bishop (2013) studied the quality of life of people with MS as related to their living arrangements. They performed research of a random and random cluster sample of 4,599 American adults with MS. Their research represented gender, age, income, geographic, racial, ethnic, and educational backgrounds of the general population. The participants also represented the memberships of the North American Research Committee on Multiple Sclerosis (NARCOMS; 30%) and the NMSS (30%).

Roessler, Gitchel, and Bishop discovered that fear of falling, education level, employment status, symptom severity, and cognitive limitation are linked to housing variables (p. 101). Education levels of participants were specified as those who had graduated from college and those who had not. Those that graduated college represented 59% of the study sample. Further, 78% of their sample group was female, and 96% identified as white (p. 105). The participants were from 40 to 60 (M = 54.11, SD = 10.16) years of age. Finally, participants were identified as: employed (42%), unaffiliated, family manager, volunteer employed, or full-time student (p. 104).

Their research indicated a need for increased vocational, educational, medical, and cognitive rehabilitation interventions for people with MS. Counselors need to have the diagnostic knowledge of the many issues affecting the lives of people with MS. These researchers also indicated that rehabilitation counselors should value the necessities of lodging “visitability” and convenience in advising people with MS. Counselors and clients need to plan ahead for possible future needs of not only an individual, but his or her family, and medical personnel. Counselors also need to advocate for modifications in community structures toward accessibility as a civil right, expanding current housing regulations to reflect that point of view (p. 107).

Making arguments to change legislation can seem unwieldy. However, writing a letter or postcard to a lawmaker, partnering with a local advocacy group, and voting for positive changes are small steps that everyone can take. Appropriate housing affects a person's success in schooling. Some housing establishments even include free Internet connections, which would allow access to web-based educational resources.

Maintaining exercise programs may be difficult for people with MS. Smith, Lanesskog, Cleeland, Motl, Weikert, and Dlugonski (2012) indicated that motivational interviewing might expand workout involvement for people with multiple sclerosis. Their study involved eight women and five men who had MS as confirmed by a physician. The participants had not had a relapse in the 30 days prior, had impaired mobility, and had not engaged in physical activity on two or more days for the six months preceding the study. Participants were organized by random assignment into motivational interviewing (MI) or standard groups. People in the MI group received three 30- to 60-minute MI sessions with a trained social worker. They focused on (a) motivation through talk about change, (b) reinforced attendance and participation in exercise, and (c) motivation for continuing exercise after the 8-week program. The standard group did not receive MI sessions. Rather, contributors received general information regarding nutrition and injury avoidance during exercise.

Participants receiving MI experienced larger amounts of physical exertion, and lower fatigue issues, but adherence to the exercise program produced no other effects. The participants attended 95% of the MI sessions. MS participants engaged in the MI sessions corresponding to the exercise program. Since participants had to fill out a consent form that indicated that they would complete the 8-week program, their motivation level may have focused on completing the schedule rather than adherence to the exercise program. This study showed that is possible to achieve positive results in an educational program with people with MS using motivational interviewing. While the small sample size and study limitations may color the research findings, the results are positive enough to warrant replication with a larger group for transferability. MI could easily be integrated into face-to-face instructional venues or web-based classes.

Reverend Wiegman's (2010) research is a narrative collection of experiences by a Catholic priest with progressive MS. The stages of grief by Elisabeth Kubler-Ross (1969) provide a frame, as his experiences track closely with the stages of grief, except the last stage. Wiegman felt that his experience was better described as 'embracing' rather than 'acceptance'. His experiences described his successes and failures at navigating his "new" life. Reverend Wiegman (2010) received his counseling license while at Bowling Green, and his descriptions of other professionals with MS would help to clarify the common and specific experiences that this disease causes for this group.

Rashikj-Canevska and Chichevska-Jovanova (2015) performed a structural, descriptive, and functional analysis of a convenience sample of 32 people over 18 years of age living with MS in the Republic of Macedonia. They researched the index of disability and found that 46.75% of people with MS have their independence restricted in performance of everyday undertakings. They also found that 56.25% of the people with MS have moderate, large, or extreme troubles with their everyday task performance. Using the Frenchay Activity Index, researchers found that 31.25% of the respondents rarely participated in daily exercise activities, and that 12.5% of examinees did not participate at all.

Rashikj-Canevska and Chichevska-Jovanova investigated a small sample in a remote area of the world. Although not generalizable, the results suggest that it is essential to train persons with MS to adjust to their condition and environment in order to integrate new physical and psychological experiences. Without this flexibility, mental and physical health can be negatively affected and make participating in educational activities difficult.

Employment concerns. A job is important for maintaining self-identity and can be a quality of life marker for people with MS (Bøe Lunde, et al., 2014). Frndak, et al., (2015) studied the influence of disclosing disease status among employed multiple sclerosis patients. The research divided participants into two non-exclusive groups. The first group completed a medical assessment that included a battery of tests to rate physical, cognitive, and emotional status. The second group submitted answers to surveys that contained questions about disease characteristics, demographics, participant symptoms, and the Disease Steps Scale (Stroud, Minahan, & Sabapathy, 2009).

Frndak et al. (2015) observed 143 people in two studies. All participants had MS, were employed, and were 18 to 60 years of age. Forty-seven people participated in both studies. The Buffalo Health Sciences Institutional Review Board granted research approval, with some important exclusionary factors. Researchers excluded those working less than 10 hours a week, people with other major disorders, individuals who struggled with substance abuse, those who had experienced a relapse in the preceding 8 weeks, and people with vision worse than 20/70. This study's exclusionary factors are a good model for other research projects.

The researchers found that employment was not related to the sharing of MS diagnosis with existing employers. The Federal American's with Disabilities Act and other laws provide protections and assistance for physically challenged workers. In addition, Frndak et al. (2015) indicated that speedy sharing might help preserve occupation status if accommodations are needed. They also agreed that the process for informing employers might not always follow a traditional path of discovering work difficulty, communicating the MS diagnosis with the supervisor, and the workplace supplying accommodations. Frndak et al. (2015) found that people who had disclosed their MS diagnosis to their current employer experienced a broader use of accommodations.

Moore, et.al (2013) sent out five hundred, and sixty-six (566) surveys and two-hundred, and twenty-one (221) were returned (39%). Of the returned questionnaires, about half of those diagnosed with MS leave the workforce before retirement age (p. 1648) due to the many symptoms that they must manage on a daily basis. When education and training are available, people with MS and other disabilities can secure more flexible work environments. Traditional classrooms may not provide an environment conducive to active learning for people experiencing symptoms of MS. Web-based instruction may be better suited for education despite MS symptomology, as symptoms such as pain, overactive bladder, and vision impairment can make attending traditional classes challenging.

Learning. Learning new skills can have a positive effect on home life and employment opportunities. Some people with disabling diseases like MS have rewarding professional and home lives. Many, however, have had to make significant changes after disease diagnosis. Reverend Wiegman (2010) started his career as a Catholic priest and was able to continue his work while convalescing in a nursing home after his MS diagnosis. Similarly, students often wish to continue on their trajectory even after a diagnosis of MS. Assistive technologies, differentiated instruction, constructivist learning, and web-based frameworks can support ongoing learning for people with MS.

Web-Based Learning With MS

Web-based instructional environments might have positive implications for those with MS. The common physical and psychosocial challenges may pose less of an obstacle in educational contexts that do not require traveling to a classroom, sitting attentively for hours, or listening and talking with others. This section will discuss web-based instruction, learning strategies, and other supportive technologies.

Some websites provide information that helps people with MS and others work through their disabilities. These sites reflect the following subjects: surveys, symptom reduction, peer sharing and communication, instruction, and lifestyle changes.

Survey. Some websites gather survey information for people with MS and other diseases. For example, Oreja-Guevara, González-Segura, and Vila (2013) provided a web-based survey of individuals with MS, focused on muscle spasticity. Members of local MS associations were invited to participate in this six-month, web-based survey. Database filters were used to ensure data quality and consistency. Lack of muscular control is a frequent symptom of MS. Approximately 17,095 people with MS in Spain were contacted in regards to the study. This survey involved 2,029 participants. Two-thirds of the respondents were ages 31 to 50 with a mean age of 40.2. Where 43.4% of the male contributors were engaged in active work, compared to 64.5% of female participants. This study found that about 66% of the sample group had spasticity. Spasticity can interfere with the performance at home and work, and increase a person's need for support and use of non-traditional educational opportunities.

McCabe, Ebacioni, Simmons, McDonald, & Melton (2015) examined 2,721 people with MS aged 19 to 92 years. This survey indicated a demand for additional knowledge concerning economic support and eligibility, transportation and workplace management of symptoms. This study extended the understanding of the needs of people with MS related to age, gender, and symptom severity.

Surveys can also be framed to collect information from health providers rather than patients. Decoo and Vokaer (2015) surveyed Belgium neurologists regarding their perceptions of treatment adherence for people with MS. They discovered that while treatment plans for patients are beneficial, they spent little time discussing the impacts of treatment adherence with their clients. The term “adherence” may be defined differently in specific regions. Less than 50% of these studies participants defined “adherence” as the rate of doses taken properly (most frequently with a limit of 80%). However, for a many of respondents (32%), the rate of compliance in MS was “average”.

Symptom reduction. Some medical websites offer help for symptom reduction. For example, Smith, Egbert, Dellman-Jenkins, Nanna, and Palmieri (2012) created a web site with professionally-led psychoeducational interventions for the reduction of depression in male stroke survivors and their spouses. Over 50% of the participants exhibited depression immediately after the stroke and three years later. Their study reported success in reducing perceived depression: approximately 40% of the dyads saw a 50% reduction in their depression scales from their baseline measure. While other environmental factors could also have influenced these test scores, the study results show a positive effect of the web tool.

Physical exercise can have a positive effect on stroke survivors. A review study by Diep et al. (2010) found that increasing physical activity from low to moderate decreased both stroke occurrence and associated negative outcomes.

Paul, Coulter, Miller, McFadyen, Dorfman, and Mattison (2014) authored a report on web-based physiotherapy for people with MS. In this pilot study, 40 participants used web-based physiotherapy two times a week, where a control group (also 40) did not. The website provided exercise diaries and a physiotherapist called participants weekly to modify scheduled activity and provide feedback. Participants reported that the web content was convenient and easy to use. Though changes to individual fitness were small or moderate, many participants indicated that they would be happy to continue using the website.

Symptom reduction helps persons with MS interact with educational resources. If a person completes a program that reduces feelings of pain or lessens the impulse to urinate, they may feel more control over their bodily functions and thus freer to increase their participation in educational activities.

Peer sharing and communication. Several websites offer peer sharing and communication, such as the one reported by Williams (2010). PatientsLikeMe® is a website that provides communication tools for people with MS and other disabilities. In this open sharing environment, users gain the value of a social sharing site and are able to exchange information more freely than in traditional medical communication, which is usually between one person and one doctor. While a doctor may have access to research by other professionals, the shared experiences of 40,000 people with MS can also provide therapeutic options for a patient seeking information, support, and relief from symptoms. In addition, social sharing sites can create a sense of community and help to alleviate feelings of isolation in patients who may be geographically scattered.

Harrington (2015) reported on several other websites, including webMD (http://www.webmd.com), National Institutes of Health (http://www.nih.gov), Yahoo! Health (http://www.health.yahoo.net), and the Mayo Clinic (http://www.mayoclinic.com), which also provide information for patients and their families. Europe is trying to provide a website located at http://care.data, although concerns over privacy of personal information and security are holding up approval (Caldwell, 2014). Political, geographic, and societal boundaries can limit socially-generated information and support for people with MS as they navigate available educational resources.

Instruction, skills, and knowledge. In the area of websites aimed at instruction, I have identified several notable examples. For instance, the NMSS's website has two new webcasts that teach about various aspects of living and thriving with MS (MS Learn Online, 2006). Many learning institutions offer for-credit and community education courses via the web are and accessible to students with disabilities. However, these web-instruction sites often do not publish a list of the specific disabilities for which a course is appropriate. All students, especially students with disabilities, benefit from specific class information. Additionally, students with disabilities need opportunities to receive course content in multiple modalities.

Though symptom manifestation can require professional medical support, one study of stroke survivors indicated possible benefits of using web-based information resources (Pierce, Steiner, Khuder, Govoni, & Horn, 2009). This study performed a random assignment of thirty-six participants to two groups: the web-users group and the non-web-users group. Both groups completed a one-year program that measured their life satisfaction and perceived depression. On average, the web-users group used the portal one to two hours per week and received websites and e-mail information from professionals and other team members. While no statistical differences were measured between web-site users and non-web site users, significant differences emerged in emergency room visits and hospital re-admissions. Stroke survivors in the website group experienced 33% fewer visits to the emergency department and 66% fewer hospital re-admissions than the non-web user group. The Pierce et al. study also claimed that the people in the web-users group spent less money on health care than the people in the non-web user group. These statistics, however, may show information based on a personal choice and not on a causal relationship between variables.

Pierce et al. (2009) also presented information confirming that neither group increased their depression ratings during the study. The web-based intervention did help users make decisions and solve problems, reducing the dependency on medical services and their associated costs. This study did not examine people looking for skill or knowledge level increases that may improve a person's quality of life, although access to medical information could have similar effects. Similar resources may be available for people with MS, but I am looking at uses of web-based educational tools that go beyond just accessing medical information.

The Pierce et al. study indicates that web-based training for stroke victims is cost effective and achievable. Therefore, it also suggests that people with other diseases may have similar experiences and that learning in a web-based class is similar to traditional classrooms. Gardner's (2011) theory of multiple intelligences showed that presenting information in multiple ways helps learners integrate new information with the old. Dewey (1938) also indicated the value of providing various experiences to teach new concepts to students. Thus, increased learning may result from web-based and face-to-face teaching that uses multiple modalities.

Research by Rezeau (2000) described Internet resources to improve the quality of life for people with multiple sclerosis. This study discussed organization websites, US government websites, overview websites, personal websites, and other websites. The research included support links to the MSLIST-L listserv and "alt.support.mult-sclerosis" discussion group, which has turned to Google Groups for their postings.

Websites can provide survey information, symptom reduction, communication, and knowledge and training for new opportunities. Each of these websites have been useful for people with other diseases. Teachers working with students with disabilities provide input on the effectiveness of these resources. These types of web resources might help people with MS, but research is needed to verify these assumptions.

Learning Strategies

People with MS may benefit from learning strategies that better match their education preferences. Several techniques have demonstrated benefits for people with

MS. These procedures include differentiated instruction, assistive technology, and constructive learning.

Differentiated instruction. Differentiated instruction is a process used to teach individuals with different learning traits and goals. Dosch and Zidon (2014) stated that the one-size-fits-all instructional practice is very limiting. They also posited that three diagnostic tools can assess student characteristics and academic abilities: readiness, interest, and learning profile (Tomlinson, 2001). In this framework, teachers can assess readiness through social and educational cues that reflect students' learning preferences. Additionally, they can gauge student interest and use this insight to create motivating learning experiences. Teachers can also design a learning profile for students individually and encourage them to learn in their preferred manners.

A student's learning preferences may involve the ability to listen and react to spoken words. Tjaden, Sussman, and Wilding (2014) studied the ability of people with MS to attend to particular speech structures. They researched talking that was clear, loud, and slow on scaled intelligibility and speech severity in people with Parkinson's disease (PD) and MS.

A DI technique known as self-generated learning allows people with MS to learn new information more easily. Chiaravalloti and DeLuca (2002) indicated that the generation effect was present in people with MS and healthy people.

More recently, Basso, Ghormley, Lowery, Comband, & Bornstein (2008) repeated this study with participants with MS who experienced mild memory impairment and a healthy control group. A score between 57 and 90 on the General Memory Index from the WMS-III indicated diminished memory. The healthy group consisted of 17 participants, 20 persons were in the MS group, and ten persons were in the MS with diminished memory group. Volunteers from a teaching hospital and family and friends of people with MS participated in this study as controls. Both groups recalled more self-generated words than those presented aurally. Though people with MS-related memory difficulty did remember fewer word pairs than healthy people, self-generation techniques optimized recall for both groups.

Self-generation may be a valuable tool for increasing learning for people with MS. This research, however, did not investigate the generation effect with people managing MS-related pain. It is possible that web-based learning environments may provide an environment which allows time for the pain to subside and learning to occur.

DI has been shown to benefit students in various disciplines and contexts: math (Chamberlin & Powers, 2010), music (Darrow, 2015), college (Dosch & Zidon, 2014), students with disabilities (Ernest, Heckaman, Thompson, Hull, & Carter, 2011), and healthy students (Morgan, 2014). The benefits experienced by other students might also help students with MS. A database search for the use of DI with people with MS yielded no results.

Assistive technology. Assistive technologies are physical devices or individual and social services that assist a person with a perceived disability (Asselin, 2014). Examples of assistive technologies include a sign language interpreter for a deaf person, training to use computer software or a walker, utilizing self-generation or spaced learning to facilitate recall of information, text-to-speech or spell-checking software for a blind or dyslexic person, a cane or scooter for mobility assistance, or underwear liners for incontinence protection. These and other tools can improve accessibility and ease of use of learning structures.

Raskind and Higgins (1998) indicated that the number of persons using assistive technologies is steadily increasing. While they do not comment on the cause of this increase, they did discuss technologies that assist students with learning disabilities. These focused on post-secondary aids such as writing tools, reading technologies, and computational supports.

Raskind and Higgins (1998) concluded that while some techniques have been useful for some students with learning disabilities, specific technologies can be beneficial to one student and not another. Similarly, specific technology may assist with a specific incapacity but not with another related disability. In addition, researchers are unclear as to the academic benefit of assistive technologies. They also found that lower-tech tools often provide better support than high-tech solutions. Finally, while some assistive technologies appear to have positive behavioral, psychological, or attitudinal effects on particular students, the usefulness of a specific technology does not necessarily affect its time- or cost-effectiveness

The 140 learning disabled students who received training with the assistive technology in the Raskind and Higgins study reported the following positive outcomes:

- participants increased their GPAs in courses with high levels of reading and writing,
- they experienced a university attrition rate of 1.4% compared to 34% for the group not receiving training and 48% for non-learning disabled students,
- they retook classed they had failed at a significantly higher rate than those who did not receive training,
- they demonstrated a 95% first-time passage rate for the Upper Division Written Proficiency Examination compared to 50% adoption rate for learning disabled students not receiving training.

This research also reported that students trained in using assistive technologies were significantly more likely to use these tools for non-academic arenas as well.

Constructive learning. Constructive learning involves designing a learning environment that allows students the freedom and power to create and manage their education. Rather than being passive recipients of information, students become active participants in meaning creation (Kvedaraitė, Jasnauskaitė, Geležinienė, & Strazdienė, 2013; Ruey, 2010).

Ruey (2010) suggested that constructivist learning modalities could have value for adults learning online. This researcher's study involved 32 college learners that formed the participant group. Seventeen pupils took the Spring 2006 term and 15 in the Fall. Twenty-five students returned the closing survey. In the Spring 2006 class, 14 were K-12 teachers, and the Fall class had ten K-12 teachers. Most students were female (Spring = 13, Fall = 9), had external jobs (Spring = 12, Fall = 13), and rated their computer skills as average (Spring = 8, Fall = 9). The majority of students saw this class as their first web-based class (Spring = 12; Fall = 12).

Ruey (2010) focused on the questions of "what" benefits adult online learners receive and "how do" they benefit from a constructivist-based online course. This research identified improvements that could help strengthen a constructivist-based course. Collaborative discussions provided varied perspectives of course materials, as well as peer experiences and viewpoints. The benefits even transferred from the academic realm to the workplace. The educational activities demanding teamwork and collaboration assisted the students in supporting their peer's learning. While this information is potentially valuable, it did not expand the use of web-based constructivist learning to people with disabilities.

This article framed a concept of constructivist learning using Piaget’s, Dewey’s, and Bruner’s writings. However, Vygotsky (1986) indicated that constructivist learning occurs within social contexts. Language is a critical feature of social learning. A person's interaction with their environment frames their reflections on thoughts and experiences (Vygotsky, 1986). Dewey (1938) also suggested that learning is dependent on a person's environment. Interaction with others is a required construct for learning about the real world. Students must discuss, negotiate ideas, argue, and work with others to generate solutions for the various problems.

Adult learners should be independent thinkers, not passive receivers of knowledge. They also need motivation and educational activities intended to best suit their learning needs, abilities, interests, and experiences (Lindeman, 1926). Murphy et al. (2005) proposed a constructivist model involving three levels of assistance. In the first tier, the instructor should guide the learner to grow his or her intellectual and metacognitive abilities. In the second, teaching assistants should monitor students as they develop task organization skills. In the third, students performed knowledge acquisition actions. Ruey indicated that instructors often have a difficult time communicating assessment information to students. Learning environments must apply high standards, suitable assessment strategies, and sufficient facilitation for web-based learning.

Effects of educational structures on learning with MS. Further research is needed to determine how web-based technologies affect people with Multiple Sclerosis. Current research can only create a foundation for understanding how individuals with the disease can use these training opportunities in their personal lives. While job re-training opportunities currently exist, this is only one among the many purposes for training resources.

Galushko et al. (2014) reported on the unmet needs of people with MS in Germany. Fifteen people with MS participated in the study with the goal to synthesize the unmet concerns of individuals having severe effects of MS symptoms. Through individual interviews, researchers found that positive involvement of family and friends, medical and psychological services, and life management skills created opportunities to thrive with MS. People with severe MS expressed the desire for more family support and service providers who would work with their individual needs, instead of ‘clustering’ all people with the disease. Participants who were more severely affected by MS symptoms and who felt less integrated with their social environment expressed fewer support needs.

Health care and palliative care services need to be better linked. Persons with severe MS need improved access to multi-professional services and workers who will treat the biological, psychosocial, and spiritual needs of the whole person and family while integrating their services.

This research has few participants and small generalization level. All volunteers participated in the interviews. Cognitive impairments and depression complicated the narrative interviews. Many participants had difficulty identifying the particular form of MS they possessed. Having a relative present may have influenced some participants’ answers, especially regarding questions of family support. Relatives sometimes helped supply answers when the participant paused to consider what to say.

This author used the word "palliative," which is often used to describe a person with a terminal illness. It is true that MS has no cure at this time and that no treatments exists for some irreversible processes that modify body and mind. However, life is a terminal illness. Since this study did not identify life-modifying versions of MS with these participants, the word probably should not have been used.

Investigations by William Ogburn about social change identified physical and social inventions (Ogburn, 1964). One cultural trait that may provide a model of social understanding is religion. This social understanding and not scientific knowledge describes why people created religious cultures based on the belief in a god or gods. At the moment, scientific knowledge seems valid as a means of understanding certain types of behaviors, while social experience is valid for others. Neither framework is leading. It is possible that the two are linked. Lifestyles 5,000 years ago probably were influenced by invention and belief. Science may have provided possible explanations and tools for investigation our environment while religion and social knowledge has provided fuel for our communal interactions. There is a continued argument about the correct framework to use when evaluating our behaviors. Both perspectives are important in our lives today and probably for future societies.

Summary and Conclusions

It is apparent that MS has a variety of physical, social, and emotional effects, some of which can interfere with a person’s ability to interact with his or her educational environment. Pain and fatigue are observable symptoms that can keep a person isolated, but so can excretory, balance, and touch disabilities. These symptoms can all negatively affect how a person interacts with traditional learning structures. Imagine how it might feel to have to leave a class every 30 minutes to use the restroom. Imagine how chronic fatigue might interfere with travel to a scheduled class. Whether it is pain or vision impairment, these symptoms and others affect the lifestyle and quality of life for people with MS. The advent of online tools might provide a flexible learning environment where a person can start and stop a module as symptoms decrease or increase.

Another benefit is that people who cannot work at a factory or business might be able to perform their jobs at a computer. Though managing technology could be problematic for people with touch sensitivity, new devices are available to help people interact with their computers. Voice recognition, pointing devices, and oversized keyboards can help people use their computers more effectively. There are many tools available now and more will assuredly be developed in the future.

Students with different abilities and proficiencies thrive in different educational environments (Dosch, & Zidon, 2014). There are learning structures that have been shown to have positive effects in environments where learners have different learning challenges, such as differentiated instruction, assistive technology, and constructive learning. These structures may benefit people with multiple sclerosis in a web-based context.

This research investigation determined how people with MS use various web-based course management systems and which features they found most and least effective, as these insights are currently lacking in the literature. This research continues in Chapter 3, which details the research strategy and method.

Chapter 3: Research Method

Introduction

The purpose of this study was to determine the ways in which people with MS use web-based learning technologies. People with MS suffer physical, emotional, and mental symptoms that can affect their quality of life (Schwartz, Kaplan, Anderson, Holbrook, & Genderson, 1999). Due to the flexibility of this academic context, web-based education may provide appropriate learning opportunities for people with this debilitating disease.

George and Bennett (2005) proposed that an interview study can be used to investigate a group of incidents. In this research, I investigated how web-based learning environments are perceived and experienced by people with MS. According to my review of the literature, few researchers have studied how people with MS use and are affected by web-based instruction, and those who have done so have produced limited findings. Thus, there is a significant gap in the literature. I sought to address this gap in knowledge by conducting this study. This chapter includes sections on research design and rationale, role of the researcher, methodology, and issues of trustworthiness. The chapter concludes with a summary.

Research Design and Rationale

The purpose of this exploratory study was to determine what web-based learning tools are used by people with MS and to describe how they use these tools. I sought to answer two research questions: What web-based technologies do people with MS use for learning? and How do people with MS interact with the web-based learning technologies they use?

Human beings often participate thoughtfully in their environments (George & Bennett, 2005, p. 129). People observe, learn, and change their environments to meet their immediate and long-term goals (Dewey, 1938). Individuals act in their constructivist environments to build personal and social structures that benefit them (see Olusegun, 2015). Quantitative and qualitative research provide ways to describe individuals' environments and their effects on such structures. Quantitative research can only provide a snapshot of a moving reality, where individuals and groups engage in activities that transform their environment (Creswell,2013). Qualitative research, however, can describe the changeable influences of social interaction to provide a deeper understanding of a person's experience (Creswell, 2013).

Yin (2013) stated that qualitative research can yield knowledge and theories. In this qualitative research study, I examined a specific group of people and analyzed their constructivist, distributed learning, and assistive technology experiences with web-based instruction environments. George and Bennett (2005, p. 19) suggest that the qualitative type of research can provide a high level of conceptual validity.

The use of an interview study approach can be used to develop an in-depth description and analysis of individual perceptions of web-based instruction (see Creswell, 2013; Yin, 2013). As such, this type of research design was most appropriate and informative in this context.

I considered ethnography but deemed it too closely related to culture sharing; I also did not believe that it would allow me to capture the behavior and context details available in an interview study (see Creswell, 2013; Geertz, 1973; Hammersley, 2001). Phenomenological is research that focuses on meaning and experience (Creswell, 2013; Vagle, 2014). This design was too limiting for this research. Finally, narrative research, which focuses on storytelling and descriptions of distinct incidents (Andrews, Squire, & Tamboukou, 2013; Creswell, 2013), was also too restrictive. A focus on "shared stories" was intriguing, but the focus of narrative research is on multiple aspects of life experiences, whereas in this research I aimed to understand an educational framework for people with MS. An understanding of participants' identities was not a primary focus of this research. Researchers can use an interview study approach to develop an in-depth description and analysis of individual perceptions of participants' web-based instruction (see Creswell, 2013; Yin, 2013). As such, this type of research was most appropriate and informative in this context.

Some researchers question the use of interview studies, due to perceptions of increased bias, and it is scientifically lesser than quantitative research (Goguen, Knight, & Tiberius, 2008; Rossiter, 2008; Staniszewska, Ahmed, & Jenkinson, 1999). However, conducting an interview study allowed me to capture the social contexts and challenges of the study's unique population of MS learners, which only served to strengthen this research. Study participants provided deeper understanding of the benefits and challenges that web-based instruction produced for this population through the sharing of individual experiences. People with MS, those working with them, and educational professionals may gain new information and understanding from the study findings.

Role of the Researcher

I performed multiple tasks in the study. I found participants, enlisted their cooperation, verified confidentiality form signatures, motivated respondents, clarified any participant confusion or concerns, verified the quality of responses, and conducted interviews according to established procedures. I also verified collected data, conducted interviews, created interview transcripts, delivered transcripts to the participants to double-check shared information, corrected and interpreted the interview responses, and completed the dissertation to share the research with my committee and the broader scholarly community.

An external agent was contracted to transcribe the interviews. These transcriptions were double checked by me. They were also checked by each respective participant to provide member checking. In addition, the Walden University Institutional Review Board assigned the research approval number 08-18-17-0032729 for this research.

I also avoided interviewing people with whom I had a supervisory relationship, either as a teacher at a local community college or as a board director for the state education association. Including these individuals in the study may have confounded data received from interviews. Membership in either group disqualified prospective study participants.

Methodology

Adults with MS shared and explained their perceptions of experiences with web-based instruction. Coding was used to analyze data collected from interviews and documents. Creswell (2013) indicated that data collection activities in a qualitative study must progress through multiple stages: site location, access, sampling, collecting data, recording, field issues, and storage of data. This section will be organized to first discuss participant selection logic, instrumentation, data collection procedures and data analysis plan.

Participant Selection Logic

Yin (2013) discussed advantages and disadvantages of various interview study designs. While a single participant interview study might be appropriate while examining an unusual, or extraordinary event, this study sought to find similarities and differences between the experiences of multiple participants with MS. Interviewing multiple people helped the researcher to identify the most commonly noted disadvantages and advantages of web-based technologies, and perhaps some outlying perspectives that could be utilized to describe areas for future research. Interviews of nine participants had been used to collect similar study information and resulted in valuable data (Okyireh, & Okyireh, 2016; Papageorgiou, Marquis, & Dare, 2016; Tramm, Ilic, Murphy, Sheldrake, Pellegrino, & Hodgson, 2016).

Due to the relatively small population size, and difficulty in generating a list of all people with MS, convenience sampling was utilized in this exploratory study. This technique, however, introduces possible sampling biases. Nine volunteer participants were identified from 18 MS self-help groups and doctor's offices in the local area who met sample qualifications and limitations. Participants were between 18 and 72 years of age, diagnosed with MS, and had experience with web-based learning. This sample size generated many of the common feelings regarding web-based instructional experiences but may not identify all attitudes. This data assisted in generating information that could be used in a larger survey. A saturation grid with a horizontal axis of major topics and vertical axis containing participant data assisted in verifying a representative sample variation across ages and gender.

Participants were sought from multiple sites. Local MS support groups were contacted in the hopes of finding research volunteers. These meetings are open to the public and conversations with the meeting coordinator provided access to participants. The volunteers appeared to be of Caucasian cultures. Their opinions and feelings may be limited to those of people with MS from other cultures. These public meetings were the primary points of recruitment.

I also posted flyers in neurologists' offices to recruit participants. A local neurologist had given permission for a flyer to be displayed informing potential participants and caregivers of this research. Similar documents were posted, with permission, in other doctors' offices, on local college campuses, and in other public places. People could read these English posters about the study protocols and call the study coordinator to request more information or volunteer to participate. This research, however, did not collect information from people who speak and read other languages and may not provide information about MS people with eyesight difficulty,

Other organizations, such as local universities, the local MS Society, and the state MS Society, could have been queried for study volunteers, using a flier similar to the one designed for the neurologists' offices. It is possible that other study announcement material was distributed by hand, mail, or e-mail.

Instrumentation

Since no previous research asking similar questions has been identified; this study uses a list of preliminary questions to ask each participant. Rather than providing quantitative validity, this research established credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985).

Data was collected using a predetermined list of questions and follow-up questions to achieve full understanding of participant experiences and feelings. The interview questions are listed in Appendix A.

Procedures for Recruitment, Participation, and Data Collection

This research is one of the first projects to examine the perceptions of web-based instruction for people who have Multiple Sclerosis. Therefore, this study could be called a pilot study. However, this study can be categorized as a case study or interview study. I will use the term interview study. Previous research with other populations used questions similar to the ones in this study but have not questioned people with MS. Topics such as credibility, transferability, dependability, confirmability and ethical procedures are discussed in the Issues of Trustworthiness section below. This research of eight to ten participants was sufficient for this exploratory study that could generate content to be used with a larger survey study (Bradney & Bradney; 2013, Horn; 2017, Kiemle-Gabbay & Lavallee, 2017).

I conducted the initial and follow-up interviews in a place that was comfortable for the participant. The data was collected from eight to ten individuals using a responsive interviewing methodology (Rubin and Rubin, 2005). In this method, the researcher obtains a participant's experience and how personal and social structures influence their understanding of their experience. The interviews occurred individually, were recorded, and then transcribed. The participants were consent form signing volunteers from the local area MS support groups, MS societies, or contacted through neurologist's offices, schools or similar groups. Local MS Societies volunteered to help if recruits are insufficient.

I conducted all 30-minute to 60-minute interviews. The interviews were recorded. An area psychologist volunteered to transcribe the audio recordings. These transcripts were verified by this researcher and shared with the participant. Follow-up contact with the participants verified and clarified transcript content. A second visit provided an opportunity to debrief and thank the participant and answer any questions. If the initial interview could not be completed in the time scheduled, then I was prepared to arrange for more time or locate other participants.

The interviewer used the same base questions for all interviews, but may have added follow-up questions as necessary to clarify participant experiences and impressions regarding their web-based instruction.

Data Analysis Plan

Open, axial, and selective coding were used to analyze the data collected from this interview study (Merriam & Tisdell, 2016). A doctoral colleague of the researcher transcribed the recordings. I verified the transcripts and shared them with the participant for review. Transcripts of the full interviews were analyzed to identify similarities and differences between participant experiences. After the first interview, preliminary open codes were generated. This organized conceptualized data into emerging themes (Merriam & Tisdell, 2016). Subsequent interviews added and refined open codes. After interviews and open coding were completed, axial coding was used to build core categories using the fragments of data generated through open coding (Merriam & Tisdell, 2016). Finally, the axial coding results were used to find relationships between individual data elements and the core concepts in a process known as selective coding.

The researcher classified participant responses as positive, neutral, or negative, with interview data determining the exact code generation in the open, axial and selective phases of analysis. These codes were chosen after the first interview and refined throughout the interview process. I analyzed patterns by assessing similarities and differences between codes, frequency of code appearance, code order, correspondence in codes, and causation of relationships between codes.

Though there are a number of software resources that can be used to analyze information from qualitative studies, I used NVivo 12® to organize and prepare data for analysis (Aydin & Tonbuloğlu, 2014; Bilge & Meral, 2015; Tonbul, 2014). NVivo 12® also stored transcripts of the interviews, as well as coding and analyses.

All data, including any discrepant data, was included in the final analysis. Since these interviews produced data that was not collected in previous research, discrepant data was difficult to identify. Therefore, all interview data was analyzed and reported.

Issues of Trustworthiness

Armfield and Ketting (2015) used random sampling to raise the technical value of their study results. People being treated for MS are not required to report or register their ailment, and therefore, it was impossible to gather a representative sample. Thus, I relied on volunteers for information gathering.

Credibility

Bias was minimized with three techniques. I constructed questions and analyzed responses, including contrary data. If one was asking about advantages of web-based learning environments, for example, then disadvantages become equally critical.

Thomas and Magilvey (2011) indicated that member checking could generate qualitative research credibility. Participants read and commented on their interview transcript to verify clarity of content and intent.

The dissertation chair and committee will identify any bias that the previous two checks have missed. Altogether, this should be sufficient to provide credible results.

Transferability

Transferability creates deep explanations of experiences and demographics of the participants (Houghton, Casey, Shaw, & Murphy, 2013; Schwandt, Lincoln, & Guba, 2007). The report included dense descriptions of the experiences of people who have MS and have participated in a web-based class. In general, information from interview studies was not generalizable; instead, the results from this study created a foundation from which a larger survey-based research can be generated.

Dependability

Thomas and Magilvey (2011) indicated that dependability occurs when other researchers can replicate a study. I used audit trails and triangulation to add dependability to this study and provided documentation to support statements made by the interviewees. The researcher also triangulated by asking questions strategically to confirm participant answers. Respondents provided more trustworthy answers to questions such as, "How did you feel after taking this class," and, "How would you feel if taking a similar class in the future". The researcher further facilitates triangulation by interviewing multiple participants, member checking, and outside reviewer feedback.

Confirmability

I understand that biases can influence the data collected and resulting reports. The researcher therefore disclosed any predispositions for the applied methodology and procedures used here. It was imperative to discuss alternatives, share processes, and disseminate specific conclusions.

Reflecting on and clarifying participant interviews strengthened confirmability. Participants had different understandings of slang or technical terms than the interviewer, so interviewees were asked to define their language when necessary to reach a mutual understanding.

Ethical Procedures

Creswell (2013) stated that researchers should consider the needs of sites, participants, stakeholders, and publishers of research. While the care of participants is a primary concern, study organizers must consider how other stakeholders may influence study parameters. Prospective participants were given a copy of the informed consent form. Only those that met the research qualifications and signed the informed consent form were able participate in this research. Participants were not harmed in this research and they could withdraw at any time. Protecting participants from physical, mental, or psychosocial harm was my primary concern.

Participants were protected by understanding and providing their informed consent (Yin, 2013). This study did not try to deceive participants by asking questions that could cause them harm. Names were changed to protect the privacy and confidentiality of interviewees.

Data were collected and interpreted primarily by the researcher. After the initial interview, an outside party transcribed interview recordings. The transcriptions were verified for accuracy by the researcher. The transcriptions were given to their respective participant to verify and clarify data with the researcher. Field notes, recordings, and all study data were stored in a secure location at my residence for 2 years, then destroyed. The local community college research staff will oversee the appropriate destruction of all research material.

Summary

This chapter has focused on research design. It identified the details of interview study methodology and included the researcher's perceptions regarding qualitative research types and choice of the interview study. It also introduced structures of this interview study and rationales for the decisions made about it. This chapter also discussed data collection and analysis techniques and rationale.

In addition, this section provided the rationale for this study and research trustworthiness. Interviews can generate bias and this is an important issue, especially with a convenience sample. The procedures discussed will support forming valid conclusions from the data analysis. This chapter has also discussed issues of credibility, transferability, dependability, and confirmability. Participants and research results were protected through ethical procedures.

The next chapter reports on the data collected from interviews. It will report on research setting, demographics, data collection, and data analysis. It will also include sections discussing study trustworthiness and study results.

Chapter 4: Results

Introduction

The purpose of this study was to discover how people with MS use web-based learning technologies. took place at several locations in the local area. I sought to answer the following research questions:

Research Question 1. What web-based technologies do people with MS use for learning?

Research Question 2. How do people with MS interact with the web-based learning technologies they use?

I gave members of self-help support groups flyers that described the research. I also posted flyers in two doctors' offices. I answered any questions that prospective participants had in person and through e-mail or telephone calls. Chapter 3 study protocols were followed completely. In this chapter, I will describe the research settings, participant demographics, and data collection and analysis procedures; provide evidence of trustworthiness; and present results. The chapter concludes with a summary section.

Research Settings

Two local doctor's offices agreed to post flyers advertising the research and protocols. In addition, I distributed flyers to 16 local MS self-help groups including the local chapter of NMSS and the local MS Society.

From these sites, nine adult volunteers agreed to participate. They met all study qualifications and had no disqualifications. Two prospective volunteers had to be disqualified due to their age. One participant was a school employee but was not a member of the state's education association and was therefore able to participate in this study.

Interviews took place at a location chosen by the participant. Each site was appropriate for interview recording. No other people were accidently recorded during the interview. The recording device also worked perfectly. No interviews had to be repeated due to equipment failure or other reasons.

Demographics

All of interviewees took their web-based courses as part of a degree, certificate, professional, or personal activity. One participant completed a degree with web-based courses, and another took a 6-day web-based course on boating safety for a state license. One participant took several web-based classes on computer programming, another took a Photoshop course to increase skills for work, and another kept MS health in check with web-based courses from the NMSS.

The participants included men (4) and women (5). While two participants were identified from the same MS support group, all other participants represented a unique geographic area. Some were married, and some were single. Most were unemployed. Most had training for a professional career, but their MS symptoms made continued employment difficult or impossible. For example, one person was being trained to be an engineer when diagnosed with MS while one was a college professor, one was a school support professional, and another was trained in criminal justice.

I did not explore participants' ethnic background. However, participants appeared to be White. Many used an assistive walking device such as a cane, walker, or wheelchair.

The first participant interview occurred on September 28, 2017, and the last on February 4, 2018. Follow-up contact with the participants was usually by phone or e-mail. Each participant read her or his completed interview transcript, provided corrections where necessary, and approved the completed interview transcript for use in this analysis.

Data Collection

I interviewed nine adults who ranged in age from 18 to 72 years. Each participant signed a study consent form and chose the interview location. Appendix B shows a summary of participant demographics.

Interview locations included a local community college (3), participant's home (3), local historic site (1), a church (1), and a bench outside a public area (1). Interviews lasted between 20 and 68 minutes. All interviews required at least two post interview communications to deliver transcripts, receive participant feedback, and obtain approval to use the participant's transcript in this research. For these communications I used either the telephone, e-mail, or the U.S. Postal Service.

I recorded interviews using an Apple iPhone 5s and the Voice Recording application, which was freely downloaded from the Apple App Store. The study procedures detailed in Chapter 3 governed the data collection process without modification. While each study participant had unique environmental and social settings for her or his use of web-based instruction, no unusual circumstances were encountered while collecting data.

Data Analysis

After having the interviewees confirm data, I began the analysis of the interview data. I used the NVivo 12 software for the Macintosh computer to analyze each interview transcript. Initial open coding units were determined by reading and analyzing each interview transcript in a recursive manner. These open codes detailed specific concepts discussed by individual participants. Some codes detailed specific MS symptoms experienced by the participant, such as fatigue, pain, bowel and bladder issues. Other codes detailed the participant's learning environments such as travel, employment, and cognitive issues. Some codes indicated participants' feelings toward specific learning experiences.

In addition, I created a comprehensive word analysis of each interview to generate open codes. I discovered that the NVivo 12 software could not do a word frequency analysis for participant responses and interviewer questions; therefore, a Microsoft Excel workbook was created to help with this analysis. The workbook contained 144 worksheets, each with a frequency table of the occurrences of the words a participant used in answering each question. These lists were generated using the UNIX operating system and the 'uniq' command that organized the words from each interview. Navigation buttons were created to facilitate movement from one question's worksheet to another. A summary worksheet was created which included a frequency of word use in all interview questions. This page also included an analysis of the answers containing a specific word and tools for analyzing specific words and the answers that contained them. For example, the word *learning* was used 51 times and showed up in 32 of the 144 answers while the word *learn* was used 35 times and appeared in 21 of the answers.

A simple word analysis was not sufficient to determine word meaning. For example, the word *box* can refer to many concepts including a geometric shape, a cardboard shipping container, or the career of Mohamed Ali. I used the word analysis, along with NVivo's search and evaluation tools, to identify word context and organize key phrases used by individual participants. This expanded word analysis completed the process of open coding. Approximately 500 codes were generated.

After open coding was complete, the task of axial coding began. During this phase, I analyzed the open code labels and grouped them in a process called chunking (Leech, & Onwuegbuzie, 2008). Open codes were organized and reorganized to identify common concepts spoken by the participants. The process of axial coding generated the 25 codes shown in Appendix C.

After axial coding was complete, the process of selective coding began. I organized the 25 axial codes to produce the headings and subheadings used in Chapter 5. These included learning management systems, e-mail, video, motivation, employment, professional, personal, learning, and social engagement.

While each participant had unique and valuable insights into their experience with web-based education, there was no evident discrepant data. While most participants appeared to be of white, Caucasian ancestry, this information was not queried in their interview. Also, according to the July 1, 2017 population report by the US Census, the local area is 77.7% white (United States Census Bureau: QuickFacts, July 1, 2017). Since those who took part in this research were volunteers from the local community, it is not surprising that the participants fell into this ethnic population.

Evidence of Trustworthiness

The researcher addressed trustworthiness by implementing actions to strengthen credibility, transferability, dependability, and confirmability.

Credibility

I reviewed the participant responses to each interview question and each participant reviewed the transcript of their interview. Thomas and Magilvey (2011) specified that reviews of interviews by participants could increase qualitative research credibility. Merriam & Tisdell (2016) indicated that triangulation increases a studies credibility. Multiple sources of data (nine participants) were compared with each other and yielded similar experiences.

Transferability

Transferability creates deep explanations of experiences and demographics of the participants (Houghton, Casey, Shaw, & Murphy, 2013; Schwandt, Lincoln, & Guba, 2007). The report included dense descriptions of the experiences of people who have MS and have participated in a web-based class. In general, information from interview studies was not generalizable; instead, the results from this study created a foundation from which a larger survey-based research can be generated.

Dependability

Thomas and Magilvey (2011) indicated that dependability occurs when other researchers can replicate a study. I used audit trails and triangulation to add dependability to this study and provided documentation to support statements made by the interviewees. The researcher also triangulates by asking questions strategically to confirm participant answers. Respondents provided more trustworthy answers to questions such as, "How did you feel after taking this class," and, "How would you feel if taking a similar class in the future". The researcher further facilitates triangulation by interviewing multiple participants, member checking, and outside reviewer feedback.

Confirmability

The same base questions were used in all nine interviews. Follow-up questions were used to generate rapport with the interviewee and confirm statement meaning by the participant. Also, it was used to achieve a common understanding of the language used by the interviewee.

Results

In this section I will first discuss the analysis of Research Question 1 as they relate to learning management systems, e-mail, and video. I will then discuss analysis of Research Question 2; topics include web-based class motivation, professional influences, personal influences, employment, and learning issues. This section will conclude with a list of specific findings and further information regarding discrepant data.

Research Question 1 was, What web-based technologies do people with MS use for learning?

Learning Management Systems

All research participants interacted with a web-based, structured learning management system to network with course content, instructors, or classmates. All participants had positive experiences with their learning environments. In fact, there were 80 uses of the word 'like', seven uses of the word 'fun', and only three uses of the word 'hated' in all nine interviews. All participant interviews included the term 'learn' (32). Each participant indicated that new learning had occurred.

Participant R indicated the use of multiple course management systems.

> Yes, I did Blackboard and Moodle before and sometimes just getting to know where stuff is due; how the content is laid out as far as what I need to do and how I needed to prepare for that was, a little challenging at the beginning. But not so much afterwards. (personal communication, September 28, 2017)

The differences between various course management systems required student flexibility and non-content learning to use them well. Participant S indicated that sometimes frustrations were experienced when a course management system failed. She said, "Yes, I did WebCT. It always crashed. Horrible system" (personal communication, October, 7, 2017). These technical problems may have provided more frustration than the learning of new content.

Participant V, and many other interviewees, did not indicate the course management system used. The user of such a system may not have an easy time determining which system was used and whether a system is commercial, public, or proprietary. The term ‘Blackboard’ was used three times and appeared in the responses to two questions. The term ‘Moodle’ appeared twelve times in 3 question responses. No other course management systems were mentioned.

Several participants also indicated the use of resources, such as e-mail and video, to find information to support their learning.

E-mail. E-mail was used to communicate with peers and instructor. Participant S said, “I liked all my information was there just log onto that I can then communicate through the teacher through that way instead of logging out and using e-mail” (personal communication, October 7, 2017). Participant Z also used e-mail communication. She said, “I had friends that we would e-mail questions back and forth to each other. But to put a formula on a computer you would have to write it up sometimes on reports” (personal communication, February 4, 2018). Certain types of communication may have been easier with other tools. Participant V said, “I'd rather just correspond with e-mail. That’s what I grew up with” (personal communication, December 15, 2017).

Not only can e-mail be used to communicate with peers, it can be used to ask questions and obtain help. Participant Y was aware of such uses of e-mail but did not feel the need to use it. He said, “It did have an online forum, though. I believe that you could ask questions. I just didn’t feel the need to use it” (personal communication, November 4, 2017). An ‘online forum’ is usually a web- and text-based utility, similar to e-mail, for communicating with instructors or one or more classmates.

MS memory symptoms may affect reading responses to forum and other e-mail. Participant Z said, “Actually, e-mails that I send to people, I don't always double check and I should” (personal communication, January 26, 2018). Checking for and responding to e-mail replies is often a regular task for learners.

Video. Another communication technology mentioned by participants was video. Course material was often presented in video format accessed through the world wide web. Communicating about how NMSS courses provide information for people with MS, Participant Y said, “I like when they built in stories or they have short videos where somebody with MS, shares their story that is relevant to the topic” (personal communication, January 26, 2018).

Participant V and several others, had comments about video instruction. She said, “I think a question with a little video episode in it would be good that would help explain a concept” (personal communication, December 15. 2017). Participant R said, “A lot of it was done through video demonstration” (personal communication, September 28, 2017). Participant V said, “There were videos and they were designed to have audio, but audio was not available at my workspace. But there was text underneath to compensate for that. So, it was user friendly” (personal communication, December 15, 2017). Participant U said, “A bunch of people, who were putting together videos on this topic, discovered that you can use computer sounds” (personal communication, December 19, 2017). He did not like the robotic computer voices that accompanied some videos. Participant U went on to say,

> I found a website with the topic that I was researching, that had a real human. It was all I could do to not send them an e-mail saying thank you so much for putting a real human being on your website (personal communication, December 19, 2017).

Participant X also found the video information beneficial. She said, "There was some interviews and short videos that we had to watch" (personal communication, February 4, 2018). Video information was universally mentioned by most participants. Participant T, who does not mention visual MS symptoms, said, "As a learner, I prefer visual aids like video, but that has nothing to do with MS" (personal communication, December 15, 2017).

While Participant V has experience using collaborative communication technology, such as Apple's® FaceTime®, none of the participants indicated student generated video documents as assignment exercises.

Research Question 2 was, How do people with MS interact with the web-based learning technologies they use?

Using the words that participants spoke, I organized the interview codes into 4 groups. The first, classified responses into the reason for taking the web-based course: either for degree completion or personal interest. The second, classified responses related to employment. The third, classified responses related to modes of learning. The fourth, classified responses related to reactions to various social engagements.

Web-Based Class Motivation

The first classification organized participants almost evenly between professional or personal learning desire. Participants R, S, U, W, and X took classes to complete a degree. Participants T, V, Y, and Z took courses for personal interest. While a few participants indicated taking web-based courses for both groups, I chose to focus on the degree completion courses for this analysis.

Professional. Participants in the professional group took their web-based class to complete a degree or certificate. Participants used the following words, or forms of the following words, to communicate their professional experience: work(47), job(4), industry(1), task(2), activity(8), office(1), operation(5), place(5), position(4), spot(1), and profession(3). Most participants shared frustrated feelings regarding the disability that their MS symptoms provided for their profession.

Each participant in this group experienced the emotional frustration of balancing their specific MS symptoms and their professional knowledge and skills. Participant R who had taken computer science and speech courses online for a degree, indicated his MS has affected his ability to use a computer mouse. He stated, “When I get fatigued is when my hand starts, my hands will start twitching really bad and that kind of stuff so then it becomes hard to mouse” (personal communication, September, 28, 2017). Participant W, who took an Introduction to Schizophrenia course for her work as a dean at Oregon State University, indicated her MS symptoms affected her ability to drive to work and stay employed. She said “For two years, I took the bus to and from Corvallis; and then it was time to take an early retirement” (personal communication, December 12, 2017). Participant U, who use to be an educational support professional, said, “And I'm thinking about that question in relation to being a staff assistant who could barely make it because it drained me so much” (personal communication, December 12, 2018). Participant S, who indicated that fatigue affected her completion of a Criminal Justice Bachelor’s Degree, said, “When I started to go to Western, I changed after, three months of being on campus because my fatigue and my unstableness with my MS symptoms started. That’s really when I started to get sick” (personal communication, October 7, 2017). Participant X, who completed an maintained her Electrical Engineer Degree, said, “The fatigue factor had me doing less across the board, not only with the online learning, which is everything in general” (personal communication, February 4, 2018). These statements show that the symptoms of MS affected a person’s education and career.

The occasion to complete degrees with a web-based class may provide opportunities otherwise closed to individuals with disabilities. Participant S said, “I took my entire (laugh) bachelor’s degree online from Western Oregon University” (personal communication, October 7, 2017). Most participants had experience with face-to-face classrooms with previous training. These skills supported their new, web-based learning, but the new structure provided some adjustments to the new environment.

A web-based class has new systems for interacting with instructors and students. These systems usually include e-mail and video content, which makes a student feel that they are the only person in their classroom. When Participant U was asked how the web-based class felt, He responded, “Like something wasn't quite there” (personal communication, December 19, 2017). Participant U felt that e-mail, video, and course management systems could not replace the personal, spontaneous, intimate, and reactive communication between peers and instructor that are present in a traditional classroom. Participant U also describes the isolation experienced by some people participating in web-based classes as

> So basically, just to sum it up, my years of enjoying being in a classroom environment with other learning people, talking with those people, talking to the teacher, suddenly I've got, what, a screen and a keyboard; No, I can't call anybody. I'm trapped. I'm in a hole. Looking at this and that gets really lonely (personal communication, December 19, 2017).

While web-based coursework may provide alternative techniques for communication and assessment of student knowledge and skill, some students prefer these methods to classroom-based assessments. Participant S stated, “I was able to do, instead of public presentations, online PDF’s and PowerPoint presentations” (personal communication, (October 7, 2017). She continued, “I loved to be able to produce my thoughts in PowerPoints and do visual diagrams. I loved how my teacher let me submit my work. That was very enjoyable” (personal communication, October 7, 2017). These assessment techniques would fall into the differentiated instruction framework which allows instructors and students to work together to find appropriate ways to demonstrate knowledge.

Participant R stated, “people were frustrated with the one class, where we didn't have a lot of contact with the faculty” (personal communication, September, 28, 2017). All participants, felt more comforted and supported when faculty provided regular and constant feedback.

Sometimes a person may need to take supplemental coursework as a requirement for continued employment in a specific career area. Participant W said, “It's a requirement of my credentials to do continuing education,” (personal communication, December 19, 2017). She indicated that learning about computers as part of her previous graduate school program did not anticipate the uses of the World Wide Web for training. Participant W said, “I went to graduate school in the 80s so it was still a very new thing” (personal communication, December 19, 2017). She also spoke to the isolation issues discussed by participant U. Participant W said, “You learn as much from colleagues as you do from the professor. The professor is kind of a catalyst for the learning. So, I missed that interaction” (personal communication, December 19, 2017).

Personal. Several of the participants used the experience with web-based instruction for personal education. Participant T engaged in activities to obtain an Oregon boating license. Participant V engrossed in a PowerPoint class for personal interest. Participant Y took classes in HTML and Cascading Style Sheets. Participant Z attended classes from the NMSS to help manage MS symptoms.

Mobility issues were mentioned by many of the participants. Participant V said, “I couldn't walk over across the quad or get to the class. You know, I could drive up to, in the parking lot and then I'd be stuck. I wouldn't have enough energy to get to the class" (personal communication, December 15, 2017). Participant T indicated that travel to campus and classrooms was difficult and that web-based classes provided some benefits. He said, "It took me 30 minutes to drive to college. I'd rather just sit at home. Do something online; honestly; in my pajamas, whatever" (personal communication, October 20, 2017).

Not only could learning be brought to students, but expert knowledge and skill can be brought to places that do not have the necessary specialists. Participant Z said,

> You know, one of the other advantages that just hit me in terms of web-based instruction is being able to hear and learn from professionals who may be at a distance, and that otherwise you wouldn't have access to their specific expertise. (personal communication, January 26, 2018).

Participant Z and others, found the lack of travel beneficial. She said, "I can't drive at night, and I can't drive long distance. I can participate in programs that otherwise I might not be able to if I had to drive to them. So, I'm thankful for the web-based" (personal communication, January 26, 2018). Travel to a classroom may involve a cane, walker, wheelchair or some other assistive device. The web-based learning opportunity can be a huge benefit for disabled people. Assistive devices can help disabled students move from place to place, but web-based learning environments appeared easier than accessing traditional classrooms if the personal interaction was not a desired part of the web-based learning environment.

Employment

The second classification identified responses related to employment. The term ‘work’ was used forty-nine (49) times and appears in thirty-five (35) of the one-hundred forty-four (144) questions. The terms ‘employer’ (3), employment’ (1), ‘worked’ (9), ‘works’ (4), ‘workforce’ (1), and ‘working’ (19) also appeared in the responses to questions. Many of these terms did not relate to the topic here, and many did. For example, Participant R said, “I knew for the computer classes, that would work for what I needed to accomplish” (personal communication, September 28, 2017). This statement did not deal directly with employment.

Many participants did not have employment that met their work goals. MS can produce symptoms that interfere with many workplace undertakings. Strober et al. (2012) said, “One of the most devastating consequences of MS in this relatively young population group is unemployment”. However, Participant V found that web-based classes could expand employment opportunities. She said, “Well, the Photoshop class, I went out looking for it, because I just felt that I wanted to learn more about that particular program, and if I had more, or better skills at work, I could have funner things to do” (personal communication, December 15, 2017).

Some web-based coursework can prepare students for future career prospects. When asked if the web-based coursework was preparing for new work opportunities, Participant Y said, “It's something that I've thought about. It's something that I feel is within my range of capabilities and it's one of the reasons I was interested in pursuing specifically that HTML course” (personal communication, November 4, 2017). Participants S and X were able to complete degrees that prepared them for careers in the criminal justice and engineering fields respectively.

Participant Z was working in behavioral health care when MS symptoms affected work. She said, “I was working in behavioral health care at the time” (personal communication, January 26, 2018). Participant Z also said. “When Internet access became something that the general population was doing, and I know that I will be entering the workforce, that was a skill I wanted to develop” (personal communication, January 26, 2018). While web-based instruction was not available when Participant Z was in school, there have been many occasions the tool has helped professional and personal knowledge acquisition. She said, “So, since I had acquired basic knowledge in how to use computers, that made it easier for me to take the class in graduate school” (personal communication, January 26, 2018). Participant Z was able to use computer knowledge to help with licensing differences between two states. She said, “The credential requirements were different in the state of Ohio. I was not working at the time, because of health issues. I thought, if I improved, I want to be able to generate income” (personal communication, January 26, 2018).

Web-based classes can also help provide other workplace skills and support future instructional needs. Participant V indicated that previous employment training helped use of web-based instruction. He said, “The previous experience would be course training like harassment or conduct training as part of our work" (personal communication, December 15, 2017).

Many people who develop MS fall out of the workplace due to disease symptoms. It can be difficult to maintain current skills or learn new ones when physical disability makes attending these classrooms impossible. Web based education may provide a new avenue for people with MS to rejoin the work force, develop new skills, and gain the social benefits that a job can provide.

Learning

The third, classifies responses related to modes of learning. The terms 'learn' (35), 'learned' (13), 'learner' (3), 'learners' (1) and 'learning' (51) were used one-hundred, three (103) times and appeared in sixty-eight (68) question responses.

Participant T was able to successfully learn licensure requirements for boat safety using web-based instruction. He described the experience as, "It's basically six different lessons, each an hour long. I probably did one a day; and you just get a video presentation. You get multiple choice questions at the end" (personal communication, October 20, 2017). Being able to repeat sections and complete the course at your own pace was beneficial. Participant Y also mentioned the benefits of self-paced instruction. He said, "You could repeat it in the case that you weren't comfortable" (personal communication, November 4, 2017). While none of the participants specifically mentioned spaced learning, this technique to improve learning was available in each learning environment.

Participant S said, “You could listen to it again at a later date, if you wanted to. So, you could repeat the class” (personal communication, October 7, 2017). The ability to repeat content is often a benefit mentioned by students of web-based classes.

Participant T also reported that while having an overall positive feeling about the web-based resources to obtain Oregon boating licensure, it was a bit frustrating that the user could not control content delivery speed. Participant T said, “I couldn't advance at my pace. I had to wait” (personal communication, October 20, 2017). The use of specific presentation features could be limited by the course management system or by decisions made by the course designer or instructor.

Participant S indicated that the Montessori school experience helped make the transition to web-based instruction easier. Her training in criminal justice was all web-based. Participant S said, “Kind of teach yourself at your own pace. And so, I had to learn how to read from textbooks, interpret it, and do math problems” (personal communication, October 7, 2017). She was skeptical regarding returning to the workplace. Participant S also said, “Unfortunately, I think that this does work against any shot at having a normal career, because I don’t think that if I get 100% better I’m ever going to just go in to work 9-5” (personal communication, October 7, 2017).

Participant R compared the type of faculty interaction in two web-based classes. He said,” I had one faculty that you wouldn't get a response until the beginning of the next week, no matter when you sent it” (personal communication, September 28, 2017). Participant R also said about a different web-based instructor, “The faculty member looks at it and you get almost instant feedback and a lot of praise" (personal communication, September 28, 2017).

When Participant U was informed about collaborative features provided by modern course management systems, there was interest in the framework. He said, "If a class, like you said, you're taking on my computer, I could go join a group of people, I'd be very inclined to maybe put out the energy it would take to go join that group" (personal communication, December 19, 2017). These tools are becoming integral to workplace environments. On August 1, 2018, I was discussing work with an electrical engineer and was told that about four hours of the day was spent conferencing with multiple people using Skype.

Participant Y indicated that the computer provided distractions for the use of web-based instruction. He said, "Because it's literally right next to the thing that I'm working on learning. I just have to press one button and I can go to be entertained. That is probably the most difficult thing" (personal communication, November 4, 2017).

Participant W shared that having MS symptoms can affect work, home, and family life. She said, "Well, I suppose fatigue would cause a problem, because I had MS and I could only study so much at a time. Plus, I was working full time" (personal communication, December 19, 2017).

Portable document formatted (PDF) files, Microsoft Word documents, and presentation graphic files such as Microsoft PowerPoint can be exchanged between student and instructor in the teaching and evaluation processes.

Social Engagements

The fourth, classifies responses related to reactions to various social engagements. The terms ‘talk (11), talked’ (4), ‘talking’ (25), ‘listen’ (11), ‘listened’ (1), listening’ (7), ‘social’ (9), ‘socialization’ (1), ‘engage’ (2), ‘engaged’ (3), ‘engagement’(2), ‘engaging’ (3), ‘dialogue’ (3), ‘communicate’ (2), ‘public’ (2), ‘participate’ (2), and ‘participation’ (1) were used eighty-nine (89) times in the interviews and appeared in seventy-nine (79) responses.

Course management tools can be available to allow immediate interaction between students and instructor. Blackboard has a collaborate tool that provides immediate video and audio communication. Instructors can provide a traditional lecture, and students can use the ‘raise their digital hand’ button to interact with the instructor. Student to student communication could occur through the presenter, text-based or phone-based technologies. Tools such as this could create web-based versions of traditional classrooms. Webinars, a technology not mentioned by interviewees, will often include a leader that can gather text-based questions from participants and feed them to the presenter when appropriate and if time allows.

Sometimes, specific MS symptoms can make accessing course content difficult. For example, if a person has specific MS symptoms, such as eyesight problems, hearing issues, bladder, walking or balance trouble they may have a difficult time interacting with traditional and web-based learning. However, some course management systems can provide multiple access points for their content. Visual and auditory delivery modes are commonly used for interaction between content and people. Tactile devices can also be used for printing and typing information. Web-based learning environments are preferred to classroom-based if the student has difficulty walking or driving to campus. Participant S stated, “Some days I don’t walk. I usually don’t sleep two nights out of a week. Seems to be my life” (personal communication, October 17, 2017). In regards to web-based learning, Participant Z said, “I think it decreased fatigue by not having to drive to school and to walk around to deal with people” (personal communication, February 4, 2018). All 9 interviewees, stated a benefit to fatigue or mobility symptoms of web-based learning environments.

Most course management systems will allow flexible interaction with content and people at the user’s discretion. The same flexibility may not be available in traditional classrooms. Students can leave messages for one or multiple people. These messages could be delivered through text, audio, video, wiki, blog, discussion areas, whiteboard, or other, depending on the tools available in the course management system. Participant R indicated “A lot of it was done through video demonstration” (personal communication, September, 28, 2017). However, Participant W said, “There were videos and they were designed to have audio, but audio was not available at my workspace. But there was text underneath to compensate for that. So, it was user friendly” (personal communication, December 19, 2017). Specific computers may provide access to software and hardware for accessing multimedia and other content.

Depending on the content delivery tools provided by the specific course management system and those utilized by the course designer and by the instructor, specific modes of communication may or may not have been available. Participant Y, for example, said, “It was all text. And actually, I preferred it that way” (personal communication, November, 4, 2017). Text can be made larger or smaller to meet user preference. And many computers have software that can read text for people with MS that have visual impairments. Other assistive technology can be provided by Braille keyboards and printers. None of the participants indicated use of these technologies, however.

The mode of communication is often different in a web-based class than a traditional classroom. Because of the lack of immediate interaction between students and instructor, some people have difficulty even considering web-based instruction as a replacement for classroom-based instruction. Participant U said, “I was basically disappointed, without the humanity that's in a classroom” (personal communication, December 19, 2017). He was hoping for the same immediate, interaction between students and instructor provided in a classroom-based learning environment. Participant U also said, “If I was sitting among other people, I would just ask people, ‘Could somebody explained to me this chart; I don't get it’" (personal communication, December, 19, 2017). By the time a peer responds to a blog, or e-mail question, the poster may have forgotten the request for help and never reads or receives a response. It’s more difficult to brush people off when you are talking directly to them. Participant Z stated,

> In the classroom setting, you can learn from and discuss with other students and you can ask the instructor questions at the time or get more information; if there's something you don't understand. You really can't do that in the same way with the web-based classroom (personal communication, February, 4, 2018).

I reported in narrative form and appendices the findings gathered from nine interviews of web-based instructional experiences. The data provided a composite of the participant responses. This summary will highlight the major findings of this study organized by research question.

Key Findings for Research Question 1

Research Question 1 was, What web-based technologies do people with MS use for learning? Key findings were

- All participants successfully used their Blackboard, Moodle, or propriety course management systems to engage in multiple learning activities.
- All participants used e-mail to communicate with peers and instructor, while the course instructor used e-mail and video to communicate to learners.
- No one mentioned telephone or collaborative systems for communication.
- One interviewee mentioned a face-to-face communication with their web-based course instructor.
- One interviewee mentioned accessibility issues with WebCT course management system.

Key Findings for Research Question 2

Research Question 2 was, How do people with MS interact with the Web-based learning technologies they use? Key findings were

- All nine participants learned from their experience with web-based instruction.
- All nine participants liked the ability to learn from home, especially by limiting travel to a traditional and sometimes inaccessible classroom.
- Many of the nine participants found benefits of home learning; easy access to bathroom and other accessibility items.
- All nine participants were able to use various ways to interact with the course content, peers and instructor.
- All nine participants had positive comments about video and e-mail.
- Vision and eyesight difficulties did not appear to be an MS issue that the nine interviewees experienced, but others might.
- Several of the nine participants mentioned the isolation experienced with web-based instruction.
- All nine participants identified either professional or personal motivations for participation in their web-based class.
- Many participants identified work benefits to web-based classes.
- Some of the nine participants reported technical and environmental issues with web-based instruction.
- Most of the nine participants were able to socially interact with peers using e-

mail.

- Two participants disliked the lack of personal contact in web-based classes.
- One interviewee thought that collaborative tools could mitigate these isolation feelings.
- Most of the nine participants found that frequent feedback from faculty increased their success.
- Most of the nine participants indicated that they would be interested in taking another web-based class in the future.

Discrepant Cases/Nonconforming Data

The literature review did not report research directed to people with MS and their web-based learning experiences. The specific search terms were even repeated several times over a 6-year period of time, to confirm research findings. Initially, I did not recognize issues with this research’s data collection technique. After-the-fact, I was concerned that while these results may be typical for sighted, English speaking participants, the study’s invitation flyer may not have been appropriate for a person who had eyesight difficulty. Also, people with language or cultural differences may have been inadvertently excluded. These two conditions can appear with people with MS. Therefore, these results may hold true only for sighted, English speaking individuals with MS.

Summary

In general, this research documents the successful use of web-based learning environments by people with Multiple Sclerosis. While some interviewees identified characteristics of their web-based instruction that could be improved, these suggestions were easily implementable. This research also uncovered some recommended design strategies for helping this population better access these learning environments. Chapter 5 will include a discussion of these and will discuss interpretations of the findings, limitations of the study, recommendations, and implications of this research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to investigate how people with MS use web-based learning. For the research I used a specialized type of case-study design known as an interview study. Data were collected from nine adults with MS between 18 and 72 years of age in the local area. Participants had taken at least one web-based class and agreed to share their experiences and feelings about web-based learning as part of this research. Their classes used various management systems such as Moodle or Blackboard. All participants said they might take another web-based class in the future.

Participants had mostly positive reports about their experience, although they also mentioned a few important disadvantageous features of their web-based classes. Many participants felt alone and disconnected from the class, peers, and instructors using only e-mail to communicate. Video presentations communicated course content to students; however, one participant shared that the computer-generated voice accompanying some videos was difficult to understand. A conclusion I drew was that instructors and designers need to investigate technologies that will help students feel more connected to their peers and instructors. In reviewing the literature, I found no previous research to explain how web-based learning environments are used by people with MS. Thus, this research extends knowledge as described in Chapter 2.

Interpretation of the Findings

This research reveals that people with MS had mostly positive experiences in regard to their web-based instruction. These experiences are supported by Chapter 2 concepts of differentiated instruction, constructive learning, and assistive technology. My research extends previous research regarding the use of web-based instruction with people with MS disabilities. The first finding is that web-based learning can provide access to new personal and professional education for people with MS. The second finding is that familiarity with and access to technologies such as e-mail and video can help students with MS who are taking web-based classes. The third finding is that the many symptoms of MS can influence a person’s ability to access face-to-face and web-based learning.

The first finding is that web-based learning can provide access to personal and professional education for people with MS. These learning environments can be considered differentiated instruction, when they provide various amounts of time flexible instruction and evaluation as conjectured by Darrow (2015). These systems also support the knowledge and skill building of learners with MS. Physical limitations that developed with their MS could hamper their access to traditional classrooms (Nielsen, & Kinkel, 2012). This access-issue was eliminated by using web-based learning. All participants shared the positive aspects of web-based learning for themselves as persons with MS.

The second finding is that familiarity with and access to technologies such as e-mail and video can help students with MS access educational frameworks. E-mail provides a way for asynchronous communication between students and instructor and allows a student to constructively learn to build new knowledge and meaning as supported by research of Dewey (1938) and Ruey (2010). Participants stated that video allowed instructors to communicate course objectives to students. Video was not mentioned as a way for students to communicate with instructors or other students. This may be because instructors are concerned with using technologies that students do not have readily available. However, many students do have access to a computer, cell phone, tablet, or other computer device capable of video capture and sharing (Beal-Alvarez, & Cannon, 2015; Moore, Vitale, & ACT Center for Equity in Learning, 2018). Many MS-related symptoms can pose barriers to interacting with traditional classes, but web-based classes provide educational opportunities with fewer obstacles.

The third finding is that the many symptoms of MS can influence a person's ability to access face-to-face learning environments. Access to face-to-face classes can be very difficult, especially if your MS symptoms limit your physical movement and communication ability. All participants were able to successfully transition to the asynchronous learning environment of web-based instruction. Web-based learning provides assistive technology that helps students with MS engage in educational activities when access to classrooms is difficult or impossible as discussed by Asselin (2014) and Raskind and Higgins (1998).

In reviewing study findings, I determined that web-based learning can have positive impact for adults with MS by providing instructor delivered differentiated instruction, student generated constructive learning, and web-based assistive technology. This study also clarified that web-based learning can provide educational opportunities accessible to some people with MS symptoms such as muscle weakness, lack of balance and coordination, numbness, fatigue, pain, and loss of sensation. However, web-based courses have different types and levels of social interaction between students and instructor. One interviewee stated that something was missing from web-based courses. Another interviewee mentioned that student-student interaction can influence learning as much as instructor-student interaction. Statements like these indicate that web-based instruction is not perfect but can provide learning opportunities for people with MS. I recommend that further exploration be done to build on these findings to improve access to quality education for people with MS.

Limitations of the Study

I gathered information from a small sample in a relatively small region. I interviewed participants face-to-face. Had I distributed a survey, I would have been able to involve a larger population and sample. The experiences of other cultures could be valuable to determine if the experience of this small sample of participants is truly universal.

I sought out adults between 18 and 72 years of age for this study. However, I might have been able to gather helpful information by expanding this age range. Many U.S. high schools have web-based instruction opportunities (Morgan, 2015). The perspectives of children who have MS, while small in numbers, could inform the design of these systems. The same could be true for those older than 72 years.

Recommendations

I recommend a survey be developed to query a larger population of people with MS. In this study I asked for volunteers, and while their experiences may reflect the use of web-based learning by some people with MS, it does not reflect the experiences of all people. A study that includes a survey might reach a larger population of people than this interview study was capable of reaching.

Implications

This research can benefit individuals with MS, learning institutions, doctors, hospitals, family, and other support systems and people.

Positive Social Change for Individuals

Individuals with MS can be reassured that web-based instruction might be an option for learning new skills and knowledge. This instruction may include new information regarding MS and its treatments or work and personal attainment. Several interviewees were able to complete degrees, and all participants could schedule web-based classes for personal achievement. Also, each participant's specific MS symptoms may have hampered her or his course completion, but the flexibility that is present with many web-based classes made it easier to manage many specific disease symptoms.

Positive Social Change for Learning Institutions

Those who design and teach web-based classes need to be aware of the variety of MS symptoms that may make use of the content difficult for people with MS. Institutions should work with their disabilities office to review accessibility of web-based content. Institutions can also promote creation of content that would be accessible for people with MS. They can also help instructors to provide learning venues that attract students with MS and other physical challenges.

Positive Social Change for Support Systems

Doctors, and health care providers can support people with MS by connecting them with appropriate learning opportunities. These could be related to MS and its symptoms, ways to increase a person's quality of life, or appropriate work opportunities. These prospects could be web-based courses to support previous learning or ways to gain new skills and knowledge. While the social benefits of a face to face class can be important, web-based learning venues have helped the people I interviewed manage symptoms such as fatigue, pain, coordination and balance, and incontinence issues.

Conclusion

Multiple Sclerosis is an autoimmune disease that affects more than 400,000 people in the United States. Approximately 70-80% of these become unemployed within five years of their diagnosis (Bøe Lunde, 2014; Strober, et.al, 2012)). If about 300,000 are not working and the average Federal and State taxes paid by each of these people is $10,000, then this would represent about $3 billion annually in lost revenue for the United States. These totals do not include the cost of unemployment, disability, insurance, and other support that these people may need in order to live. In addition, these numbers only represent a shadow of the physical, mental, and emotional consequences of this disease for individuals, family, and friends.

However, if web-based instruction can assist even half of these people in obtaining or maintaining their occupation, $1.5 billon can be returned to the U.S. infrastructure and fewer dollars would be spent to support the lives of these people. In addition, the individual and social benefits of gainful employment may support the physical, mental and emotional wellbeing of our neighbors with Multiple Sclerosis.

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Appendix A: Participant Interview Questions

I. Education:

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1. Please tell me the title of the web-based class you took?
2. Please tell me what situation brought this web-based class to your attention? (Public media, friend/family, printed advertisement)
3. Tell me about the web-based class that you took?
4. How did taking this web-based class make you feel?
5. What previous experiences prepared you for or hindered you for taking this class? (High school/college class, learning preferences, other Web-based coursework)
6. What class structures in this web-based class were positively motivating and why? (Course content, course structure, friend/family influence, work requirement)
7. What class structures in this web-based class were a hindrance for you and why? (Course content, course structure, friend/family influence, work requirement)
8. Please share, if you are comfortable, how the online course did or did not help with MS symptom management.
9. In what ways do your MS symptoms influence (facilitate or challenge) your interaction with Web-based education?
10. In what ways do your MS symptoms influence (facilitate or challenge) your

interaction with face-to-face (traditional) education?

11. In what ways is a web-based class more difficult for you?
12. What technologies in this web-based class made learning easier or more difficult for you?
13. What technologies would you look for in web-based classes you might take in the future?
14. How do you think you would feel if you took another web-based class?
15. Are there any other things you would like to share regarding web-based or face-to-face (traditional) educational experiences as they relate to your MS?

Appendix B : Participant Demographics

Participant	Interview date	Interview location	Interview length (minutes)	Gender
R	9/28/17	MHCC	37	Male
S	10/7/17	Park Bench, Salem	24	Female
T	10/20/17	MHCC	36	Female
U	11/4/17	Fort Vancouver	28	Male
V	12/18/17	Church	20	Male
W	12/19/17	Participant’s home	36	Male
X	12/19/17	MHCC	32	Female
Y	1/26/18	Participant’s home	53	Female
Z	2/4/18	Participant’s home	68	Female

Appendix C : Axial Codes

Number	Code title
1	Assistive technology
2	Bladder & bowel issues
3	Cognitive fatigue
4	Other cognitive issues
5	Constructive learning
6	Depression issues
7	Differentiated instruction
8	Employment issues
9	Fatigue issues
10	Group issues
11	Home & lifestyle issues
12	Instruction
13	Knowledge
14	Living issues
15	Pain
16	Paralyses
17	Peer sharing and communication
18	Psychological issues
19	Skills

20	Strength & balance issues
21	Stress issues
22	Touch issues
23	Traditional education issues
24	Vision issues
25	Web-based learning issues