Experiences of Using Intelligent Virtual Assistants by Visually Impaired Students in Online Higher Education

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Experiences of Using Intelligent Virtual Assistants by
Visually Impaired Students in Online Higher Education

by

Michele R. Forbes

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Curriculum and Instruction
with a concentration in Career and Workforce Education
Department of Leadership, Counseling, Adult, Career and Higher Education
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Keywords: artificial intelligence, assistive technology, disability-related stress, dis(ease)ability theory, social model of disability, students with disabilities

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# TABLE OF CONTENTS

List of Tables ........................................................................................................................................ iv

List of Figures ......................................................................................................................................... v

Abstract .................................................................................................................................................. vi

Chapter One: Introduction ..................................................................................................................... 1
   Statement of Problem ......................................................................................................................... 3
   Purpose of Study ................................................................................................................................. 5
   Theoretical Framework ....................................................................................................................... 6
   Significance .......................................................................................................................................... 10
   Limitations ........................................................................................................................................ 11
   Definition of Terms ........................................................................................................................... 12
      Academic Stress ................................................................................................................................ 12
      Accessible ......................................................................................................................................... 12
      Artificial Intelligence ...................................................................................................................... 12
      Assistive Technology or Device ..................................................................................................... 12
      Barriers ........................................................................................................................................... 12
      Disability ......................................................................................................................................... 13
      Dis(ease)ability Theory .................................................................................................................. 13
      Effort ................................................................................................................................................ 13
      Intelligent Virtual Assistant .......................................................................................................... 13
      Reasonable Accommodation .......................................................................................................... 14
      Social Model of Disability .............................................................................................................. 14
      Visual Impairment ........................................................................................................................... 14
   Summary ............................................................................................................................................ 14

Chapter Two: Review of Literature ........................................................................................................ 17
   Workforce Preparation for Students with Disabilities ..................................................................... 18
   Online Higher Education ............................................................................................................... 26
   Academic Stress and Students with Disabilities ............................................................................... 34
      Time-Management .......................................................................................................................... 38
      Effort Put Forth ............................................................................................................................... 40
   Access to Instructional Materials ..................................................................................................... 42
   Artificial Intelligence and Intelligent Virtual Assistants .................................................................. 43
      Academic Purposes ........................................................................................................................ 50
      Non-Academic Purposes ................................................................................................................. 52
   Advantages and Limitations ............................................................................................................. 55
   Summary ............................................................................................................................................ 56
Chapter Three: Research Procedures and Methods ....................................................... 59
  Research Design ........................................................................................................ 61
  Context and Participants ............................................................................................ 64
  Data Collection and Instruments ............................................................................... 67
    Demographic Questionnaire ...................................................................................... 67
    Semi-Guided Interview .............................................................................................. 69
    Semi-Structured Journal ........................................................................................... 70
  Data Analysis ............................................................................................................... 73
  The Reflective Researcher ............................................................................................ 76
  Summary ...................................................................................................................... 79

Chapter Four: Research Findings .................................................................................... 81
  Sample Demographics ................................................................................................. 82
  Intelligent Virtual Assistant Features Used ............................................................. 86
    Academic Purposes .................................................................................................... 88
      Language ............................................................................................................... 89
      History & Social Studies ......................................................................................... 90
      Mathematics, Science & Technology ..................................................................... 91
      Research & Knowledge Acquisition ...................................................................... 93
      Teaching & Presentations ....................................................................................... 96
    Non-Academic Purposes .......................................................................................... 96
      Communication ........................................................................................................ 97
      Entertainment ......................................................................................................... 99
      Health & Wellness ................................................................................................. 101
      Daily Living ............................................................................................................ 102
      Organization .......................................................................................................... 104
  Experiences in Using Intelligent Virtual Assistants .................................................... 106
    Accuracy .................................................................................................................... 107
    Convenience ............................................................................................................. 108
    Familiarity ................................................................................................................ 109
    Helpfulness .............................................................................................................. 110
    Outlook ..................................................................................................................... 111
    User-Friendliness .................................................................................................... 112
  Intelligent Virtual Assistant Use to Mitigate Disability-Related Stress ................... 113
    Improve Accessibility ............................................................................................... 113
    Streamline Processes ............................................................................................... 116
    Manage Time ........................................................................................................... 117
  Summary ..................................................................................................................... 118

Chapter Five: Conclusions and Discussion ....................................................................... 121
  Interpretations and Conclusions ................................................................................ 121
    Intelligent Virtual Assistant Features Used ........................................................... 122
    Experiences in Using Intelligent Virtual Assistants ............................................... 126
    Intelligent Virtual Assistant Use to Mitigate Disability-Related Stress .................. 131
  Discussion .................................................................................................................. 134
    Implications ............................................................................................................. 140
Future Research .......................................................... 143

References .......................................................................................... 147

Appendix A: Collaborative Institutional Training Initiative Certification ............................................. 158

Appendix B: National Institutes of Health Certification ................................................................. 159

Appendix C: Institutional Review Board Approval ........................................................................... 160

Appendix D: Consent Form .............................................................................................................. 162

Appendix E: Demographic Questionnaire ......................................................................................... 165

Appendix F: Semi-Guided Interview Protocol ................................................................................... 168

Appendix G: Semi-Structured Journal ............................................................................................ 170
LIST OF TABLES

Table 1  Soft Skills for Self-Advocacy ................................................................. 23
Table 2  Sample Alexa Skills ............................................................................. 53
Table 3  Demographics by Diagnosis ................................................................. 83
Table 4  Frequency of Preferred Virtual Assistants by Device Type ................. 84
Table 5  Participant Profiles ............................................................................. 85
Table 6  Disability-Related Stressors ................................................................. 114
LIST OF FIGURES

Figure 1  Combining the Social Model of Disability and the Dis(ease)ability Theory.................. 9
Figure 2  Frequency of Categories by Purpose ................................................................. 87
Figure 3  Frequency of Academic Features by Category..................................................... 88
Figure 4  Frequency of Non-Academic Features by Category............................................... 97
ABSTRACT

In today’s world, the attainment of higher education impacts the acquisition of competitive employment and, thus, quality of life. As a group, persons with disabilities continually fall behind others in such academic progress, requiring new efforts to support their earning of advanced credentials. Though highly beneficial for these individuals, obtaining a degree comes with elevated levels of stress. As enrollment of students with disabilities grows in all formats of higher education, those involved must understand the stress endured by these students and how to diminish it. Theories speculate that technology, such as intelligent virtual assistants, may be a viable tool for reducing such stress, thus increasing the completion of higher education by these individuals. A qualitative approach informed by three instruments—a questionnaire, an interview, and a journal entry—was utilized to examine this philosophy, focusing on the features used and for what purposes, the experiences had, and how this technology is used to mitigate disability-related stress. The research found that virtual assistants may assist in reducing the barriers and stress that often deter individuals with visual impairments from acquiring higher education, whether online or face-to-face. This technology was shown to increase the independence, autonomy, and social integration of these individuals while decreasing limitations. The fields of education and technology may use this evidence to optimize such benefits, thus increasing the use of virtual assistants by students with visual impairments and, subsequently, increasing their attainment of higher education and competitive employment.
CHAPTER ONE:
INTRODUCTION

In today’s economy, the attainment of higher education proves beneficial, if not necessary, for the acquisition and retention of competitive employment (Moya et al., 2017). Carnevale, Smith, and Strohl (2013) predict that, over the next few years, 65% of all available jobs will require postsecondary education. One population that continually falls behind in educational attainment is that of persons with disabilities (Bureau of Labor Statistics [BLS], 2018). The National Center for Education Statistics [NCES] (2016) found that, during the 2011–12 academic year, only 11% of students enrolled in undergraduate education reported having a disability. Among those enrolled in higher education, attained degrees and completion rates vary. In 2017, the Current Population Survey (CPS) conducted by the U.S. Census Bureau, reported both educational attainment and employment-population ratios among individuals with and without disabilities (BLS, 2018). Of the 255 million individuals represented, approximately 11.9% were identified as having a disability. Within this smaller population, the highest education achieved was reported as follows: 34.1% completed high school, 25.3% attended college up to an associate degree, and 17.7% earned a bachelor’s degree or higher. Employment rates corresponding to each of these attainment levels were 15.2%, 22.1%, and 27.6%, respectively. These facts indicate the need for new efforts to support the attainment of higher education credentials by individuals with disabilities.

As the pursuit of higher education through traditional means is fraught with obstacles for
many, distance education has become a viable alternative (Betts et al., 2013; Woods, Maiden, & Brandes, 2011). The NCES (2016) reported that undergraduate enrollment in distance education at postsecondary institutions doubled between the academic years of 2003-04 and 2011-12. Although no statistics directly related to the enrollment of students with disabilities in distance learning, NCES (2016) reported an increase in overall undergraduate enrollment of these students. According to Woods et al. (2011), a similar trend could be inferred for distance education as research shows similar levels of participation between the populations of students with and without disabilities within these educational formats. As enrollment of students with disabilities grows in all formats of higher education, it is imperative that those involved possess a deep understanding of the levels of stress—academic or otherwise—experienced by these students, as well as the contributing factors. Furthermore, it is essential that we examine ways in which such stress may be ameliorated or even eliminated for this particular student population.

Equality, accessibility, and the provision of accommodations have been hot topics in regard to the disabled population for many years. Over the past few decades, specifically, legislation has been put in place to protect these basic rights for individuals with disabilities. Although much of the current legislation was first implemented during the 1960s and 1970s, it has evolved over the years to expand the protection of the rights that all American citizens are entitled to, but have, in the past, been overlooked in regard to the disabled population. One example of legislation that protects the rights of individuals with disabilities is the Rehabilitation Act of 1973. This act is made up of several sections that pertain to various aspects of life, but two that are often relevant to education are Sections 504 and 508. Section 504 bars agencies that receive federal assistance, including institutions of education, from discriminating against individuals with disabilities that qualify to work for or participate in programs (Department of
Labor [DOL], n.d.). Section 508 pertains to the accessibility of information and communication technology, such as hardware, software, or services, owned and maintained by the federal government, whether for federal employees or the public at large (DOL, n.d.). To be deemed accessible under Section 508, information technology should be easily attended to by more than one sense either with or without the use of assistive technology (DOL, n.d.).

Another impactful piece of legislation protecting persons with disabilities is the Americans with Disabilities Act of 1990 (ADA). Best known for protecting individuals from discrimination, this law also pursues equality in rights and opportunities across all areas of life (Department of Justice [DOJ], 2009; DOL, n.d.). The ADA, like the Rehabilitation Act, is divided into sections. Titles I and II protect individuals with disabilities from discrimination in the private and public sectors, respectively (DOJ, 2009; DOL, n.d.). Under Title II, the public sector is required to provide any reasonable accommodations that do not impose undue hardship in their implementation (DOJ, 2009). Title III requires all businesses and non-profit service providers, including private schools and testing agencies, to provide accessible services or alternative arrangements to accommodate individuals with disabilities (DOJ, 2009).

Although not all disability legislation pertains to education, much of it has been used as a guideline within this realm. This is especially true of online education at the postsecondary level. Even so, inequalities and inaccessibility are often present within this area of education, unintentional as they may be.

Statement of Problem

An ever-present reality for students with disabilities is the existence of disability-related stress that occurs in addition to the general worries experienced by their non-disabled peers (Fuller, Healey, Bradley, & Hall, 2004; Hong, 2015; Moriña, 2017). Even more concerning is the
fact that such additional stress often causes students to perform at a lower level than they might otherwise and often results in withdrawal from a course or program of study prior to completion (Hong, 2015). Sanford et al. (2011) found that students with disabilities who had enrolled in a four-year college completed their program at a rate of 29.4%, while their non-disabled peers did so at 42.2%. Although there is little research that reports retention and completion rates of students with disabilities in online education, specifically, it is speculated that a similar trend is likely to exist within this delivery method (Betts et al., 2013). Armed with this knowledge, it seems imperative that factors leading to such statistics require attention. As the presence of a disability is frequently accompanied by the existence of related stress, both of which often consume the focus of the student (Fuller et al., 2004), this phenomenon may be a contributing factor for investigation. Specific disability-augmented stresses in academia that may be of consideration include time requirements and scheduling, level of effort and pace of progression, access to instructional materials and technology, distractions and agitators within the physical environment, imposed roles, and limited personal attention (Florida College System, 2009; Fuller et al, 2004; Hong, 2015; Moriña, 2017).

With the growing presence of artificial intelligence (AI) devices within the household, assistance for students with disabilities may be more readily available than ever before. Intelligent virtual assistants (IVAs), such as Amazon’s Alexa, Apple’s Siri, and Google Assistant, may have the capability to help alleviate disability-related stress experienced by persons with disabilities who are pursuing postsecondary online education. The use of simple features, such as alarms, reminders, calendars, search engines, and more may be the key to minimizing additional academic stress experienced by students with disabilities by making tasks
easier and quicker to complete, thus allowing them to concentrate on their education, achieve their goals, and reach their potential.

While existing literature provides insight into the existence of disability-related barriers within education, the amount of research regarding this topic as it relates to stress levels within online education is minimal. Furthermore, examination of the use of AI and IVAs to alleviate academic stress in education, much less postsecondary online education, seems to be a large gap in the existing research. To better understand the stresses students with disabilities experience in postsecondary online education and examine how artificial intelligence or, more specifically, intelligent virtual assistants may be used to minimize such stress, research within this specific realm must be conducted. The pursuit of such research may, subsequently, contribute to the knowledge base on advanced techniques that have the potential to diminish the existence of disability-related stress for students with disabilities in postsecondary online education, as well as in education, overall. By doing so, the research may take part in identifying a more cost-effective, efficient, and mainstream technique by which to increase the potential for the achievement of educational goals by these students.

**Purpose of Study**

This qualitative research aimed to examine the experiences of online higher education students with visual impairments in using artificial intelligence devices, known as intelligent virtual assistants. First, the study explored the virtual assistant features use by participants and for what purposes. Second, it investigated the experiences of participants as they worked with the technology, itself. And, finally, it examined how participants used this technology to mitigate disability-related stress. In an effort to reach the goals set forth, participants were asked to share their thoughts, feelings, and stories regarding the previous use of intelligent virtual assistant(s).
Three IVAs were considered within this study including Amazon’s Alexa, Apple’s Siri, and Google Assistant on either mobile (i.e., smartphone and tablet) or stationary (i.e., smart speaker) devices. In order to collect the data required for a comprehensive analysis, participants within the study were asked to complete a demographic questionnaire, a semi-guided interview, and a semi-structured journal entry regarding their prior use of and experience with currently or formerly owned virtual assistant(s).

In an attempt to achieve the purpose of this research and serve as a guide, I have created the following research questions:

1. What features of intelligent virtual assistants are used by higher education students with visual impairments?
2. What experiences are reported by higher education students with visual impairments in regard to using intelligent virtual assistants?
3. How do higher education students with visual impairments use intelligent virtual assistants to mitigate disability-related stress?

**Theoretical Framework**

In the world of disability studies, many theories and models have been proposed. For this study, however, the conceptual underpinning will be provided by the social model of disability, along with the dis(ease)ability theory. While each of these, individually, leaves holes in the theoretical framework within which this study is being conducted, the combination of the two successfully fulfills this need.

The social model of disability credits society with the creation and presence of a disability based on its response to an individual’s impairment (Brandon & Pritchard, 2011; Disabled World, 2017a; Donaldson, Chabon, Lee-Wilkerson, & Kapantzoglou, 2017;
At the core of this model is the view that the concepts of impairment and disability are individual and possess unique meanings (Haegele & Hodge, 2016). An impairment is considered, by the social model of disability, to be merely a physical or mental attribute, while a disability is interpreted as the limitation(s) placed on an individual by society (Donaldson et al., 2017). In this way, disabilities are seen as socially constructed, and the intensity of an individual’s functional limitations, in regard to participating fully in society, are dictated by actions and reactions of society as a whole (Disabled World, 2017a; Mitra, 2006). Furthermore, the social model of disability tasks society with the rectification of imposed disabilities by stating that society, at large, must make both environmental and attitudinal changes (Disabled World, 2017a; Haegele & Hodge, 2016; Mitra, 2006).

While I agree that social response is greatly accountable for the limitations placed on an individual, it is not my assertion that society is solely responsible for making all necessary changes in order to eliminate or reduce such limitations. Instead, I believe that this responsibility should be shared between society and the individual. In an attempt to mitigate this view with that of the social model of disability, I have also chosen to employ the views of the dis(ease)ability theory (Conversano, Manzulli, & Binacchi, 2012), which focuses its attention on the use of technology to assist in improving communication and learning for people with disabilities or disabling attributes, especially in regard to limiting the learning gap. Within this theory, Conversano et al. (2012) focus on the ability of technology to help individuals with disabilities overcome perceived and experienced limitations while increasing their potential for learning and communication. This theory aims to harness and utilize the power of technology to increase the autonomy of persons with disabilities, while better integrating them into society and, more specifically, the learning community (Conversano et al., 2012). While Conversano et al. (2012)
speak more from a pedagogical standpoint in which the theory is primarily implemented by a teacher in an attempt to enhance both the teaching and learning of students with disabilities, it is my assertion that the underlying ideas may be applied by anyone involved in any sector of educating such persons, including the individuals themselves.

As with the social model of disability, the dis(ease)ability theory does not focus on the disability as strictly being a deficit within an individual. Instead, this latter theory considers both internal limitations caused by an impairment and externally imposed limitations, such as fears, stressors, and social reactions (Conversano et al., 2012; Conversano & Manzulli, 2013). Further, this theory considers how the use of technology can assist in removing such obstacles within the learning environment, whether physical or virtual (Conversano et al., 2012; Conversano & Manzulli, 2013). Conversano and Manzulli (2013) also take into account disability-related stress experienced by the individual and advocate a shift of focus from what an individual with a disability is capable of doing alone to what that same individual could do with assistance from technology (Conversano et al., 2012).

As the current research focuses on the use of technology, the dis(ease)ability theory will take precedence, but, as displayed in Figure 1, the combination of this theory with the social model of disability will support the view that an individual’s functional limitations are not merely an internal side effect of an impairment, but, instead, are inflicted by the external environment, as well as social interactions with and reactions to that individual’s impairment. Although the social model strongly supports the rectification of this imposition by society as a whole—including the impaired individual, but implying an emphasis on the external society—the dis(ease)ability theory narrows this focus to the more immediate social environment of the individual. Social enlightenment about disabilities, as well as related needs, barriers, and effects
Figure 1. Combining the Social Model of Disability and the Dis(ease)ability Theory

is of penetrating importance throughout both the model and theory and, likewise, plays an
immovable role within this study. Furthermore, such enlightenment extends to the investigation
and implementation of methods that may assist in minimizing or nullifying functional limitations
of persons with disabilities. These last statements permeate the current study, as it strives to
educate those involved in online higher education in regard to all of the mentioned aspects.
Significance

As the economy becomes more competitive, the necessity for postsecondary education increases (Moya et al., 2017). Individuals with disabilities, an already disadvantaged group, would be even more so without the attainment of the required education. In many cases, traditional educational opportunities prove difficult or even impossible for this student population to take advantage of, thus, the presence of online education has been viewed as a potential alternative. Although this delivery method provides numerous benefits for these students, several disability-related stressors remain present.

While studies have been conducted to assess barriers and stressors for students with disabilities in educational settings (Erten, 2011; Florida College System, 2009; Hong, 2015; Moriña, 2017; Soukup & Feinstein, 2007), the literature pertaining specifically to online education remains thin. Further literature discussing the utilization of AI-based intelligent virtual assistants in postsecondary education is available in limited quantities (Phu, Fredrickson, & Meyer, 2016), but, again, overwhelmingly applies to more traditional delivery methods and not specifically regarding use for or by students with disabilities. As much of the research concerning students with disabilities is focused on traditional educational settings or education as a whole, the current study endeavors to provide further understanding of this population’s experience within online education. Furthermore, the study aims to examine the experiences of students with visual impairments when using AI-based intelligent virtual assistants to minimize the presence of stress within the online delivery system at the postsecondary level.

As the mitigation of disability-related stress plays a key role in the retention and completion rates of students with disabilities in higher education, it is imperative that this factor is understood, as well as achieved. This research intends to raise the level of disability awareness
among online education participants and provide enlightenment on how IVAs may aid in eradicating additional stress experienced by these students. Further, this research may contribute to the decrease of accommodations required in online courses, as well as the increase of on-time submissions and preparedness among students with disabilities. Finally, institutions will benefit from this research as it will assist in efforts to increase satisfaction, retention, and completion rates among students with disabilities in online education by evidencing the importance of minimizing disability-related stress experienced by students with disabilities.

Limitations

Although there is a great need for a study to be conducted that examines the utilization of and experiences with artificial intelligence-based virtual assistants in response to academic stress among online higher education students with visual impairments, having access to this specific population is challenging. As a result, it was not possible to use random sampling strategies within the current study, thus minimizing the transferability of the findings to the greater population. Such a reduced ability for transferability diminishes the direct impact of the research, but, instead, is hoped to elicit further research for substantiation.

As technology played a large role in this study, the levels of familiarity with and literacy in using intelligent virtual assistants were of initial concern. As the recruitment process and sampling strategies did not screen for such characteristics, it was speculated that the data collected could be rendered insubstantial, thus influencing the accuracy of the results. To minimize the potential for such an influence on the results of future research, it may be advantageous to implement measures that control for this variable. By doing so, a more accurate understanding could be gained of this population’s experiences when using the technology for assistive reasons, as well as the ways in which it is used.
Definition of Terms

To provide terminological clarity regarding vocabulary used within this study, the meanings of several terms are presented below.

Academic Stress

*Academic stress* refers to the presence of internal or external frustrations pertaining to the participation in and completion of academic tasks, often related to the concern of academic failure and triggered by a wide range of factors (Lal, 2014).

Accessible

To be deemed as *accessible*, a facility, program, or electronic resource must be available for use by any individual, whether through the implementation of assistive technology or not (Disabilities, Opportunities, Internetworking, and Technology [DO-IT], 2017).

Artificial Intelligence

*Artificial intelligence*, or AI, is a broad term that encompasses the act of investigating and creating technological systems that can imitate aspects of human intelligence, specifically learning and comprehension (Niveditha & Basavaraj, 2017).

Assistive Technology or Device

Any device, physical or electronic, that is used to help individuals with disabilities participate in everyday tasks is referred to as *assistive technology or device(s)* (DO-IT, 2017). Such tools attempt to enhance participation and well-being by improving individual functionality and independence (World Health Organization, 2018).

Barriers

The World Health Organization defines *barriers* as factors that impose limitations or disabilities on an individual (as cited in Centers for Disease Control [CDC], 2016). According to
the CDC (2016), barriers exist in many forms, including attitudinal, communication, physical, policy, programmatic, social, and transportation. For this paper, the term barriers will be used to discuss the existence of limiting factors in general and as a whole.

**Disability**

A *disability* is classified as the significant limitation of at least one major life activity of a person due to a perceived or documented physical or mental impairment (ADA Amendments Act, 2008). For this research study, visual impairments will be the disability of focus.

**Dis(ease)ability Theory**

The *dis(ease)ability theory* is a philosophy that focuses on the use of technology to decrease communication and learning limitations for students with disabilities (Conversano et al., 2012). This theory specifically views technology as a powerful tool for increasing the autonomy and social integration of these students within the learning community, thus limiting the learning gap (Conversano et al., 2012).

**Effort**

According to the *Oxford Living Dictionaries* (OLD), *effort* refers to physical or mental exertion (“Effort”, 2018). While the OLD, in their definition, indicates a level of difficulty in the exertion of effort (i.e., a strenuous exertion), this paper will use the term to mean any level of exertion put forth.

**Intelligent Virtual Assistant**

Called by many names (i.e., digital assistants, intelligent agents, chatbots), an *intelligent virtual assistant*, or IVA, is an application or software that exists on electronic hardware (i.e., computer, tablet, smartphone) and interacts with humans through natural verbal exchanges (“Virtual assistant”, 2017). IVAs, such as Amazon’s Alexa, Apple’s Siri, and Google Assistant,
have the ability to carry out several daily tasks, including answering questions, adding events to calendars, setting timers and alarms, providing reminders, and more (“Virtual assistant”, 2017).

**Reasonable Accommodation**

A *reasonable accommodation* is a common label that refers to any temporary or permanent modification made that enables an individual with a disability to fully function within a particular situation, including adjustments to facilities, equipment, materials, or schedules (ADA Amendments Act, 2008).

**Social Model of Disability**

The *social model of disability* is a well-supported philosophy within research that views society as imposing limitations on individuals with impairments, thus causing disabilities (Donaldson et al., 2017). To achieve greater social integration of these individuals, the model emphasizes the need to remove socially imposed limitations through social change regarding both environment and attitude (Disabled World, 2017a; Haegele & Hodge, 2016; Mitra, 2006).

**Visual Impairment**

A *visual impairment* is a medical condition that refers to a wide variety of disorders impacting the vision, which is not correctable with contact lenses or eyeglasses (Disabled World, 2017b). A visual impairment, or visual disability, may come in many forms, such as total blindness, low vision, color blindness, and blurred vision, and affects one’s ability to complete daily living tasks (Disabled World, 2017b).

**Summary**

While understanding the problem at hand and having a clear plan by which to proceed is imperative in a research study, it is only the first step. As the saying goes, ‘to move forward, we must first understand the past.’ Within qualitative research, this sentiment applies to both the
research, as well as the researcher. Just as we have become familiar with the basic nature of the problem requiring attention, we must also familiarize ourselves with the person who endeavors to attend to this problem through conducting the study at hand.

Chapter 1 has provided a brief background of the situation and the underlying rationale for which to pursue the current study. Research supports the growing need for career preparation of all individuals, including those with disabilities, but alternative methods may be required. As you will learn in Chapter 2, research suggests that higher education plays an important role in the workforce preparation of individuals with disabilities, but, due to a variety of obstacles, such as those mentioned earlier, these individuals often turn to distance or, more specifically, online education as a viable alternative. Even though online education has been found to be a practical option for this student population, the existence of disability-related stress remains a concern. It is, then, suggested that we turn to technology, specifically intelligent virtual assistants, to help mitigate such stress, thus thriving to improve the retention and completion rates of students with disabilities in higher education.

To understand the motivation behind any study, it is important to become acquainted with the identity of the researcher and gain an understanding of his or her connection to the topic at hand. As an educator with a visual impairment, myself, I have a significant personal and professional interest in learning more about how technology may be used to minimize disability-related stress. Throughout my educational and professional careers, I have interacted with an array of technologies in an attempt to alleviate the stress placed on my eyes, my mind, and my body as a result of my impairment. Over the past few years, I have become familiar with intelligent virtual assistants and have integrated them into all aspects of my life. In utilizing this technology to complete a variety of tasks, both personal and professional, I have found a
beneficial tool. This experience has triggered the desire in me to learn more about this technology, including how it may be used by individuals with disabilities in education and their experience in using it. In an attempt to construct a strong foundational understanding of my interest, as the researcher, in the topic of study, a more in-depth section of reflexivity will be presented in the third chapter of this paper.

Finally, possessing a solid grasp of what previous research has to offer assists in laying the contextual groundwork upon which new research can build. To provide such context for the current study, I have endeavored to gather and review appropriate documents chronicling relevant studies within the existing literature. As the topic at hand is very specific and gaps within the existing research have previously been noted, the search for relevancy was expanded to include literature that is indirectly related to the topic. Studies associated with students with disabilities in any educational mode, the use of artificial intelligence in education, and the online education of students with and without disabilities are some examples of indirect relevance that were considered. An extensive search for such literature was conducted and an in-depth review completed in an attempt to provide a solid basis on which to construct new literature within the field. The results of this effort are presented in the next chapter.
CHAPTER TWO:
REVIEW OF LITERATURE

Although students with disabilities may be found in all aspects of education, current research pertaining to this student population frequently focuses on traditional, classroom settings. Overwhelmingly, such research concerns inclusion, accommodations, or assistive technology. Furthermore, throughout this existing body of research, students with disabilities are less often study participants than they are simply the subject being discussed by others, including teachers and administrators. In light of this, firsthand accounts of lived experiences by these students are greatly missing.

In reviewing the existing literature, it was evident that, while some studies touched upon indirect aspects, the main focus of the current study—the use of intelligent virtual assistants by higher education students with visual impairments—was not directly discussed. In order to build a foundation for this study, topics that are indirectly related to the current focus were reviewed. While the topics discussed were varied, they, individually and collectively, provided relevance that supports the need for uncovering the information sought, herein. For the purpose of laying the groundwork and providing context, topics discussed include the importance of higher education in workforce preparation for students with disabilities, the role of online higher education, the existence and effect of academic stress and barriers on students with disabilities in various educational settings, and the use of artificial intelligence, specifically intelligent virtual assistants, within education.
Workforce Preparation for Students with Disabilities

Throughout our lives, many factors impact our perceptions and satisfaction, most of which, during our adult years, surround the work we do (Elleven, Wircenski, Wircenski, & Nimon, 2006; Levinson & Palmer, 2005). Furthermore, work frequently shapes our personal lives by dictating the socioeconomic class within which we live, thus influencing our general health and well-being (Elleven et al., 2006; Goodman, 2015). This is no less true of individuals with disabilities and, in fact, is likely even more deeply poignant. Regardless, a substantial disparity persists between the number of individuals who have a disability and those who are actively working (Ju, Pacha, Moore, & Zhang, 2014). According to the CPS survey, in 2017, 11.9% of civilian non-institutionalized individuals between the ages of 16-64 reported having a disability, while only 2.2% reported having a disability and being employed (BLS, 2018). In terms of numbers, this means that approximately 25 million civilian non-institutionalized individuals with disabilities of working age are either not employed or not in the labor force, thus exemplifying the significant gap in employing these, often, very capable and talented individuals (Best Colleges, 2018; Elleven et al., 2006).

The potential of persons with disabilities is frequently miscalculated, consequently overlooking the advantages they may provide if properly prepared for and integrated within the workforce (Best Colleges, 2018; Irvine & Lupart, 2008). Research has shown that employing individuals with disabilities can prove greatly beneficial for employers and their establishments. For example, Wittmer and Wilson (2010) outline various ways in which hiring such persons can boost profitability, including increased employee retention, improved customer perceptions and allegiance, and decreased financial burdens. These and other benefits were evidenced through a series of qualitative research studies conducted by Rosenbaum, Baniya, and Seger-Guttmann.
(2017), which examined how placing employees with disabilities in highly visible and interactive service positions affected customer perception, consumer attitudes, and company image. Within these studies, customer perception of service quality was shown to be positively influenced by interactions with these employees. For instance, the employment of individuals with disabilities was found, as represented in online customer reviews, to improve service-related outlooks by overshadowing negative aspects such as premium costs and substandard food quality. It was further revealed that, overall, the employment of servers with disabilities optimistically impacted customer attitudes and behaviors, leading to positive appraisals of the employing establishment shared through word-of-mouth communication. This research uncovered several promising results that collectively promote the employment of individuals with disabilities and convey favorable corporate outcomes for establishments that take part in such practices. Rosenbaum et al. (2017) summarized this research by pointing to the various benefits to all stakeholders, including diminished unemployment among individuals with disabilities, enhanced experiences for consumers, and improved reputation and profitability for establishments.

Building on the benefits identified by Rosenbaum et al. (2017), work opportunities provide a wide range of advantages that enhance the lives of individuals with disabilities. Economically, work provides these individuals with the benefit of greater financial independence and self-sufficiency (Eggleton, Robertson, Ryan, & Kober, 1999; Goodman, 2015; Kitis, Eraslan, Koc, Giresun, & Usta, 2017). Psychologically, it helps them attain improved well-being through identity development, purpose identification, and achievement realization (Goodman, 2015; Kitis et al., 2017). The ability to enhance characteristics such as self-esteem, autonomy, and social competence through employment opportunities further bolsters this stance (Eggleton et al., 1999).
Increased social participation is a natural by-product of most work situations, which has been shown to improve both physical and mental health, as well as quality of life (Goodman, 2015; Kitis et al., 2017). Goodman (2015) supports this by discussing the general acceptance of a link between health and employment among individuals with disabilities. For instance, within their study, Kitis et al. (2017) found elevated levels of health, vitality, and quality of life among persons with disabilities between the ages of 18-30, which they attributed to the employment of this group. Similarly, Eggleton et al. (1999) found a substantial difference in the quality of life between employed and unemployed individuals with intellectual disabilities across the sample population, supporting their summation that employment provides both economic benefits and advantages to personal well-being. Unfortunately, many persons with disabilities are underemployed or work only part-time, which often adversely affects their levels of social participation and health status, thus diminishing the potential benefits of employment (Goodman, 2015; Kitis et al., 2017).

Of course, to realize these and other benefits, individuals with disabilities must acquire proper workforce preparation. One existing concern is that efforts made to lay such preparatory groundwork for these individuals in high school are not always sufficient (Hitchings et al., 2001; Mader & Butrymowicz, 2017). Elleven et al. (2006) assert that life experiences guide individual interests and, consequently career choice, yet young individuals with disabilities are frequently ill-equipped to make these choices in light of their often inadequate breadth of experiences. Involvement in decision-making among youth with disabilities is regularly limited in all aspects of their lives (Shah, 2007). Well-meaning adults, traditionally a parent, tend to shelter these youth from life’s many challenges and realities, often interceding to handle situations for the child (Sanders, 2006). As a result, expectations for children with disabilities to participate in
social interactions and decision-making processes are lowered, thus creating an environment within which these youth are allowed to settle and become dependent on others, rather than encouraged to strive for their independence and potential (Hitchings et al., 2001; Sanders, 2006). Consequently, the opportunity and motivation for these children to master such important tasks are greatly diminished (Sanders, 2006). Negative attitudes of others and physical restrictions commonly narrow social experiences among youth with disabilities even more, which only serves to exacerbate the situation (Sanders, 2006). This perpetual cycle directly aligns with the social model of disability as, through the reactions of society, an individual’s impairment becomes a disability with social limitations. It is imperative, then, that these students be given the opportunity to act independently of their protectors, in an effort to take part in a safe yet less restrictive environment within which such experiences may be expanded in a naturally occurring manner.

A number of skills are essential for success in both work and life, many of which are categorized as either hard skills or soft skills. While hard skills refer to occupation-specific abilities, soft skills relate to social aspects inherent to all occupations (Doyle, 2018). Some soft skills that are most sought-after by employers include those related to communication, teamwork, leadership, critical thinking and work ethic (Doyle, 2018; National Collaborative on Workforce and Disability for Youth [NCWD/Youth], 2011). Through the acquisition of soft skills, individuals are able to adhere to proper workplace conduct and effectively navigate interactions with others, two areas that may otherwise elude individuals with certain disabilities (NCWD/Youth, 2011). Furthermore, it has been reported that students who possess a variety of soft skills find greater success in social relationships, postsecondary education, and employment (NCWD/Youth, 2011). Unfortunately, it has been reported that many students exit high school
without acquiring these vital skills, especially those with disabilities (Mader & Butrymowicz, 2017; NCWD/Youth, 2011). Research has documented a lack of adequate time and attention dedicated to teaching soft skills to students with disabilities at this level, effectively barring this group from mastering many of the skills that would prove crucial in transforming their futures and maximizing their potential for success (Best Colleges, 2018; Hitchings et al., 2001; Mader & Butrymowicz, 2017; NCWD/Youth, 2011).

While many students with disabilities experience difficulties in their academic to career transition, higher education may help this group navigate the labyrinth of challenges laid before them by nurturing the acquisition and application of soft skills (Best Colleges, 2018; Dutta, Kundu, & Schiro-Geist, 2009; Griffin, McMillan, & Hodapp, 2010). Inclusive postsecondary education has been found to afford students with disabilities the opportunity to improve skills related to communication, decision-making, organization, and self-regulation, which all fall within the category of soft skills (Griffin et al., 2010). One relevant way to demonstrate the importance for individuals with disabilities to attain soft skills is through the necessity of self-advocacy. Self-advocacy is the action carried out by an individual, frequently one with a disability, when they take the initiative to convey their personal needs and views in an attempt to gain independence and integration within their everyday environments, some of which may be found to impose discriminatory effects on these individuals (Colon, Keys, & McDonald, 2006). The primary purpose of self-advocacy is frequently to attain the basic human, civil and legal rights afforded to all individuals and that allow individuals with disabilities to become more fully integrated into society (Colon et al., 2006). Table 1 depicts a link between the descriptors of self-advocacy, as outlined by Autism Speaks (2013), and a variety of soft skills presented by Doyle (2018).
<table>
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<tr>
<td>Speaking up for yourself</td>
<td>Confidence, Cooperation, Dealing with difficult situations, Giving clear feedback, Honesty, Independence, Interpersonal skills, Managing difficult conversations, Self-awareness, Verbal communication, Writing skills</td>
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<tr>
<td>Asking for what you need</td>
<td>Confidence, Decision making, Honesty, Independence, Innovation, Presentation, Problem solving, Resolving issues, Self-awareness, Troubleshooting, Verbal communication, Writing skills</td>
</tr>
<tr>
<td>Negotiating for yourself</td>
<td>Adaptability, Conflict management, Conflict resolution, Cooperation, Creativity, Critical thinking, Flexibility, Innovation, Listening, Logical thinking, Negotiation, Patience, Persistence, Persuasion, Problem solving, Respectfulness, Self-awareness, Verbal communication, Writing skills</td>
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<tr>
<td>Knowing your rights and responsibilities</td>
<td>Critical thinking, Disability awareness, Research</td>
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<tr>
<td>Using the resources that are available to you</td>
<td>Creativity, Flexibility, Innovation, Resourcefulness, Thinking outside the box</td>
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<tr>
<td>Being able to explain your disability either by the use of written words, pictures or gestures</td>
<td>Interpersonal skills, Nonverbal communication, Presentation, Self-awareness, Verbal communication, Visual communication, Writing skills</td>
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A research study conducted by Judge and Izuzquiza Gasset (2015) inspected the impact higher education integration had on individuals with disabilities in regard to aspects of workforce preparation. This study examined the UAM-Prodis Patronage Chair program, a postsecondary certification program generated collaboratively by the Prodis Foundation and the Autonomous University of Madrid (UAM) in Spain. Offered at the College of Professional Training for Teaching and Education, this program was created to enroll students with intellectual disabilities.
between the ages of 18-30 in employment preparation after completion of their compulsory education (Judge & Izuzquiza Gasset, 2015). During the two-year duration of the program, students participated in both classroom-based and work-based learning experiences, which culminated in the acquisition of 70 postsecondary education credits and a certification.

Student outcomes of the first four graduating cohorts (n=60) of the UAM-Prodis Patronage Chair program were encouraging. As of 2015, when the study was conducted, 92% of graduates were employed with three-fourths of this amount possessing permanent work contracts (Judge & Izuzquiza Gasset, 2015). Program participants reported realizing wide-spread benefits of both the program and the university environment in which it was offered. Improved employability, independent living skills, and community integration ranked among the top program-related benefits identified, while benefits facilitated by the surrounding environment included increased autonomy and confidence (Judge & Izuzquiza Gasset, 2015). University students (n=268) who were not enrolled within the UAM-Prodis Patronage Chair program were also surveyed to determine their perception of having students with intellectual disabilities integrated into campus life. Judge and Izuzquiza Gasset (2015) documented reports that values (i.e., acceptance, camaraderie, flexibility) were strengthened, stereotypes were demolished, and overall social accountability was improved by the presence of program-enrolled students. Employers added to this by conveying a high level of satisfaction in their decision to hire program graduates, noting employee responsibility and job enthusiasm as two major reasons (Judge & Izuzquiza Gasset, 2015).

While the UAM-Prodis Patronage Chair program did not bestow a traditional college degree upon its graduates, this study evidenced many benefits for the inclusion of students with disabilities in the higher education environment for all involved. It is apparent, through the
review of this study, that such an environment has the power to expose students with disabilities to new experiences while allowing them the time and opportunity they need to learn and apply critical skills. Students, both enrolled in the program and the general university, identified highly valuable benefits linked to the expansion of experiences within this climate that were mutually advantageous. As demonstrated through the employer-reported traits of value, graduates of the program wielded some of the most sought-after soft skills within the workplace with mastery, thus gaining the admiration and respect of their employers (Doyle, 2018; Judge & Izuzquiza Gasset, 2015). Judge and Izuzquiza Gasset’s (2015) research supports the importance of college-based workforce education for students with disabilities, as inclusion within such an environment allows these students to develop employment-required skills in a safe, supported and semi-controlled atmosphere. This, in turn, serves to improve both self and employer confidence in the abilities of students with disabilities throughout the employment process.

In order to properly prepare individuals with disabilities for successful involvement in the workforce, they must be provided ample opportunities to expand their life experiences and master skills that will enhance their employability (Yuen & Shaughnessy, 2001). Researchers such as Yuen and Shaughnessy (2001) advocate the need to encourage students with disabilities to participate in and graduate from institutions of higher education as a significant step toward achieving these goals. Through the provision of real-world opportunities, specialized support services and inclusion in semi-structured environments, higher education has the potential to help these students gain the experiences, knowledge, and skills that will assist in smoothing their transition into work life (Best Colleges, 2018; Elleven et al, 2006; Mader & Butrymowicz, 2017). As research clearly links higher education to increased satisfactory employment
opportunities and social status for individuals with disabilities, as conveyed by Sachs and Schreuer (2011), the need for new efforts that support continuing education may be emanant.

**Online Higher Education**

As higher education grows in importance within the future of individuals with disabilities and enrollment rates of this population rise, efforts that support their acquisition of such educational attainment intensify (Lambert & Dryer, 2018). With continual advancements in technology touching so many aspects of our lives, today, it is not surprising that it is found at the center of educational opportunities (Erickson & Larwin, 2016; Koç, 2017). By taking advantage of the power held by technology, distance education, especially when conducted online, has become a viable alternative to traditional face-to-face higher education, which often possesses a variety of barriers for this population (Hensel, 2018; Kumar, 2015; Tankersley & Clement, 2013; Verdinelli & Kutner, 2016).

*Distance education* refers to methods used in facilitating instruction across time and space gaps that exist between the instructor and student (Allen & Seaman, 2017). Throughout its history, distance education courses have utilized any number of technologies, including cable broadcasting, cassette tapes, CD-ROMs, DVDs, and computer conferencing, in an effort to conduct instruction, but, over the past few decades, the Internet has taken a prominent place within this modality (Allen & Seaman, 2017; Kung-Ming & Khoon-Seng, 2009). While the initial aim of distance education was to accommodate students who were unable to attend traditional face-to-face classes due to geographic location or other personal limitations, online education has proven advantageous for a wide variety of students through its provision of flexibility and freedom (Erickson & Larwin, 2016; LaFave, 2016; Larwin & Erickson, 2016). Due to enrollment growth in online education, universities are placing greater emphasis on this
delivery method and incorporating it into their long-term plans (LaFave, 2016). Such an emphasis is displayed through the reporting of distance education enrollments at a majority (69.3%) of universities during 2015, yet these enrollment rates vary depending on the institutional type and level (Allen & Seaman, 2017; Mackey, 2016). According to NCES (2018), in 2015, private for-profit institutions witnessed the highest percentage of students enrolled in all online courses at 55.5%, while public and private non-profit institutions saw 10.0% and 16.5%, respectively. Public institutions, on the other hand, boasted the highest percentage of students enrolled in at least one, but not all online courses at 18.0%, with private non-profit and private for-profit institutions nearly matching each other at 8.5% and 8.6% (NCES, 2018). While these statistics are helpful in shedding some light on enrollment rates, a review of the raw numbers clearly shows that a significant portion of distance education enrollees attend four-year public universities as undergraduate students (Allen & Seaman, 2017).

Just as distance education, in general, has made use of a variety of tools to facilitate learning, so does online education. A diverse range of Internet-based technologies may be used to implement and enhance online learning, including digital libraries that house e-books and digital articles for research and information gathering, blogs and podcasts for information consumption and dissemination, and real-world simulations for the virtual application of learned knowledge and skills (LaFave, 2016). Since such tools are, for the most part, easily accessible by students from their chosen study location and device, full participation in the course is simplified (Plascencia, 2016).

To further simplify access to and interaction with instructional content, online courses often utilize software known as a learning management system (LMS), such as Moodle or Canvas, to house the virtual classroom (Nash, 2016). In brief, an LMS is a comprehensive
delivery system that stores course content, facilitates user interaction, and tracks student progression in a safe and unified environment (LaFave, 2016; Nash, 2016). An LMS may be used to host part or all of the instructional content within a course, depending on whether it is considered to be blended or online (Nash, 2016). A blended course makes use of both face-to-face and online elements for instructional purposes, while an online course is considered to be one that distributes at least 80% of its instructional content via the Internet (LaFave, 2016; Larwin & Erickson, 2016). Many universities use an LMS to offer courses taken toward partial or total completion of a degree program, thus allowing students a much more diverse catalog of opportunities from which to choose (Allen & Seaman, 2017; Mackey, 2016). As NCES (2018) reported 12.3% of undergraduate students and 26.1% of graduate students enrolled in degree-granting postsecondary institutions participated solely in online courses during 2015—up from 6.5%, overall, in 2012 (NCES, 2016)—statistics have shown that students are increasingly taking advantage of these alternative options. In addition to students enrolled in fully online degree programs, NCES (2018) conveyed that another 16.7% undergraduate and 8.3% graduate students were enrolled in at least one, but not all, online courses in 2015.

As lifelong learning becomes more imperative within the current workforce, students increasingly come to college with a variety of experiences and responsibilities (Calderon & Lopez, 2013; Kumar, 2015; Mackey, 2016; Merisotis. 2016; Tankersley & Clement, 2013). In light of this, the flexibility of online education is proving to be critical for many students (Erickson & Larwin, 2016). This flexibility permeates various aspects of the online delivery method, from assignment completion to favored response format to participation preferences (Erickson & Larwin, 2016; Hensel, 2018; Kung-Ming & Khoon-Seng, 2009; Larwin & Erickson, 2016; Mackey, 2016). While online courses may be conducted either synchronously (time-
dependent) or asynchronously (time-independent), the latter has risen in prevalence as a response to the needs of these students (Kung-Ming & Khoon-Seng, 2009; Larwin & Erickson, 2016; Mackey, 2016; Nash, 2016). This does not mean that synchronous elements, such as real-time group chats and live lectures, are no longer a part of online education, rather, it provides some context for understanding attendance-related difficulties and subsequent feelings of knowledge and experience deprivation in the midst of their use (Nash, 2016; Mackey, 2016). It is, however, asynchronous activities, such as discussion board posts, that provide a majority of the flexibility and freedom that is valued by online students and which frequently yield greater levels of productivity (Lambert & Dryer, 2018; Nash, 2016; Mackey, 2016).

Both synchronous and asynchronous online course elements have their strengths and weaknesses. While synchronous activities place time-constraints on student responses, they allow for more immediate interaction between participants, thus creating a more familiar and comfortable atmosphere within which to participate (Kung-Ming & Khoon-Seng, 2009). Asynchronous activities, on the other hand, provide students with time to research and contemplate their responses, which often elevates student confidence levels and satisfaction in their participation, but lack immediacy in interactions (Kung-Ming & Khoon-Seng, 2009; Mackey, 2016). In synchronous interactions, instructors may not have the time to provide extensive feedback, while asynchronous interactions allow freedom for greater consideration and provision of detail (Kung-Ming & Khoon-Seng, 2009).

One ever-present concern attributed to online education is the lack of personal contact, which frequently results in feelings of isolation for students (Richardson, 2016). This, however, is less of a concern with synchronous activities and has been contested by many as being a foregone characteristic of asynchronous elements (Kung-Ming & Khoon-Seng, 2009; Mackey,
Instead, both synchronous and asynchronous online courses, if appropriately managed by instructors, have the potential to personalize learning experiences for—and by—students, therefore, increasing both content relevancy and student motivation (LaFave, 2016; O’Doherty et al., 2018). If instructors make use of innovative techniques, such as communities of learning, that engage students in collaboration and active participation, such worries of isolation are likely to dissipate (LaFave, 2016; Mackey, 2016).

Participation in online courses also provides a natural platform through which one can gain necessary employability skills, such as soft skills and digital literacy (Hensel, 2018; LaFave, 2016; Mackey, 2016; O’Doherty et al., 2018). Within this mode of education, more time and less supervision are given for assignment completion, thus requiring students to form strong time-management skills, as well as to improve independent thinking, self-discipline, and responsibility (LaFave, 2016; Mackey, 2016). Collaboration and teamwork skills are accentuated in these courses, as students often need to work together in and interact throughout the course (LaFave, 2016). Through working with various forms of technology in online courses, students have the opportunity to build and continuously evolve their technical skills and, as a result, acquire the digital literacy necessary within the current workforce (Mackey, 2016; O’Doherty et al., 2018). By participating in online education and, consequently, mastering such skills, individuals become invaluable to their future employers, as well as the global economy at large (Hensel, 2018; LaFave, 2016).

For students with disabilities, online courses have the potential to provide additional advantages of significance, including decreased stress related to transportation, physical accommodations, and academic modifications (Hensel, 2018; Moisey, 2004). Since these courses are taken at the leisure of the student, autonomy is provided regarding when and where they
choose to participate, as well as on what devices (Hensel, 2018; Kung-Ming & Khoon-Seng, 2009; Larwin & Erickson, 2016). Online education offers an array of communication and interaction tools, which allows students with disabilities the opportunity to choose what form best fits their needs, be it audio recordings, typed responses, or the use of third-party applications such as VoiceThread (Hensel, 2018; Nash, 2016). In light of this, many of the accommodations required within a face-to-face classroom are no longer relevant and, those that are, frequently become much easier to execute (Hensel, 2018). These students are also given the freedom to become integral participants without fear of stereotypes and undesirable reactions in response to their disability (Lambert & Dryer, 2018; Mackey, 2016). In many cases, the need to disclose one’s disability is diminished or absent in online classes due to the minimal requirement for instructor-implemented accommodations, thus cultivating more confidence and imposing fewer limitations than in traditional instructional settings (Hensel, 2018; Lambert & Dryer, 2018). Overall, online education opens doors for many students, especially those with disabilities, to the realization that earning a college degree is possible even if attending classes on campus is not (Moisey, 2004).

A study conducted by Richardson (2016) at the Open University in the United Kingdom examined the impacts of face-to-face versus online tutoring in regard to the performance and success of students with disabilities, as well as a preference for teaching mode. Within the two undergraduate humanities courses used as the population within which the study was conducted, students had the choice of participating in either face-to-face or online tutoring. Both styles made use of similar techniques but differed in time-dependency with the former being synchronous in nature and the latter being asynchronous. When examining the sample for a preference of modality, 4,514 students participated with 6.5% reported to have at least one disability. Within
this sample, 78.5% of all students chose face-to-face tutoring, while 21.5% chose online tutoring. Interestingly, similar percentages of students with (20.5%) and without (21.6%) disabilities chose online tutoring, although both at a much lower rate than face-to-face.

In evaluating the impact of face-to-face versus online tutoring on student performance, Richardson (2016) turned to grade averages. Within this study, students without disabilities continually out-performed those with disabilities in both modalities, although the difference was minuscule—less than one percentage point—within the online tutoring group. While students who participated in online tutoring scored higher than their face-to-face counterparts, the difference was found to be not significant among both those with and without disabilities, witnessing a difference of approximately five percentage points and two percentage points, respectively.

Finally, although success, assessed by examining passing rates, was found by Richardson (2016) to vary mildly, no significant difference was identified. Of those students who participated in face-to-face tutoring, 68.5% passed, overall, with a passing rate of 62.3% among those with disabilities. Within the online tutoring group, 70.1% passed, overall, with 71.2% of students with disabilities passing. While not statistically significant, passing rates among the online tutoring group were solidly higher than those of the face-to-face group.

Overall, this study found that, while no significant difference existed within any of the aspects studied, non-significant tendencies seemed to favor the online tutoring option, especially for students with disabilities. Such findings help build the case for online educational opportunities among higher education students, as well as show advantages to participating in such offerings for students with disabilities.
Larwin and Erickson (2016) conducted a meta-analysis to investigate the impact of online education on student achievement among students with disabilities. To collect documents for scrutiny, the authors partook in an extensive search across several databases. From this search, seven studies involving a total of 24,031 participants were chosen based on specific criteria for examination. Similar to Richardson’s (2016) findings, this study found that students with disabilities performed better when involved in online education as opposed to face-to-face learning; however, Larwin and Erickson (2016) declared this difference to be significant in their study. This difference was evidenced in a variety of areas, including reading and writing, as well as at all grade levels. Again, these findings further support the importance of providing online education for all students, especially those with disabilities.

The use of online education for students with disabilities employs both the social model of disability and dis(e)ability theory. In traditional classrooms, students with disabilities often experience negative reactions and stigma related to their impairment that inflict limitations on them, but, due to the level of anonymity provided by online education courses, these students have the ability to choose how much they share about their impairment, which, in turn, allows them to enjoy the benefits of being integrated without experiencing such disabling limitations (Disabled World, 2017a; Kung-Ming & Khoon-Seng, 2009; Lambert & Dryer, 2018; Mackey, 2016; Mitra, 2006). A prime example of the dis(e)ability theory (Conversano et al., 2012), online education utilizes the Internet—a powerful technology—to help integrate students with disabilities into the learning community and to reduce the learning gap. In every aspect of online education, technology is used as a tool by which individuals with disabilities can increase their potential for learning and communication while gaining autonomy and becoming more integrated into the community (Conversano et al., 2012).
Academic Stress and Students with Disabilities

Academic stress, as defined by Lal (2014), refers to the presence of internal or external frustrations pertaining to the participation in and completion of academic tasks. This definition continues by stating that this type of stress may be triggered by a wide range of factors and is frequently related to the concern of academic failure. Kumar and Side (2015) explain academic stress as “the psychological or physiological responses of university students to physically or psychologically challenging events or circumstances (stressors) associated with their academic life.” In other words, as students move from the secondary to the postsecondary level of their education, they are exposed to unique circumstances, responsibilities, and opportunities with which they may be unfamiliar, thus experiencing stress related to the presence of such new experiences. DeDeyn (2008) provides assurance that it is normal for all students to experience some level of academic stress when attending college in response to precisely these new experiences, but what about those students who have been diagnosed with a disability? Do they experience the same level of academic stress as their non-disabled peers? This is a question that has prompted some research.

A quantitative study conducted by Kumar and Side (2015) at a university in Ethiopia examined the academic stress of students with disabilities and the ways in which they cope with it. In this study, the authors made use of a three-dimensional conceptual model of stress in students with disabilities that includes general academic stress (experienced by all students), specific academic stress (experienced by students with all disability types), and disability-specific academic stress (experienced by specific disability type). To assess each of these dimensions, instruments were created, including the General Academic Stress Scale (GASS), Specific Academic Stress Scale (SASS), and Disability Specific Academic Stress Scale.
Further, the Academic Stress Coping Scale (ASCS) was created to assess coping mechanisms used within the population. Simple random sampling was used to identify participants. The GASS was administered to two pooled undergraduate samples (117 students with disabilities and 103 students without disabilities), while the SASS and DSASS were administered to sub-samples within each of these (i.e., disability type).

Kumar and Side (2015) reported significant differences found through a one-way ANOVA in regard to general academic stress, $F(3, 216) = 6.04, p<.01$, and specific academic stress, $F(2, 114) = 6.57, p<.01$. The use of independent sample t-tests indicated that there was a significant mean difference among two sub-samples (students with physical disabilities and with visual disabilities) and their corresponding groups of students without disabilities, while no significant mean difference was found between a third sub-sample (students with hearing disabilities) and their corresponding group. Further, results demonstrated mostly moderate levels across stress dimensions and disability groups, with levels in the visually disabled group being higher across all dimensions. Also, no significant difference was found across disability groups nor between students with and without disabilities in regard to coping strategies, as problem-focused coping strategies were the prevalent mechanism used.

In regard to Kumar and Side’s (2015) stated hypothesis that students with disabilities experience higher levels of academic stress when compared to that of their non-disabled peers, mixed results were found. Looking at all disabilities as one group, they found this hypothesis not to be true, while examining disability types, individually, presented varied findings. Two significant outcomes showed that students with visual disabilities experienced higher levels of academic stress than their peers (both non-disabled and those of other disability types), while students with physical disabilities were actually found to experience lower levels of academic stress.
stress than their non-disabled peers. With these findings, it seems as though the question of whether or not students with disabilities experience higher levels of academic stress than their non-disabled peers may be a little more complex than first thought.

A study by Heiman (2006) examined several aspects of university life concerning students with learning disabilities. The perceived social support, stress, and sense of coherence of these students were compared to that of their colleagues with no disability. This study then investigated the relationship between the items mentioned above and the presence of academic success within the two populations.

A total of 381 undergraduate students (191 students with learning disabilities and 190 without) at a single distance learning university took part in this quantitative study. The sample was created as a result of voluntary student responses to a questionnaire mailed to 600 students (300 with learning disabilities and 300 without). Likert-style scales pertaining to social support, perceived stress, sense of coherence and academic success and lack of academic success were used as instruments for collecting the desired data.

A multivariate analysis of variance was conducted to determine any difference present between students with and without learning disabilities in regard to their perceptions of social support, stress, and academic success, as well as their scores of coherence and total score. This test found a significant main effect, $F(1,380) = 4.69, p<0.01$, with a medium effect size of 0.28. Univariate ANOVAs were then used to evaluated differences within groups for each variable with low to medium effect sizes between 0.15 and 0.24. Results from this second set of tests indicated that students without learning disabilities experience significantly higher levels of social support, while students with learning disabilities experience higher stress levels and lack of success scores. Further univariate analyses were conducted to examine the subscales of social
support, stress, and presence of success with mainly medium effect sizes between 0.16 and 0.33. Results showed that students without learning disabilities reported receiving higher levels of support from family and friends than their counterparts with learning disabilities. They also reported experiencing academic success due to internal factors, whereas students with learning disabilities attributed lack of academic success to external factors. Interestingly, these findings support the view of the social model of disability, in that societal reactions—in this case, lack of social support—place limitations on individuals with disabilities, which may be, in part, the cause for elevated stress levels and lower levels of success.

In regard to stress levels in students with learning disabilities, Heiman (2006) found that total stress scores, including both daily life stress and academic stress, were significantly higher in these students than in their non-disabled peers who displayed relatively low scores. While daily life stress was found not to be significantly different between the two groups, academic stress was found to be significantly different, reporting that students with learning disabilities experienced higher levels, as was hypothesized by Heiman (2006).

In attempting to identify potential reasons for elevated stress levels in individuals with disabilities, researchers have pointed to the fact that such persons often live in a world filled with landmines that make navigating everyday activities more complicated to manage and often affect their level of performance or participation (Hong, 2015; Moriña, 2017). These are often referred to as barriers, many of which come from external forces, such as social stigmatization or medications, while others may be related to internal struggles that grow from such external factors (Hong, 2015). Regardless of the manifestation of these barriers, the potential for elevated stress levels in persons with disabilities resulting from their presence is high (Hong, 2015). That being said, due to the continual presence of such barriers throughout their personal and
professional lives, these individuals have often learned ways to traverse the seemingly insurmountable, thus overcoming barriers that greet them in any aspect of life (Moriña, 2017).

The existence of such barriers is no less impactful on the educational endeavors of students with disabilities. While these students experience the same academic stresses as their non-disabled peers, the occurrence of barriers related or in reaction to an individual’s disability causes additional stress, which may have dire consequences to their academic achievement (CDC, 2016; Fuller et al., 2004; Hong, 2015; Moriña, 2017). General barriers that may cause such superfluous stress for students with disabilities in higher education include time-management, effort put forth, and access to instructional materials.

**Time-Management**

Students with disabilities often experience difficulty in managing their time, in regard to both personal and academic activities (Erten, 2011; Hong, 2015). Scheduling can pose an immense barrier for many students with disabilities, as they must plan and attend necessary medical appointments while fulfilling their academic obligations (Hong, 2015). To ensure appropriate time-allocation for such essential engagements, students must consider, in advance, what days and times would be conducive for their courses (Hong, 2015).

Not only can medical appointments conflict with class times, but the utilization of disability-related medications may also have an impact on course time selection. Many students with disabilities who take medications to assuage symptoms of their disability can also experience difficulty waking up for early classes or staying awake for those scheduled in the evening (Hong, 2015). Such in-depth scheduling may be challenging for anyone, but are likely to be exacerbated within the lives of students with disabilities. Furthermore, such tasks may be stress-inducing for these individuals, as they attempt to sustain responsibilities within all realms
of their lives successfully. In a qualitative study of seven female students attending a Canadian university, Erten (2011) found that students experienced difficulty in effective time-management, which resulted in academic issues, as they were unable to uphold the requirements set forth.

Even when time-management is isolated within the academic realm, extended stress may be faced by students with disabilities as they encounter barriers related to assignment and examination completion (Hong, 2015; Rice & Carter, 2016). In a qualitative study utilizing journaling methods to gain insight on the experiences of students with disabilities in postsecondary education, Hong (2015) found that these students had difficulty in meeting deadlines that required the completion and submission of multiple assignments at one time. Although their study focused on the secondary level, Rice and Carter (2016) conducted a case study that found time management in online education to be crucial in assuring students would not fall irrevocably behind on their coursework. Within this same study, the authors also found that time-management pertained within assignments, as well. Rice and Carter (2016) discovered difficulties experienced by students with disabilities in completing their assignments and exams prior to the occurrence of their computer or software timing out. In this case, stress comes from an anticipated time restriction of which the student becomes fearful will further impair their ability to complete their work, thus negatively affecting their progress.

In reviewing the existing literature, it is apparent that time-management is a looming stressor for students with disabilities. This particular issue seems to permeate all levels of a student’s personal and academic life, thus possessing great potential to affect the level of academic stress one experiences. Unfortunately, the only suggested resolution identified within the literature is that of self-regulation of learning by Rice and Carter (2016). Although a viable solution, the authors also discuss its drawbacks with regard to the teaching of self-regulatory
skills in the online environment, as well as the need to provide more personalized assistance when the student does not fully implement such skills. A study conducted by Verdinelli and Kutner (2016) further supports this solution, as its findings indicated that online courses (a form of self-regulated learning), in fact, help alleviate time-management issues for many disability types. This study found that many students with varying disabilities believed online courses provided the flexibility they required to attend to both their disability needs and their academic responsibilities. For instance, due to the flexible nature of the time supplied for assignment completion, students with health or physical conditions were able to take breaks, at their discretion, in order to accommodate their disability-related needs without feeling that it would compromise the completion of their work (Verdinelli & Kutner, 2016). Those with ADHD and ADD were able to participate in their studies during personal times of optimal concentration, thus making better use of their time than if they were required to learn on a strict schedule that was imposed upon them (Verdinelli & Kutner, 2016). Furthermore, this study found that time-management was made easier by online courses due to the nullification of tasks that often prove to be time-consuming for students with disabilities such as transportation and mobility.

**Effort Put Forth**

Another common theme throughout the existing literature pertaining to barriers for students with disabilities in postsecondary education is the required application of greater effort to be put forth than is required by their non-disabled peers. To clarify, *effort*, for the current research, refers to physical or mental exertion expended by an individual to complete a task. Two proposed reasons for the requirement of elevated levels of effort include frequent fatigue caused by a disability or disability-required medications (Dalton, 2013; Hong, 2015) and pace of course progression (Fuller et al., 2004).
Students with disabilities are often plagued by fatigue related to their disability or prescribed medications that control disability-induced symptoms (Hong, 2015). Major requirements of most academic coursework include reading, writing, and otherwise interacting with teachers, peers, and content. Students with disabilities often become fatigued by these tasks due to the elevated level of effort required, and, thus, benefit significantly from regular breaks, extra assistance, and discrete personal attention (Dalton, 2013). Furthermore, fatigue tends to be a common and inescapable side effect of many medications consumed by students with disabilities (Hong, 2015). While such medications are deemed necessary to regulate the effects of a disability, their use may, inadvertently, affect a student’s ability to wake up on time for class, complete all academic requirements, or remain alert in class as a result of experienced fatigue (Hong, 2015).

The pace of course progression is a commonly discussed complication for students with disabilities in any educational setting. Within the traditional classroom, Fuller et al. (2004) found that 44% of students with disabilities experienced difficulty learning through lectures due to pace-related issues. The findings of this study indicated such issues often resulted from a fast speaking rate and progression through visual materials of the lecturer, both of which left students with disabilities feeling confused and overwhelmed. This further resulted in a decreased level of concentration and comprehension of the content being presented, as well as a decline in the quality of notes taken. In response to such pacing issues, a research study done by Soukup and Feinstein’s (2007) found that 74% of classroom teachers at the K-12 level reported utilizing a slower pace of teaching to accommodate deaf or hard of hearing students with learning disabilities. Rice and Carter (2016), on the other hand, discovered that teachers in the online K-12 setting often created pacing guides to outline a more detailed schedule of when assignments
were due, as well as how a student that was falling behind could make up missing work. In their study, Verdinelli and Kutner (2016) found that online courses often naturally overcame pacing issues, as they frequently allow students to set their own pace which, according to the findings, lessened the amount of stress and tension experienced by students with disabilities.

While students with disabilities felt that they were able to accomplish their goals through time, effort, and dedication, they also specifically reported having to work twice as hard as their peers to realize such achievements (Moriña, 2017). Managing demanding schedules places a great deal of stress on any student, but even more so for those who have medical factors to consider. While it is imperative that these students be provided the opportunity to attain higher education, it is of further importance that such extraneous stress be lessened to allow for their health and success.

**Access to Instructional Materials**

Education, as a field, makes use of a wide variety of instructional materials, all of which must be accessible to and for every student. *Access*, in this case, refers to more than merely gaining permission to use or having within one’s possession. It, instead, more profoundly encompasses the ability of each student to interact with and consume the content presented efficiently. Research conducted within the Florida College System (2009) found that one of the most frequently reported barriers across the 28 colleges studied was access to textbooks in alternative formats. For many students with disabilities, print textbooks are difficult to read, transport, and manipulate (Smith & Buchannan, 2012). Even when textbooks are available in alternative formats, they may still not be truly accessible as certain PDFs are unreadable by screen readers (Betts et al., 2013). Of course, digital textbooks are not always sufficient for students with other disabilities, either. As discussed by Betts et al. (2013), sometimes there is no...
substitute for a hard copy and, even in online educational settings, print or Braille hard copies may be necessary.

Whether in online or traditional educational settings, lectures are often a method for teaching. During such presentations, several stress-inducing barriers may arise for students with disabilities. Fuller et al. (2004) discussed the need for permission to be given for lectures to be recorded, as well as for handouts and other visuals to be in an accessible format. Smith and Buchannan (2012) noted the benefit of students having access to recorded lectures as a means of reviewing and reinforcing the content. They further discussed the importance of placing these lectures and supportive PowerPoint slides on a learning management system where they would be available to all students, fully equipped with captions and in formats that interact well with various types of assistive technology. Through using technology in these ways, the existing learning gap between students with and without disabilities is narrowed, and all are empowered to interact with the content pertinent to the learning experience actively, thus exemplifying the aim of the dis(ease)ability theory.

The availability of fully accessible instructional materials is essential for the participation and success of students with disabilities. Although the provision of such access is the responsibility of the institution, everyone involved benefits from it (Betts et al., 2013). Even so, the existing literature continually cites such access as a barrier and, as anyone can attest, disabled or not, attempting to complete a task without the necessary tools is frustrating and culminates in an elevated level of stress.

**Artificial Intelligence and Intelligent Virtual Assistants**

*Artificial intelligence*, as a field, involves the creation and improvement of computerized technologies that strive to simulate how we, as humans, contemplate, comprehend, and process
information (Niveditha & Basavaraj, 2017). Such technologies come in a variety of formats and use machine learning methods to continuously evolve and improve in performance. Machine learning is an area of AI that focuses on the ability of technology to learn from data by identifying patterns and adjusting actions without human assistance (Expert System, 2017). Currently, one of the most common forms of AI is the intelligent virtual assistant, which endeavors to create an experience that replicates natural human interaction through the use of automatic speech recognition (Henderson, 2009; Saad, Afzal, Eid, & El-Issawi, 2017; Vigliarolo, 2019; Zajechowski, 2014).

Automatic speech recognition (ASR) is the technology employed to simulate natural humanlike communication between an individual and a computer interface (Zajechowski, 2014). The process involved begins with the recording of an utterance spoken by the individual, followed by the use of algorithms that help deconstruct the recording and identify building blocks, called phonemes, of the words used (Henderson, 2009; Zajechowski, 2014). A sequential analysis of the phonemes is then conducted in order to convert the recorded speech into a format that is more compatible with the computer, thus replicating input that may have been received through more traditional means, such as a keyboard (Henderson, 2009; Zajechowski, 2014). Once this conversion is completed, a database search is conducted for significant words found within the utterance in an attempt to contextualize the request (Zajechowski, 2014). At this point, the computer should possess an understanding of what the user desires, thus moving forward to the creation of a response constructed by speech synthesis, otherwise known as text-to-speech, software (Siri Team, 2017). To create such a reply, the software conducts another search to locate pre-recorded phonetic segments, which are then combined and returned to the user (Henderson, 2009; Siri Team, 2017). Through the use of ASR and speech synthesis, users have
the ability to interact with equipped devices without the need for physical contact, which, according to Henderson (2009), has proven beneficial to many, especially those with disabilities.

In the world of artificial intelligence, three intelligent virtual assistants currently reign supreme: Amazon’s Alexa, Apple’s Siri, and Google Assistant. Each of these cloud-based assistants is available on a variety of devices—both mobile and stationary—and interacts with users quickly and conveniently through hands-free control and verbal responses (Eckel, 2019; Forrest, 2018; Frue, 2019; Herget, 2019; Varma, 2018; Vigliarolo, 2019). With their aid, users can easily complete basic tasks such as checking the weather, staying up to date on the news, and setting reminders (Varma, 2018). Even more beneficial is their ability to help users improve their time-efficiency by reducing the number of steps required to complete a task and increasing one’s ability to complete multiple tasks at once through routines and shortcuts (Forrest, 2018; Frue, 2019). Furthermore, the personalization of IVAs through language, location, and more can help this technology return results that are more relevant to the user (Frue, 2019). Unfortunately, this technology does not come without its drawbacks. As virtual assistants often boast open microphones that are always listening for their assigned activation word or phrase, privacy concerns have arisen (Frue, 2019; Vigliarolo, 2019). Apprehension related to the proper operation of this technology has also resulted from accidental activations, misunderstood queries, or lack of responses (Frue, 2019). Of course, all virtual assistants are not created equal. Instead, each possesses strengths and weaknesses that help users determine which intelligent virtual assistant best fits their needs.

In June 2015, Amazon’s Alexa and it’s housing device, the Amazon Echo, debuted to the general public after an initial invitation-only release the prior year (Vigliarolo, 2019). Since its appearance in the commercial market, Amazon has expanded Alexa’s reach by making this
virtual assistant available not only on the full line of Amazon Echo units but also on third-party devices. Furthermore, while pre-installed on some Android smartphones, the Amazon Alexa app has the power to bring this virtual assistant to any smartphone that is connected to either Google Play or the iOS App Store (Varma, 2018). Regardless of the type of device Amazon’s Alexa resides on, this IVA comes packed with numerous basic capabilities that can easily be expanded by choosing and enabling skills created to carry out desired tasks (Varma, 2018; Vigliarolo, 2019). Two of Alexa’s greatest strengths, in fact, are the ability for the integration of both third-party apps and devices and the significant number of skills available for expansion (Graham, 2019). Other strengths of this virtual assistant include a selection of four wake words from which to choose, the fact that no computer or smartphone is required—only electricity and an Internet connection—and the range of devices at various price points (Herget, 2019). Amazon’s Alexa thrives in the smart home environment and, with the release of Alexa for Business in late 2017, has also proven beneficial in the smart office (Vigliarolo, 2019).

Of course, with great success comes criticism and Amazon’s Alexa is no exception. Some point toward the poor management of skills as a weakness of this virtual assistant because less useful and ineffective skills are allowed to exist (Herget, 2019). As with all intelligent virtual assistants, privacy is also considered a weakness of Amazon’s Alexa (Herget, 2019). Interestingly, though, while this virtual assistant is always listening, it does so in a three-second loop and only saves recordings when it hears the assigned wake word (Vigliarolo, 2019). In an effort to elevate privacy and user experience, Amazon announced improvements for its virtual assistant during an event held in September 2019. A few of these include the ability to review recordings from an Alexa-enabled device, the automatic deletion of recordings after a
determined amount of time, and the detection of user frustration when interacting with Alexa (Rawes & Wetzel, 2019; Vigliarolo, 2019).

In early 2010, Apple acquired the company that created their now intelligent virtual assistant, Siri (Eckel, 2019). In late 2011, this assistant was released on the iPhone 4s, then expanded to all Apple devices running a subsequent iOS, macOS, watchOS, or tvOS (Eckel, 2019). Finally, in 2017, Apple released the HomePod, its Siri-enabled smart speaker (Eckel, 2019). With many features built into this virtual assistant on any device, Siri’s capabilities cannot be expanded as with Amazon’s Alexa but, instead, can innately adapt to one’s needs and actions over time to become more helpful and minimize the need for user interaction (Eckel, 2019).

Consumers often find Apple’s Siri to be user-friendly and best for completing basic, everyday tasks, thus increasing their interactions with this virtual assistant and, as a result, providing it with the time required to hone its capabilities (Graham, 2019; Varma, 2018). Another strength of Apple’s Siri is its ability to access and synchronize content across a user’s Apple devices via their iCloud and iTunes accounts (Eckel, 2019).

While Apple’s Siri has improved over the years by using machine and deep learning, some weaknesses remain (Eckel, 2019). According to many, one of Siri’s biggest weaknesses is its exclusivity to Apple devices, which are quite expensive and possibly out of range for many to purchase (Varma, 2018). In addition, the late entry of Apple’s HomePod has been blamed, in part, for Siri’s shortcomings in comparison to its competitors (Eckel, 2019). Another weakness of this assistant is a tendency to return web search results for the user to cull through, instead of verbal answers (Herget, 2019). Finally, complex commands often cause issues for Apple’s Siri due to comparatively limited capabilities, thus leaving this virtual assistant better able to aid users with basic, time-saving tasks (Eckel, 2019; Varma, 2018).
Google Assistant first showed up on the scene in 2016, initially on the Google Pixel smartphone and Allo smart messaging app, followed later in the year by the Google Home smart speaker (Forrest, 2018). Although not specifically a descendant of the company’s previous assistant, Google Now, Assistant showed many similarities with some improvements including two-way interaction capabilities. Built into a variety of devices including Android smartphones and tablets, the Google Home line of smart speakers, Android TVs, smartwatches, and third-party devices, Google Assistant can also be added to Apple’s iOS devices through the installation of an application (Forrest, 2018; Herget, 2019). In all forms, this IVA excels in a wide variety of tasks and understands contextual information especially well (Forrest, 2018).

One of Google Assistant’s greatest strengths, though, is its connection to the company’s search engine, which allows for a higher level of accuracy and depth when responding to general questions and inquiries (Graham, 2019; Varma, 2018). Not only does Google Assistant provide accurate responses, but it also does so quickly and in a personalized way (Herget, 2019).

When researching the weaknesses attributed to Google Assistant, few were found. As is the case with most virtual assistants, privacy was one major concern that arose as the more private information Google Assistant can gather about the user, the better the results it can provide (Herget, 2019). For example, in 2018, Google introduced Duplex, which allows the company’s intelligent virtual assistant to make phone calls and book reservations on behalf of the user (Forrest, 2018). While an attractive feature, the virtual assistant would require access to a significant amount of private information to successfully complete such actions. Also, although not necessarily a weakness within itself, Google Assistant was found to possess less functionality in comparison to Amazon’s Alexa due to the sheer volume and quality of skills available for the latter (Varma, 2018).
Overall, these virtual assistants provide a wide array of capabilities across a vast number of devices, thus making them both helpful for and available to anyone with an Internet connection and a desire to use them. Of course, when considering their use by individuals with disabilities, the question of accessibility may arise. While spoken interactions may be ideal for those with visual or mobility impairments, this may not be the case for individuals with other disabilities such as hearing or speech impairments. Fortunately, individuals are able to interact with each of these virtual assistants by typing their inquiries or tapping on icons, but these functionalities are, of course, restricted to IVA-enabled devices with display screens (Forrest, 2018; Tillman, 2018). Regardless, such capabilities allow for a higher level of accessibility that provides more individuals with the opportunity to use intelligent virtual assistants.

While there has been an increase in interest regarding the use of AI, especially in the areas of performance and user experience (Saad et al., 2017), there remains an apparent lack of such research. Where studies pertaining to AI, in general, exist in small amounts, scholarly research focusing on intelligent virtual assistants, specifically, are nearly impossible to find. This is especially the case when attempting to locate academically accepted studies that attend to the utilization of IVAs in education, even more so when focusing on online education (Phu et al., 2016). The single study that was identified within the topic of IVA utilization in online education was conducted by Phu et al. (2016). In their research, these authors concentrated on the integration of an IVA into a learning management system used by undergraduate students for online courses. In this case, the virtual assistant was used to answer common questions from students in an attempt to minimize extraneous work on the instructor, increase support interactions, and improve timely response to student inquiries as a way of decreasing dropout rates in online education. Based on their findings, Phu et al. (2016) asserted that the use of virtual
assistants in online education is a viable option to help alleviate the time discrepancies in communication between students and teachers. They further stated that IVAs could prove beneficial in advancing the performance and experience of students in online courses. While these findings are not specific to students with disabilities, they evidence the ability of technology to improve both communication and learning experiences for all, thus applying the dis(ease)ability theory to the general population, within which this sub-population resides.

The scant amount of research studies that have been conducted and reported through academic journals and reports is likely the reason Bundy (2017) has communicated a need for increased funding for research within artificial intelligence. Furthermore, due to this lack of existing scholarly research, alternative sources will be utilized to attain information that conveys the uses, advantages, and limitations of intelligent virtual assistants for the purposes of this literature review.

**Academic Purposes**

Virtual assistants possess the ability to help students in a number of ways that span many educational subjects. Fundamental language skills such as spelling and word definition may be supported and strengthened through the use of such an intelligent entity (Dodson, 2017; Ellis, 2017; Flanagan, 2016; Learning Abled Kids, 2013). When it’s a rhyming word a student seeks, they need only inquire from their assistant (Warren, 2016). More advanced language information, such as synonyms and antonyms, may also be attained from these smart assistants, thus advancing mastery of language and improving writing skills (Ellis, 2017; Flanagan, 2016). Some virtual assistants are even capable of helping students reinforce and expand their vocabulary through short quizzes and games (Ellis, 2017).
Knowledge of history and social studies are gained in fun, yet educational ways through the utilization of virtual assistants. Geographic information may be easily attained through simply asking the assistant relevant questions, thus minimizing the need for sometimes time-consuming internet searches (Ellis, 2017). Moreover, quizzes are available to help students learn content such as state capitals (Warren, 2016). One of the easiest and most commonly used features of popular IVAs provides up-to-date news briefings and current events (Christopherson, 2016a; Ellis, 2017; St. John, 2017). Not only do students have the power to remain aware of current affairs through posing questions to their chosen virtual assistant, but they also possess the ability to learn about the past (Ellis, 2017; Warren, 2016). Amazon’s Alexa, for example, has several skills that will provide information about specific dates in history, including reporting headlines all the way back to the year 1851 (Ellis, 2017). Students even have the opportunity to have documents such as the United States Constitution read to them.

Mathematics and science are often difficult subjects for students, thus enlisting the help of an intelligent virtual assistant could prove very beneficial. A student can improve their math skills by practicing with virtual assistants in game or quiz format (Ellis, 2017; Warren, 2016). These supportive technologies have the ability to do a range of tasks from counting to calculations to providing a needed formula (Flanagan, 2016; Learning Abled Kids, 2013). When engaged in scientific study, students may appreciate the ability of virtual assistants to simplify the process of converting units of measurements (Ellis, 2017; Warren, 2016). Such features allow for students to learn through demonstration and interaction, as well as to double-check their work (Ellis, 2017).

Information location, reading, and knowledge acquisition may be difficult for many students, especially those with disabilities. Virtual assistants are frequently capable of features
that could alleviate the frustration and stress associated with such tasks by helping students become more efficient in these areas (Learning Abled Kids, 2013). In response to a question posed by a student, such a companion is often able to conduct a simple or complex internet search and, subsequently, report the internet-based findings to that student through verbal communication, thus potentially bypassing the need for extensive reading (Learning Abled Kids, 2013). Alexa, for example, is able to search for topics on Wikipedia and speak the resulting articles aloud (Ellis, 2017; Learning Abled Kids, 2013). Furthermore, this specific IVA is able to play audiobooks and audibly read Kindle books from Amazon (Ellis, 2017; Montejo, 2016; St. John, 2017). Other IVAs also boast similar reading abilities, but often with their own company’s products (Christopherson, 2016a).

**Non-Academic Purposes**

Uses that are supportive of academic performance and growth, but not directly related to educational tasks permeate intelligent virtual assistants. The notification, retrieval, and reading of e-mails is a universal and valuable feature of IVAs as this is often the preferred mode of communication for instructors, especially in online education (Saad et al., 2017). Most of the popular IVAs make managing one’s schedule easier by adding, editing, and speaking calendar events, including academic due dates and non-academic appointments (Christopherson, 2016b; Flanagan, 2016; Montejo, 2016; Saad et al., 2017; St. John, 2017). Creating and managing to-do lists with an IVA may further help students organize and remain on task (Montejo, 2016; St. John, 2017). To ensure task completion and scheduling commitments, virtual assistants can set reminders so that students do not miss important events or forget to submit any assignments (Christopherson, 2016b).
<table>
<thead>
<tr>
<th>Table 2. Sample Alexa Skills</th>
</tr>
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<tbody>
<tr>
<td><strong>Language Arts</strong></td>
</tr>
<tr>
<td><strong>Grammar Tool</strong></td>
</tr>
<tr>
<td>Grammar Tool will interact with you to give you a word, its part of speech, its definition, and a short example.</td>
</tr>
<tr>
<td><strong>Word Lookup</strong></td>
</tr>
<tr>
<td>Word Lookup skill with random word, word of the day, synonym and word definition lookup.</td>
</tr>
<tr>
<td><strong>Spellcaster</strong></td>
</tr>
<tr>
<td>Do you have trouble spelling hard words? Spellcaster can help you learn how to spell any word in the entire English language.</td>
</tr>
<tr>
<td><strong>History and Social Studies</strong></td>
</tr>
<tr>
<td><strong>State Capitals Quiz</strong></td>
</tr>
<tr>
<td>Take a multiple choice quiz to learn state capitals. If you do this enough, you can memorize them all and impress your friends!</td>
</tr>
<tr>
<td><strong>Constitution Guide</strong></td>
</tr>
<tr>
<td>This guide contains the full text of the United States constitution, and allows you to explore the parchment that defines the United States today.</td>
</tr>
<tr>
<td><strong>This Day in History</strong></td>
</tr>
<tr>
<td>History happens every day! Check in with Alexa to find out about the historical events that happened on this day and every other day of the year.</td>
</tr>
<tr>
<td><strong>Mathematics and Science</strong></td>
</tr>
<tr>
<td><strong>Math Flash</strong></td>
</tr>
<tr>
<td>Test your math knowledge with Math Flash from the American Printing House for the Blind! These math flash cards will ask you addition, subtraction, division, and multiplication problems.</td>
</tr>
<tr>
<td><strong>Physics Formulae</strong></td>
</tr>
<tr>
<td>Physics Formulae is designed to give you any formulae relating to physics that you may need.</td>
</tr>
<tr>
<td><strong>Science Bowl</strong></td>
</tr>
<tr>
<td>Science Bowl is based on the National Science Bowl buzzer competition for middle- and high-school students. It gives you ten questions per round to play.</td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
</tr>
<tr>
<td><strong>Text to Voice</strong></td>
</tr>
<tr>
<td>Text To Voice allows your Alexa enabled device to say anything you want. Whatever you type, Alexa will speak.</td>
</tr>
<tr>
<td><strong>Ask the Powerful Internet</strong></td>
</tr>
<tr>
<td>Ask Alexa for random articles and information about a topic. Learn about science, religion, philosophy, dogs, cats, you name it.</td>
</tr>
<tr>
<td><strong>My Notebook</strong></td>
</tr>
<tr>
<td>Never forget those brilliant thoughts or mundane to-do items. Seamlessly capture notes without giving a second thought.</td>
</tr>
</tbody>
</table>
While presenting a brief discussion of intelligent virtual assistants may help lay the groundwork for understanding their functional value at a basic level, an illustration of some features, both academic and non-academic, specific to one particular IVA might assist in visualizing its potential applications. To achieve this, Table 2 identifies and describes a small number of Amazon Alexa capabilities, better known as skills, that may provide beneficial assistance to students at various levels. For accuracy of representation, official skill names and descriptions were taken directly from Amazon.com (2019).

Beyond features that actively help organize and complete tasks, IVAs may also assist in orchestrating necessary breaks that maximize the learning potential for students with disabilities (Dalton, 2013). One way to facilitate such breaks is the use and manipulation of timers and alarms set by Alexa, Siri, Assistant or others (Christopherson, 2016a; Flanagan, 2016; Montejo, 2016; St. John, 2017). A great use of time and way to rejuvenate during these study breaks is to partake in a short meditation exercise. Some virtual assistants have the capability to provide a pre-established, guided meditative break, while others can simply play relaxing music and sounds for a chosen length of time (Ellis, 2017; Warren, 2016). A fun and useful feature of many popular virtual assistants that could enhance the use of timers, alarms, and meditation exercises include the ability to control smart home devices, such as lights, thermostats, and speakers (Christopherson, 2016a). For instance, when a meditation break begins, calming sounds and music may be played through external speakers for a more enveloping experience, while the lights are dimmed and changed to a relaxing color and the thermostat slightly raises the temperature. When a study timer goes off, those same speakers may politely announce that it’s time to return to work, while the lights adjust to a more productive and energetic color and brightness and the thermostat returns to a cooler temperature.
Advantages and Limitations

Regardless of whether intelligent virtual assistants are being used for direct or indirect educational purposes, their impact is extensive and often runs deep below the conscious mind of the user. Externally, artificial intelligence, such as these assistants, can improve productivity and accuracy, as well as positively affect the time-consumption and quality of decision-making and problem solving (Bundy, 2017; Learning Abled Kids, 2013; Niveditha & Basavaraj, 2017). Furthermore, the utilization of virtual assistants has the power to increase efficiency and save time while minimizing frustrations and stress levels (Christopherson, 2016b; Learning Abled Kids, 2013). Internally, virtual assistants can provide increased levels of independence, especially for individuals with disabilities (Dodson, 2017; St. John, 2017). In fact, for those individuals with a disability, the use of such technology may likely be used to help participate in and complete tasks that are made difficult or even impossible by that very disability (St. John, 2017). The potential is there, then, for this technology to minimize limitations while enhancing the capabilities and autonomy of these individuals, thus embodying the dis(ease)ability theory.

Unfortunately, AI is not perfect and does come with some limitations. Niveditha and Basavaraj (2017) discussed the level of distrust users feel when first interacting with AI-based virtual assistants, as well as the biases they hold. These authors also touch upon the difficulty experienced in attaining help from experts. Christopherson (2016b) admits that these assistants are not always reliable, but that they are continuously learning and growing smarter. This author further asserts that, although this technology can become frustrating when it isn’t working properly, the benefits it provides when working as expected are sufficiently rewarding to balance out the negative. Nevertheless, Saad et al. (2017) express an understanding that several
limitations still exist in intelligent virtual assistants that should be given attention prior to expanding further into areas such as visual interaction.

**Summary**

Most students in higher education experience some level of frustration and stress, but these aspects of academic life are often exacerbated for those with disabilities. Barriers permeate both the personal and academic lives of such students, which frequently cause elevated stress levels (Hong, 2015). Two major causes of such barriers include social perception and stigma, as well as functional limitations of an existing disability (Conversano et al., 2012; Lambert & Dryer, 2018). Barriers constructed from social perception and reaction demonstrate the social model of disability and frequently require individuals to overcome related stress by proving their capability to uphold the everyday responsibilities of a socially integrated citizen. In order to do so, the research looks toward higher education as a way for individuals with disabilities to master necessary skills and better prepare for successful participation in both the workforce and society. The dis(ease)ability theory may, especially in regard to education, be exhibited through the use of technology to overcome barriers resulting from functional limitations of a disability, for the purposes of increasing autonomy and social integration. To conquer barriers triggered by both internal and external factors, it is imperative to investigate potential ways to minimize the presence and impact of these causes.

In alignment with the dis(ease)ability theory, the use of artificial intelligence in both one’s academic and personal lives may have the potential to achieve this goal. Through voice commands spoken to devices with intelligent virtual assistants, individuals who have difficulty controlling or organizing their surroundings may gain this power (Christopherson, 2016a). IVAs have the ability to keep track of appointments, due dates, and e-mails, and then to convey such
elements to the student in a way that can help them stay on track (Christopherson, 2016b; Flanagan, 2016; Montejo, 2016; Saad et al., 2017; St. John, 2017). Academically, these assistants provide numerous functions that are relevant in a wide variety of subjects and may have the ability to mitigate limitations caused by a disability, thus better equipping the individual for social integration and participation. Not only is the use of an IVA helpful in promoting organization, independence, and efficiency, but they also have the potential to enhance and reinforce learning through quizzes, games, fact sharing, and reading of books and articles found on the internet (Christopherson, 2016a; Christopherson, 2016b; Dodson, 2017; Ellis, 2017; Learning Abled Kids, 2013; Montejo, 2016; St. John, 2017; Warren, 2016).

Overall, the existing literature pertaining to academic stress and barriers experienced by students with disabilities in education creates a united view. Themes are recurring and continually validated. While limited use of qualitative measures are present, it overwhelmingly provides a picture drawn by the teachers of students with disabilities and minimally by the students, themselves. In light of this, literature repeatedly points to the fact that students with disabilities have been left out of the research process. Although this may have been the case in the past, it no longer seems to be an accurate view. While the existence of research that utilizes this student population as the primary source of information would be greatly beneficial in expanding upon what currently exists, the literature seems to be reasonably well-rounded.

A few gaps do seem to prevail within this area of research, though. As mentioned, quantitative measures were used very infrequently. Overwhelmingly, the literature that is currently available pertains to traditional educational settings. While some studies are related to online education, these are frequently focused on the secondary level or lower. Studies that concentrate on barriers that may exacerbate the academic stress of students with disabilities in
online education at the postsecondary level are lacking; thus, the field would greatly benefit from such a research focus.

Research on the use of artificial intelligence-based virtual assistants in education is nearly non-existent, especially when the specific area of interest is students with disabilities in online education. Although the existing literature implies that the use of IVAs by students with disabilities in education would benefit greatly (Christopherson, 2016a), this is an area that remains in need of further research. Moreover, the impact of IVAs on the academic stress levels of students with disabilities in online education seems to be missing altogether, thus requires immediate attention is an attempt to lessen academic stress on these students, decrease dropout rates, and increase retention rates. While the use of virtual assistants in education is a new concept, the literature indicates that it may be a valuable tool for all involved (Phu et al., 2016).

In an attempt to validate this stance and expand upon the existing literature, the current study endeavors to investigate disability-related academic stress experienced by students with disabilities in online higher education and the influence that the use of artificial intelligence-based virtual assistants may have on it. To achieve this objective, specific procedures will be utilized for data collection, and certain strategies will be implemented for data analysis. In the next chapter, such aspects of the methods used within this research will be detailed.
CHAPTER THREE:
RESEARCH PROCEDURES AND METHODS

As evidenced through the literature review presented in the previous chapter, students with disabilities experience a vast array of stress, academic and otherwise, in addition to that often experienced by their non-disabled counterparts. To provide these students with an educational experience equivalent to that of their peers, educators must understand and be able to identify the many factors that impose such extraneous stress. Furthermore, being aware of and knowledgeable on how to implement certain strategies, such as the use of intelligent virtual assistants, may assist in minimizing the existence and effect of such stress, which would greatly benefit all involved.

As the current topic of study focused on the lived experiences of a specific portion of the population, it was essential to elicit open and detailed accounts of these experiences. When choosing an appropriate research approach and design, the need to gain such thorough information was a significant factor in the decision-making process. Similarly, when determining the best sampling strategies to implement, the need to truly hear what each participant said weighed heavily, which necessitated the use of a small sample size.

To ensure proper conduct when working with human subjects, the researcher has completed the appropriate training before conducting any portion of this study. As verification of successful completion, certificates were awarded for each training program, including the Collaborative Institutional Training Initiative (CITI) (see Appendix A) and the National
Institutes of Health (NIH) (see Appendix B). In an attempt to guarantee ethical conduct regarding all aspects of the study, approval from the institutional review board (IRB) was also obtained before beginning (see Appendix C). Upon receipt of these documents, the data collection phase began. Although this was the initial phase of the study, it overlapped with the analysis stage. After the completion of data collection, the analysis phase, in turn, overlapped with the interpretation and reporting processes.

To answer the research questions posed, three instruments were utilized to collect data, which was then analyzed and summarized. Below is a brief outline discussing how the researcher gathered and evaluated this information in order to provide intelligent and supported answers to each of the research questions.

1. What features of intelligent virtual assistants are used by higher education students with visual impairments?

A section of the semi-guided interview was dedicated to gathering information for answering Research Question 1, with one item of the journal entry seeking to provide support and expand where needed. Data collected for this question was examined for recurring patterns and, where found, assigned to appropriate categories.

2. What experiences are reported by higher education students with visual impairments in regard to using intelligent virtual assistants?

In an attempt to shed light on the answer to Research Question 2, information was gleaned from both the interview and journal. All data collected for this question was analyzed, with salient points presented in later chapters.

3. How do higher education students with visual impairments use intelligent virtual assistants to mitigate disability-related stress?
Data for Research Question 3 was, again, collected through both the interview and journal, then scrutinized for prominent themes. The findings were then organized and will be presented in Chapter 4.

**Research Design**

When embarking on a research study, determining guidelines within which to conduct the study is imperative. Over the history of scholarly research, such guidelines, known as research approaches, have been tested and deemed valid (Lapan, Quartaroli, & Riemer, 2012). A research approach supplies an outline that guides decisions regarding appropriate methods of sampling, data collection, and data analysis (Schensul, 2012). Furthermore, an approach provides structure to a research study and helps ensure the writing of an intelligible report that facilitates replication (Schensul, 2012). One approach that fits this description and frequently appears within research is the qualitative approach. This approach utilizes social-scientific means to collect descriptive (words) data significant in a social area of interest (Lapan et al., 2012). As the current study sought to examine the real-life experiences of online higher education students with visual impairments as they use intelligent virtual assistants, a qualitative research approach informed by demographic questionnaires, in-depth interviews, and journal entries was employed.

While a research approach provides a blueprint for the structure and details of a study, a research perspective provides a foundation of beliefs through which to view the study and its elements. As one of the most prevalent research perspectives utilized in qualitative research, interpretivism holds that one’s reality is uniquely formed by their personal experiences within the surrounding environment (Lapan et al., 2012; Schensul, 2012). Due to this belief in unique realities, interpretivism seeks to elicit the detailed perceptions of study participants through the use of open-ended and evolving questions (Lapan et al., 2012).
The epistemological standpoint of the current study would fit well into that of interpretivism. While I aimed to uncover the meaning of the phenomenon of interest—the experiences of online higher education students with visual impairments in using intelligent virtual assistants—I realized that such meanings would likely vary among participants due to the presence of unique realities. For instance, although multiple participants may share a general type of disability (i.e., visual impairment), each, most likely, experiences that disability in different ways and to different extents (i.e., totally blind, partially blind, monocular vision). In light of this, each participant, inevitably, interacts with their environment uniquely and, thus, finds personal meaning in their realities. Furthermore, the existence of a disability may cause interactions with technology to be individualistic, thus likely affecting how a participant used and experienced that technology. Due to the belief in unique realities, meanings, and experiences among the population of interest, this study employed an interpretivist perspective.

As the purpose of the current research was to provide a source of robust, reliable information to assist in future decisions and practices regarding the phenomenon of study, it was essential to evidence the trustworthiness of the study in terms of data collected, analyses conducted, and interpretations made. The qualitative legitimation model (Onwuegbuzie & Leech, 2007) was applied to achieve this task. Within this model, aspects of internal and external credibility are used to demonstrate trustworthiness (Onwuegbuzie, 2002). According to this model, in evaluating the internal credibility of research, the integrity and dependability of data collected and interpretations made must be examined. External credibility, on the other hand, corresponds to the confirmability and transferability of data-based inferences made and findings reported within the study (Onwuegbuzie, 2002).
Many strategies were implemented to establish internal credibility within the current study. Credibility, or integrity, was demonstrated through bracketing, researcher-participant rapport, triangulation, and member checking while creating an audit trail helped exhibit dependability (Creswell, 2014; Onwuegbuzie & Leech, 2007; Statistics Solutions, 2018b). As this research aimed to understand the authentic experiences of participants regarding the phenomenon studied, individuals needed to answer questions honestly and without influence from the researcher. Bracketing helped in these efforts by minimizing the impact of researcher bias on participant responses and behaviors, while building researcher-participant rapport increased the level of comfort required to facilitate open and honest sharing (Morgan & Guevara, 2008; Tufford & Newman, 2012). The triangulation of both research methods and sources assisted in the assurance that data collected was accurate and relevant (Moore, Lapan, & Quarataroli, 2012). The use of both a semi-structured interview and a semi-guided journal assisted with the former, while the latter consisted of implementing these methods to multiple participants within the study (Statistics Solutions, 2018b). In support of interpretive validity, member checking verified proper representation of content and context, as well as assuaged any potential illusory correlations (Creswell, 2014; Onwuegbuzie, 2002; Onwuegbuzie & Leech, 2007; Statistics Solutions, 2018b). Through an accurate transcription of interviews, descriptive validity prevailed (Onwuegbuzie, 2002). Furthermore, by retaining all study-related documents and, thus, creating an audit trail, data accuracy can be confirmed and study replication can occur (Onwuegbuzie, 2002).

This study also emphasized external credibility. Through the creation of an audit trail, both the processes used in data collection, analysis and interpretation and the reasoning behind them was clearly delineated, thus supporting the ability to confirm the accuracy of and source
from which findings were derived (Creswell, 2014; Onwuegbuzie & Leech, 2007; Statistics Solutions, 2018a). Further assisting in the effort to show confirmability, the researcher partook in reflexivity throughout the study to examine how her personal experiences and thoughts drove the decisions made within the study (Bogumil, Capous-Desyllas, Lara, & Reshetnikov, 2017; Statistics Solutions, 2018a). Finally, to bolster the transferability of findings discovered, data analysis strove to uncover patterns and themes that may prove applicable outside the current study (Lapan et al., 2012). Once again, member checking acted as a tool in establishing the accuracy of these themes, which will be richly described in later chapters, thus allowing the reader to determine the extent to which the study findings are transferable (Lapan et al., 2012).

Although equipped with a clear plan for the current study, it was my intent, as the researcher, to remain open to and flexible in light of the natural progression the study took (Moore et al., 2012). Committed to my role of inquiry, I continually searched for answers to the questions at hand and, in doing so, sought understanding from the view of the participants (Moore et al., 2012). As is frequently characteristic of qualitative research, I partook in simultaneous and recursive data collection and analysis to facilitate the dynamic nature of this process and encourage the continual discovery of relevant information and findings (Moore et al., 2012).

**Context and Participants**

In an attempt to uncover relevant information for this study, a sample was drawn from the population of interest—online higher education students with visual impairments. Specific criteria were defined to identify individuals who qualified for participation. First, as the study focused on students in higher education, admission to a postsecondary institution as a part- or full-time student was required. Students from all subject areas and all levels were welcome to
participate. Second, to be deemed eligible for participation, individuals were required to be diagnosed with a visual impairment by an accredited physician, an accredited agency, or a combination of both. Each participant was also obligated to have either taken or be taking at least one online—synchronous or asynchronous—course at the time of the study.

As the participant target outlined, above, is somewhat limited, this qualitative study made use of purposeful sampling strategies to identify participants who could provide rich and informative data (Hardon, Hodgkin, & Fresle, 2004; Schensul, 2012). As the implementation of this study occupied a specific timeframe, convenience sampling was the chosen purposeful sampling strategy used, thus identifying participants who were available at the time and met the stated requirements (Hardon et al., 2004).

The researcher intended to acquire seven to twelve participants who qualified for involvement in the study. The number and diversity of participants, though, were ultimately dependent upon the characteristics of the students who showed interest in and qualified for participation. While a preference lies with a sample diverse in demographic traits such as age, gender, educational level, and diagnoses, the use of convenience sampling does not provide for this. In light of this, it was difficult to ensure a sample that represented the greater population.

Recruitment occurred via a closed Facebook group run by the National Association of Blind Students, a part of the National Federation of the Blind. A short message was approved by the group administrator and posted on the private wall for members to see. This message notified group members of the study, provided basic information, and conveyed the need for participants. A link to the study website was attached to this post to provide in-depth information about the study and the technology of interest, as well as to give access to the consent form, demographic questionnaire, and journal entry form. Individuals who showed interest in participating in the
study were asked to review the consent form (see Appendix D) in full, then click on a link at the bottom to convey their agreement with its contents. Once clicked, the link directed visitors to a webpage containing the demographic questionnaire. This questionnaire collected information about gender, age, academic level, online enrollment status, diagnosis, and preferred intelligent virtual assistant(s). When help was needed, interested parties had access to the researcher by e-mail through a link at the bottom of each webpage or by Facebook Messenger. Upon submission of the questionnaire, the website simultaneously generated a unique six-digit Participant Identification Number (PIN) and sent all collected information to the researcher in electronic format. For the duration of the study, this PIN acted as the identifier for each participant and accompanied all documents concerning that individual.

Once the demographic questionnaire was submitted, the individual was considered to be an active participant in the study. This remained the case unless one of two scenarios occurred: 1) Upon review of the information provided, the individual was found not to meet the requirements or 2) The participant decided they wanted to terminate their participation. When the first scenario occurred, the participant was informed of their ineligibility, immediately, and removed from the study. Although the second situation did not arise, if it had, no action would’ve been taken as the right to terminate their voluntary participation in the study was protected. As stated in the consent form, if at any time a participant decided to be removed from the study, they would be able to do so without any penalty or ramifications. Those individuals who were found eligible and chose to remain involved in the study proceedings were awarded compensation for the tasks completed, as outlined in the consent form.

After review of the initial information and confirmation of participant eligibility, contact was made by the researcher via e-mail to schedule the interview. This opening interaction also
provided participants the opportunity to share any questions or concerns they had, before beginning the study, thus building rapport between the participant and the researcher, while also facilitating an elevated level of comfort and openness (Morgan & Guevara, 2008).

**Data Collection and Instruments**

The use of three instruments—a demographic questionnaire, an interview, and a journal entry—assisted in collecting the data sought after by the current qualitative study. Data accrued through these tools resulted in primary material, as it was obtained directly from a sample of the greater population upon which this study focused. More specifically, the students, themselves, provided this information directly, rather than through a third-party such as a teacher or parent.

Assistance provided for participants relating to study procedures helped to ensure a high rate of response. As the researcher, I made myself available to participants through several communication methods, including text message, telephone, e-mail, and Facebook Messenger, thus allowing participants to choose the most convenient mode for them. While I intended to ensure that all disability-related needs were met, I also took responsibility for safeguarding the accuracy and context of the data collected. Technical assistance was available, when needed, to help with accessing and completing study procedures, as well as troubleshooting any issues experienced. Through the provision of such assistance, participants received more support, displayed a higher level of comfort and confidence, and, thus, completed all study procedures.

**Demographic Questionnaire**

A demographic questionnaire is a tool that may be used to gather data regarding specific traits possessed by individuals within a population. These traits frequently include age, gender, race, ethnicity, and level of education, and may offer insight into why individuals think or behave in a certain way (French, 2014; Stoutenborough, 2008). Demographic data may also
provide the basis upon which generalizability of findings may be built (French, 2014). While these outcomes may be present within the current study, the primary reason for the use of a demographic questionnaire, here, was to determine the eligibility of interested parties.

As agencies frequently collect demographic data for numerous reasons, standard topics have arisen that align with those used by the federal government for census and survey purposes (Stoutenborough, 2008). For the current study, such standard demographic information was gathered, including name, e-mail address, gender, age, and ethnicity. Due to the specificity of this study, some non-standard information needed to be collected, as well (Stoutenborough, 2008). Topics such as educational enrollment level, online course enrollment, diagnosis of visual impairment, and required accommodations were addressed in order to amass data regarding education and disability status. Similarly, general information on the use of intelligent virtual assistants was collected in an effort to gain a clear picture of which assistants were used by individuals and in what form. To review the demographic questionnaire used in this study, please see Appendix E.

Before submitting their demographic questionnaire via the study website, interested parties were required to read the accompanying consent form. If questions arose, individuals were asked to contact the researcher before providing their information. If no queries surfaced after reading the consent form, though, prospective participants were directed to verify their agreement with the contents of this document by submitting their completed demographic questionnaire. Upon submission, the creation of a unique, randomly generated Participant Identification Number (PIN) occurred, which appeared on the submission confirmation page for each individual to record. This PIN also accompanied the demographic information transmitted to the researcher for use in the proper labeling of all documents created within the study.
Semi-Guided Interview

A semi-guided interview is a qualitative tool that is often used to gather detail-rich information that conveys both similarities and differences between individuals in a study’s sample (Schensul, 2012). As the nature of this type of interview mimics, to an extent, natural conversation, it allows for greater freedom of both expression and exploration (Schensul, 2012). Schensul (2012) explains that, while it is beneficial to have an interview protocol to guide the line of questioning, it is just as advantageous to make affordances for flexibility and adaptability. The semi-guided interview provides a blend of these benefits as one would be equipped with a basic guide of questioning, while also being allowed the opportunity to determine, on the spot, and ask the most relevant questions (Schensul, 2012). One caution made by Schensul (2012), though, is the potential for open-ended questions to lead the interview into unrelated topics and produce irrelevant information. In light of this, the researcher must be skilled in directing the conversation and focusing the interview (Schensul, 2012).

The administration of one semi-guided interview per participant occurred at the beginning of the study. This interview was utilized to gain a deeper understanding of each individual’s disability and needs, experiences in online classes, causes of stress, and familiarity with and use of artificial intelligence-based virtual assistants. As per individual needs and preferences, the interview took place via FaceTime or telephone and varied in length. While estimated at approximately one hour and fifteen minutes, the actual duration of this procedure largely depended on the participant. The interview consisted of mostly open-ended, neutral questions, so as not to influence the responses given by participants (Moore et al., 2012). Finally, the researcher concluded each interview by asking the participant if they had anything they wanted to share that was not already addressed.
The researcher began each interview by addressing any questions or concerns raised by the consent form, thus ensuring the participant had a deep understanding of what was being asked of them. This semi-guided interview then proceeded by eliciting information about one’s disability and needs within the educational setting. After discussing such topics as accommodations frequently used, the discussion moved toward the participant’s experiences in online classes. Next, the interview shifted toward the potential causes for any stress—disability-related or otherwise—the participant may have experienced within their academic lives. Following this, the researcher guided the interview toward the topic of intelligent virtual assistants, including the participant’s use of, experiences with, and thoughts about IVA(s). As the meeting drew to a close, the researcher provided an opportunity for open discussion, thus allowing the participant to raise any topics of interest or concerns not previously addressed. Finally, at the very end of the interview, the researcher spoke briefly about how to access and complete the journal entry. To view the interview protocol for this study, please see Appendix F.

For transcription and review purposes, each interview was recorded using QuickTime (Schensul, 2012). Participants were, of course, asked for permission before beginning and were made aware that these recordings would only be available for review related to the current study. As with all other study-related documents, the designated PIN identified each recording when stored in a password-protected folder on the researcher’s secured computer. Upon submission of the final report for this research, all recordings will be held for five years, then disposed of appropriately.

Semi-Structured Journal

Upon completion of the interview, each participant was asked to complete a semi-structured journal entry. An e-mailed link to the journal entry, found on the study website,
provided each participant with easy access to this procedure. While they were asked to complete this task only once, the link allowed participants to visit as many times as they needed and at their convenience, thus allowing them the time and flexibility to ponder their answers before submission, if desired. Since this procedure acted as a follow-up to the interview, it garnered new information, while also providing support for that which was previously collected. Specifically, the journal entry acquired data regarding which virtual assistant(s) were used by the individual and other IVA usage information, including the frequency of and purposes for use. Through this procedure, participants also shared their experiences and thoughts about that usage.

The journal employed a form structure, which began with instructions and included questions of either multiple-choice or open-response format. Definitions of relevant terms were viewable by clicking on a hyperlinked icon placed after questions in which they may be found, including barrier, disability, experience, intelligent virtual assistant, and stress. When further assistance was required to complete this task, participants had easy access to the researcher via a designated link found on the webpage.

As illustrated in Appendix G, participants were asked to reflect on their previous use of and experiences with IVAs, then answer the following questions in a clear and detailed manner:

1. Which intelligent virtual assistant(s) do you use?
   a. Approximately how often do you use an intelligent virtual assistant?
   b. What specific features do you use (i.e. reading, taking notes, managing your calendar, etc.)? Why did you decide to use each feature?
   c. Does using these features affect how you completed tasks (i.e. steps taken, whether or not you procrastinated, whether or not you enjoyed completing them, etc.)?
d. Does using these features make completing tasks easier/harder, quicker/slower, less stressful/more stressful, etc.? Please explain.

2. How was your overall experience with the intelligent virtual assistant(s)?
   a. Do you feel that using an intelligent virtual assistant is easy and fun, hard and frustrating, or something else? Please explain.
   b. Have you used an intelligent virtual assistant to help minimize stress or overcome a barrier? If so, please explain.

3. Do you feel that using an intelligent virtual assistant was or would be helpful when taking an online course? If so, how?

4. Do you have any suggestions for or concerns about future use of an intelligent virtual assistant?

The electronic transfer of participant responses to the researcher for review occurred instantly upon submission of the journal entry. Each entry was automatically labeled with the assigned PIN, then manually cataloged into a password-protected folder. Although each participant was allowed to take as much time as they needed to complete the journal entry, the expected duration was approximately fifteen minutes. The option to dictate responses directly to the researcher was available when any participant experienced difficulty in manually completing this procedure. Although satisfactory completion of the demographic questionnaire and interview were expected to provide a substantial amount of data for use during the analysis stage if any participant decided not to complete the journal entry, no participant chose to exercise this option.

As is discussed by Hayman, Wilkes, and Jackson (2012), participant journaling poses some significant challenges, including poor participation, feeling exposed, and staying on track. The researcher distributed e-mail reminders for journal completion to address the concern of
poor participation. An initial e-mail acted as a gentle reminder to complete the journal entry at one week after interview completion. If the journal entry remained incomplete at two weeks post-interview, the researcher sent a second reminder inquiring about the need for assistance. In an attempt to assuage any feelings of exposure, the researcher worked to build a respectful and safe environment within which participants felt comfortable sharing their true stories, opinions, and beliefs. It was made clear to each participant that their journal entry would be kept confidential and would be stored in a folder under an alternative labeling strategy, thus keeping their name and other identifying information private. Finally, to help keep participants on track and improve completion rates of journaling, clear questions were presented to guide entries.

**Data Analysis**

As methods for conducting qualitative data analyses are plentiful, researchers must identify the steps taken during their study to accommodate replication and demonstrate trustworthiness (Attride-Stirling, 2001; Nowell, Norris, White, & Moules, 2017). For the current study, it was not only necessary to choose an approach that was qualitative in nature, but also interpretive; thus an inductive, data-driven thematic analysis (TA) was conducted (Braun & Clarke, 2006). Braun and Clarke’s (2006) six phases of analysis guided this stage of the research process. As was the intention of the researcher, the utilization of this methodical approach acted to maximize the meaning and usefulness of the study results (Attride-Stirling, 2001).

Data analysis, as is often the case with qualitative research, coincided with data collection and was iterative throughout this study (Braun & Clarke, 2006; Creswell, 2014). Although the researcher, as an active participant in the data collection stage, holds basic knowledge of the data collected, Braun and Clarke’s (2006) first phase of analysis aims to achieve the deeper level of familiarization required to conduct an effective analysis. First, the textualization and
organization of data were accomplished. Interviews transcriptions occurred through a combination of methods, including input by keyboard and voice. Initial transcription was conducted in approximately five-minute increments using either the keyboard or Voice Typing, a dictation feature found in Google Docs on the Chrome operating system. Each section was then visually checked against and adjusted to reflect the recording for accuracy. Once transcription of the entire interview was complete, it was reviewed, as a whole, against the original recording to ensure proper representation of what was both said and conveyed (Braun & Clarke, 2006). Next, all data was actively read, in full, while the researcher took brief notes of any salient aspects or areas of interest that may prove helpful in future coding and theme identification (Braun & Clarke, 2006). The organization of the information collected prepared the raw data for presentation and allowed for the use of descriptive statistics relevant to the research questions posed.

Once profoundly familiar with the data, the researcher began the second phase by examining each piece of data for classification with an initial label or code (Braun & Clarke, 2006). The salient points or areas of interest recorded during the first phase acted as a starting location for this process. These initial ideas were, then, revised and expanded through systematic scrutiny of all data with an eye toward potential patterns (Braun & Clarke, 2006). As Braun and Clarke (2006) suggest, during the coding phase, data extracts were recorded inclusively to ensure proper contextual understanding and often coded multiple times. When the latter occurred, an asterisk was utilized to notate this for reference within later phases. The re-organization of data into coded groups for easy identification and location followed the sufficient accomplishment of initial codification. The completion of this coding process helped streamline the data by grouping
extracts into specific categories for later efforts in identifying and presenting broader themes that represent significant aspects found within the study (Braun & Clarke, 2006; Creswell, 2014).

According to Braun and Clarke’s (2006) next three phases, the researcher focused on grouping patterns at a broader level, called themes. The third phase involved reviewing the existing codes and examining their relationships to determine possible themes, including a ‘miscellaneous’ theme for uncategorized codes (Braun & Clarke, 2006). As was the case with data extracts when coding, coded data was re-organized into themes, thus compiling similar codes within overarching ideas (Braun & Clarke, 2006). An inductive approach was taken within this phase, allowing the data to drive the creation of themes (Braun & Clarke, 2006; Nowell et al., 2017). The review and refinement of these overarching ideas fell within Braun & Clarke’s (2006) fourth phase. The primary goals of this revision phase were to ensure coherence among data extracts within themes, delineate cohesiveness between themes, and guarantee proper data representation among themes (Braun & Clarke, 2006). At this point, the researcher completed a review of the data extracts coded within the ‘miscellaneous’ category for reclassification. The fifth phase of this process aligned with the naming, defining, and further honing of themes (Braun & Clarke, 2006). Each theme was assigned a clear, concise, and informative name, then described in terms of individual meaning, data encompassed, and importance within the overall study. An examination of data extracts assisted in the selection of representational pieces used to support the accuracy and credibility of each theme.

The final analysis and creation of a detailed report, as delineated by the last stage of Braun and Clarke’s (2006) process, began after the solidification of patterns and themes. Descriptive accounts of what these conveyed, independently and collectively, were presented within this report in a way that attempts to catch the attention, trust, and confidence of the reader.
Participant quotations of varying lengths assisted in the validation of the patterns and themes presented (Braun & Clarke, 2006; Nowell et al., 2017). Ultimately, the resulting report discussed the interpreted data as it existed within themes and related to the research questions posed, as well as to the overall aim of the study. A discussion of the findings further investigated the interpretations, with particular attention to what they meant, if they aligned with the existing literature, and if further research was required.

**The Reflective Researcher**

In qualitative research, it is often advantageous for the researcher to provide a section of reflexivity. Within this research approach, it is generally accepted that the researcher is inextricably tied to the research itself. The identity, beliefs, values, assumptions, and experiences of the researcher, inevitably, affect the interpretation of the data collected (Bogumil et al., 2017; Gabriel, 2015). To increase researcher awareness and reader understanding of such immovable influences present throughout the research process, transparency through reflexivity is critical (Bogumil et al., 2017).

Aside from the qualitative nature of the current research study, I felt that personal reflexivity was imperative as I am, personally, deeply entrenched within the population to which this research pertains. I believed that a thoughtful review of my background and pre-existing beliefs was necessary to provide full disclosure and transparency by which to more deeply understand the role I would play within the meaning-making process of data collected and findings presented (Bogumil et al., 2017). By taking the time to do this, the interpretations made and conclusions reached by the researcher, as well as the reader, should become more comprehensible. Furthermore, it should better allow readers to examine the findings with a critical eye to what was brought to the table by both the researcher and themselves.
A visually impaired student at the postsecondary level, myself, I felt that I was able to identify with the participants within this study. That said, disabilities are unique to each individual, so I continually reminded myself that what works for me, may not work for someone else with a disability. I also have a relatively extensive amount of knowledge related to technology, which allows me to work with and understand an array of devices and software easily. This was not always the case with participants, so I needed to be tolerant of unfamiliarity and available for assistance.

Throughout my postsecondary education, I have participated in both face-to-face and online courses. For me, traditional face-to-face classes posed some significant obstacles and stresses, including transportation (access to and time consumed by), placement of assistive technology, and separation from classmates (often due to the location of electrical outlets required by assistive technology). I also found myself not participating as much as my peers, as it required more concentration and time for me to take notes, thus distracting me from being fully immersed in class discussions. All of this changed when I enrolled in online education, which provided me with a much more satisfying and beneficial educational experience. Many of the issues that plagued me in the traditional classroom no longer hindered me in this environment. Transportation was no longer a concern. I was able to participate in class discussions and interact with my peers fully. While online education has been conducive to my situation and needs, this was not true for all participants. For this study, I needed to recognize this bias toward online education and belief that it provides superior educational experiences for students with disabilities, so as not to allow it to unduly impact the findings and interpretations.

Of course, online education held its challenges for me, as well. Although some time-management issues were alleviated, others arose. Learning online, in my experience, required an
even more considerable amount of reading, which often ended in eye strain and fatigue. While I utilized a screen reader when possible, sometimes I needed to read the text visually to absorb the content. Other times, documents were unreadable by the screen reader, thus forcing me to overuse my eyes. In this case, reading took me substantially longer to complete than it would my peers, thus forcing me to manage my time more wisely. In my case, this meant reading for a short amount of time, taking a break, and then reading some more. In light of this, keeping up with the pace of my classmates was often a challenge. Furthermore, it was not always possible for me to complete the required readings by the instructor-placed deadline, which left me feeling frustrated and unprepared.

I believe that students with disabilities are required to put a higher amount of effort forth to achieve at the same level as their peers. This includes the dedication of more time, energy, and concentration. Because of this, imposed deadlines often interfere with the level of work submitted by students with disabilities and cause a higher level of stress than is necessary. While the existing literature may substantiate this, I needed to allow the research to speak independently of my beliefs.

In my experience, little is more frustrating and stressful to a student with a disability than encountering inaccessible instructional materials. In my courses, both face-to-face and online, instructors have often provided documents and articles for the class to read. As mentioned, while I would attempt to do so, I was not always able to complete these readings on time due to inaccessibility. The most significant example I’ve experienced is the scanning of printed text as either an image or a non-editable text file, both of which contain text that is often unrecognizable to screen readers. In an attempt to remedy this, I have tried several different optical character recognition (OCR) software programs and applications, but, unfortunately, these often proved
insufficient in accurately converting image or non-editable documents into readable text documents for me. As many options are available for this type of software, there are many I have not tried. In light of this, it is my understanding that, although some of the participants may have had a similar experience with inaccessible instructional materials, unlike me, some may have been able to find a better resolution.

Due to my experience, I hold some strong biases that have likely shaped my interpretation of the findings. Although it is acceptable for these biases to influence my interpretations mildly, they must not override the data and obscure the accuracy of the findings. For instance, my personal experiences and biases needed not to lead me to seek and report only findings that supported my beliefs. To help achieve this goal, I took special care when engaged in the interpretation process and tempered my personal beliefs to an extent. I intended to represent, to the best of my ability, the feelings and experiences of the participants involved.

**Summary**

A qualitative research approach informed by three instruments—a questionnaire, an interview, and a journal entry—was utilized to achieve the goals proposed for the present study. Participants selected through convenience sampling, based on availability and eligibility, completed each of these instruments. Criteria for determining eligibility included postsecondary admittance, diagnosis of a visual impairment, and involvement in online education. As participation was voluntary, individuals received compensation for each instrument completed and were free to withdraw at any point without penalty.

Several steps were taken in an attempt to amass robust, trustworthy information regarding the phenomenon under study, while also protecting participants. Before beginning the study, the researcher completed training in human research and attained IRB approval. Strategies
such as bracketing, researcher-participant rapport, triangulation, member checking, and creating an audit trail helped ensure trustworthiness and allow for the replication of the study. Confidentiality across all aspects of the study was upheld through the use of randomly generated PINs and password-protected storage.

Finally, as this research depended on the lived experiences of each participant, it was imperative to elicit open and honest information, which, during the review process, was accurately represented. To adhere to these essentials, the researcher utilized open-ended, evolving questions and refrained from unduly influencing either the participants or the findings. Instead, themes were naturally developed through the use of inductive, data-driven thematic analysis, specifically, Braun and Clarke’s (2006) six phases of analysis. These themes and patterns will now be presented in Chapter 4, accompanied by supporting quotations from participants. This organized presentation of data will constitute the findings of the current study.
CHAPTER FOUR:
RESEARCH FINDINGS

The purpose of the current study was to examine the experiences of online higher education students with visual impairments in using artificial intelligence-based virtual assistants. Three specific aspects were of interest, including the features used, the experiences had, and how use minimized disability-related stress. For study recruitment, an announcement was posted to elicit interest on a closed Facebook page run by the National Association of Blind Students. If interested, individuals were directed to complete a demographic questionnaire, which collected the information needed to establish availability and verify eligibility. Once deemed eligible, participants were asked to complete one interview and one follow-up journal entry to fulfill the requirements of the study. While interviews varied in length, each focused on the general topics outlined by the interview protocol (see Appendix F).

Over the next several pages, a significant amount of information related to and obtained during the current study will be presented. First, a description of the study sample will be provided to build a foundation upon which the reader can better understand the findings and evaluate their transferability to the population under study, as well as others not currently investigated. Next, the findings will be presented in relation to each research question. Participant quotations appropriated directly from the data collected will be used to provide support and context for these findings. Finally, in an attempt to assist with the minimization and clarification of the content dispensed, a summary will be provided.
Sample Demographics

The initial goal of the researcher was to identify seven to twelve individuals who expressed interest in and met the eligibility criteria for participation in the study. Although thirteen individuals showed interest by completing the demographic questionnaire, only seven qualified to participate. In an effort to determine the transferability of study findings, information on several demographic characteristics was gathered. Within this sample, the level of diversity found in each of these characteristics varied. Gender, for example, was close to being evenly distributed with three male participants and four female participants. Age was similarly distributed with four participants age 25 or younger and three participants age 26 or older. Although not as evenly distributed, enrollment status displayed diversity with five participants enrolled full-time and two enrolled part-time. Regarding the academic level of participants, five undergraduate students and two graduate students comprised the sample, thus slightly favoring the undergraduate side. A more detailed breakdown showed that two participants were first-year undergraduates, one was a second-year undergraduate, two were third-year undergraduates, one was at the master’s level, and one was at the doctoral level. Major fields of study represented in the sample varied slightly, including three participants in computer science, two in education, one in foreign language, and one in music. All participants reported having taken at least one online course with four participants not enrolled in online courses at the time of the study, two enrolled in at least one asynchronous course, and one enrolled in at least one synchronous course. Postsecondary institutions in seven states across the nation admitted study participants, thus demonstrating diversity in location.

As the diagnosis of a visual impairment was one of the eligibility criterion and a major characteristic defining the population being studied, the collection of data demonstrating the
presence and distribution of this characteristic was necessary. Three diagnoses were represented within the sample, with three participants identifying as partially or legally blind, two as totally blind, and two as other visual impairment. Table 3 presents a cross-tabulation of all demographic characteristics in terms of the diagnoses reported.

<table>
<thead>
<tr>
<th>Table 3. Demographics by Diagnosis</th>
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<tbody>
<tr>
<td>Demographics</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>≤25</td>
</tr>
<tr>
<td>26≤</td>
</tr>
<tr>
<td>Enrollment Status</td>
</tr>
<tr>
<td>Full-Time</td>
</tr>
<tr>
<td>Part-Time</td>
</tr>
<tr>
<td>Level</td>
</tr>
<tr>
<td>Undergraduate</td>
</tr>
<tr>
<td>Graduate</td>
</tr>
<tr>
<td>Online Enrollment</td>
</tr>
<tr>
<td>Synchronous</td>
</tr>
<tr>
<td>Asynchronous</td>
</tr>
<tr>
<td>Not Currently</td>
</tr>
<tr>
<td>Major Field of Study</td>
</tr>
<tr>
<td>Computer Science</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Foreign Language</td>
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<tr>
<td>Music</td>
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</table>
As this study focused on the use of intelligent virtual assistants, it was essential to gather data pertaining to the usage and preferences of this technology. When asked how frequently they used virtual assistants, six participants reported using them several times a day, while one reported a few times a week. As shown in Table 4, when participants were questioned about which IVAs they used, Google Assistant was mentioned most at six times, Amazon’s Alexa next at five, and Apple’s Siri least at four. As is evident by the totals in this table, participants often reported using more than one virtual assistant. In fact, three reported using two different virtual assistants, while another two reported using three different virtual assistants.

<table>
<thead>
<tr>
<th>Virtual Assistants</th>
<th>Type of Device</th>
<th>Mobile</th>
<th>Stationary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon’s Alexa</td>
<td></td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Apple’s Siri</td>
<td></td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Google Assistant</td>
<td></td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

Each of these virtual assistants is available on different types of devices, including those that are mobile (i.e., smartphone or tablet) and stationary (i.e., smart speaker). With the exception of one participant, all reported utilizing IVAs on both types of devices. As displayed in Table 4, participants reported using more mobile-based assistants than stationary. Of the five participants that reported using multiple IVAs, all discussed using them on different types of...
<table>
<thead>
<tr>
<th>Participant</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td>This 46-year-old female is a partially blind special education teacher and full-time doctoral student in education who has previously taken online courses. She reported using Amazon’s Alexa and Apple’s Siri several times a day via a smartphone, smart speaker, or computer with an excellent overall experience.</td>
</tr>
<tr>
<td>Participant 2</td>
<td>This 24-year-old female is a totally blind teacher and part-time masters student in education who was taking at least one synchronous online course at the time of the study. She reported using Amazon’s Alexa and Apple’s Siri several times a day via a smartphone, tablet, or computer with an excellent overall experience.</td>
</tr>
<tr>
<td>Participant 3</td>
<td>This 21-year-old female is a totally blind full-time undergraduate student in music who has previously taken online courses. She reported using Google Assistant several times a day via a smartphone, smart speaker, or computer with an excellent overall experience.</td>
</tr>
<tr>
<td>Participant 4</td>
<td>This 19-year-old female with a high visual acuity and diminished depth perception is a full-time undergraduate student in computer science who has previously taken online courses. She reported using Amazon’s Alexa and Google Assistant a few times a week via a smartphone, smart speaker, or computer with a good overall experience.</td>
</tr>
<tr>
<td>Participant 5</td>
<td>This 19-year-old male is a partially blind full-time undergraduate student in computer science who was taking at least one asynchronous online course at the time of the study. He reported using Amazon’s Alexa, Apple’s Siri, and Google Assistant several times a day via a smartphone, tablet, smart speaker, or computer with an excellent overall experience.</td>
</tr>
<tr>
<td>Participant 6</td>
<td>This 31-year-old male is a partially blind part-time undergraduate student in foreign language who has previously taken online courses. He reported using Google Assistant several times a day via a smartphone or computer with a good overall experience.</td>
</tr>
<tr>
<td>Participant 7</td>
<td>This 36-year-old male with a diminished visual acuity and light sensitivity is a full-time undergraduate student in computer science who was taking at least one asynchronous online course at the time of the study. He reported using Amazon’s Alexa, Apple’s Siri, and Google Assistant several times a day via a smartphone, tablet, smart speaker, or computer with an excellent overall experience.</td>
</tr>
</tbody>
</table>
devices. Interestingly, one participant reported using the same virtual assistant on both mobile and stationary devices.

To better understand some of the possible factors affecting the use of and experiences with intelligent virtual assistants as shared by each participant, it is necessary to gain a clear picture of who each of these individuals is. In an attempt to help put the demographic information presented above into perspective, a brief profile of each participant is presented in

**Intelligent Virtual Assistant Features Used**

According to the existing research discussed in Chapter 2, many features are available on intelligent virtual assistants that may prove helpful to students in various aspects of their lives. For the current study, Research Question 1—What features of intelligent virtual assistants are used by higher education students with visual impairments?—was interested in uncovering the specific features used by students with visual impairments. As study participants provided an overwhelming amount of information on this topic, it was imperative that the data be organized and simplified for coherent review. To this end, data collected was arranged based on a multi-level format. The first level divided the features reported into purposes with the second level grouping them by category. Finally, the third level named the specific features, themselves, that were reported by participants. Although this data could be evaluated in any number of ways, it was determined by the researcher that, to directly and adequately answer this research question, features reported by the study participants would be identified and then discussed in terms of how many individuals reported their use, as well as how these individuals used them and for what reasons.

As shown in Figure 2, the current study identified two purposes for which participants used IVAs—academic and non-academic. In this study, an *academic purpose* constitutes that
Figure 2. Frequency of Categories by Purpose

which was directly related to education or personal growth, whether school-related or otherwise. A *non-academic purpose*, on the other hand, refers to that which was related to everyday life, although may indirectly provide support for educational endeavors. Figure 2 also illustrates the identification of ten categories that are divided equally between these two purposes, while demonstrating that participants did not indicate equivalent usage for both. Instead, participants reported using intelligent virtual assistants for non-academic purposes (55.8%) more frequently than for academic (44.2%).
**Academic Purposes**

Participants within the current study identified several ways in which they use intelligent virtual assistants for academic purposes in both online and face-to-face classes. A majority of the features reported were used within both course delivery modes and aligned with those recognized within the existing literature. Specifically, eleven features spanning five categories were reported by participants as being employed for such purposes, as shown in Figure 3. These categories include Language; History & Social Studies; Mathematics, Science & Technology; Research & Knowledge Acquisition; and Teaching & Presentations.

![Figure 3. Frequency of Academic Features by Category](image-url)
**Language.** As reading and writing are significant aspects of academia, many participants discussed using virtual assistants to help with related tasks. In fact, within this study, Language ranked as the second most reported academic category utilized. More specifically, six out of seven participants, or 85.7%, discussed using at least one category-related feature available on their virtual assistant. Three main features were classified within this category, including Definitions, Spelling & Synonyms; Grammar & Pronunciation; and Translation.

In the course of reading, individuals may frequently stumble upon unfamiliar words. Similarly, writing may often be difficult when one does not excel in spelling or in finding alternative words to use. These are some of the reasons five out of seven participants (71.4%) indicated the use of an IVA for help with Definitions, Spelling & Synonyms. Participant 2, for example, mentioned using Amazon’s Alexa to “help look up the meanings of unknown words and how to spell words when completing assignments for class.” When explaining why he liked to use this feature, Participant 5 stated that the virtual assistant is “just kinda right there,” and that it is “easier just to ask it than have to open up a web browser, type it out, and know what it is.” Participant 1 agreed with this assertion and expressed that:

> Accessing the information on my phone by voice, rather than by selecting the folder, then app, saves me time and frustration. The use of [A]lexa helps me to overcome the barrier of my inferior spelling. If I can check the spelling and or [sic] definition while I’m typing, I save time and feel less stressed.

While this participant conveyed pleasure in using virtual assistants to check spelling and definitions, she also mentioned that Amazon’s Alexa is “not that great at synonyms.”
With only two (28.6%) participants discussing it as a virtual assistant feature they used, Grammar & Pronunciation was a lesser exploited feature within the Language category. Participant 6 explained his use of this feature while completing French homework as follows:

Occasionally, if I don’t have my…if I don’t feel like looking and searching through my PDF [textbook], I will ask Google…“Google, what is the conjugation for this?” or “Okay Google, explain to me this subjunctive,” or “What’s the difference between the passé composé and the imparfait?” or “What’s a conditional?” Stuff like that.

In considering the use of an IVA for pronunciation, Participant 7 wondered how a user could convey the word of interest if they didn’t first know how to pronounce it. In answer to this ponderance, Participant 5 explained that he would guess how to pronounce the word and let the virtual assistant correct him, if necessary.

Similarly, Translation, the final feature within this category, was reported to be used by two out of seven participants (28.6%). This feature proved helpful to Participant 5 when translating words between English and Spanish. Participant 6 also found it useful when translating simple English words to French, but conveyed a preference to “use the IVA to open the website and…read it” himself for more complex words or phrases.

**History & Social Studies.** While being familiar with the Constitution of the United States and knowing state capitals are important aspects of one’s education, this knowledge is often only needed in limited situations. Similarly, participants within the study reported only moderate use of features within the category of History & Social Studies, which was described by 57.1% of participants as encompassing IVA features that they use. Not only did participants employ features within this category less frequently than others, but they also identified fewer features that were, subsequently, assigned to it. Specifically, the two features recognized within
the category of History & Social Studies were Historical Information and News & Current Events.

One of the least used features among all identified by the study participants was that of retrieving Historical Information (n=1). Participant 6 relayed his use of an IVA to learn about historical events, asking, for example, “What happened to Space Shuttle Columbia?” This participant went on to state that he uses the virtual assistant to ask “questions that are easier to find,” which, in other words, means that they are more common knowledge questions.

Many individuals with visual impairments strive to become better-informed people by gaining knowledge of what is happening in the world around them. To achieve this goal, four out of seven participants (57.1%) within this study indicated using an intelligent virtual assistant to stay up-to-date with News & Current Events. Although such information is obtainable through many formats, including newspapers, television, and radio, Participants 1 and 7 conveyed their preference for receiving it via a virtual assistant. “We’re not gonna sit down and read the newspaper,” said Participant 7 about the difficulty persons with visual impairments often have when engaging in this traditional practice. He, instead, points to the fact that the virtual assistant “brings that news content to us,” which can be a much less frustrating and time-consuming way to receive this information.

Mathematics, Science & Technology. In education, STEM subjects—science, technology, engineering, and mathematics—have become the focus of many and are seen to penetrate all aspects of our lives in the 21st century (Engineering for Kids, 2016). Within the current study, the category of Mathematics, Science & Technology was identified by four out of seven participants (57.1%) as being an area within which they used their intelligent virtual
assistants. Similar to the previously discussed category, only two features were allocated to this category, including Calculations & Conversions and Commands & Variables.

While reported by less than half of the participants (n=3) within this study, Calculations & Conversions was deemed to be a beneficial feature in many settings. Not only did Participant 1 speak of using it for her own mathematical needs when she didn’t “feel like getting the calculator out,” but she also taught the children in her classroom to use Amazon’s Alexa for assistance in this area. Participant 5 confided that he tends to use this feature because it’s “much faster than having to mess with a physical calculator,” and finds it to be pretty accurate, “as long as it isn’t graphing.” Alternatively, Participant 7 discussed using this virtual assistant feature for measurement conversion, especially when cooking.

Although infrequently mentioned within this study—reported by only one participant (14.3%)—the Commands & Variables feature was discussed as an attractive alternative to manually acquiring such information. In this instance, the word command refers to pieces of computer language used to tell an application what to do (Fisher, 2019). As it is imperative to enter commands precisely (Fisher, 2019), the individual may need to double-check their memory while entering. Participant 4 supported this sentiment by stating that she “always mess[es] up the syntax for the split and join commands,” and confided that it’s “a lot to remember if you’re trying to work quickly.” Beyond merely asking an intelligent virtual assistant to provide individual commands when needed, this participant discussed the potential for creating a skill or application that would deliver more in-depth and widespread information within this area. The term variables, on the other hand, refers to numbers or pieces of information required to complete an equation or formula. For example, Participant 4 talked about using an IVA to determine the specific heat capacity of an element when completing a science lab report. She
said that asking a virtual assistant for this information was “easier than having to go to a new
window, Google it, make sure I have the number copied right, go back to my lab book, make
sure my data’s right, and then go back into the Word document.”

Research & Knowledge Acquisition. At the college level, students are often tasked with
consuming large amounts of information, whether provided by instructors or individually
selected. The identification of Research & Knowledge Acquisition as the most frequently
reported academic category within the current study reflected such demands. This ranking
conveyed a high level of relevance among the participants with all seven (100.0%) discussing the
use of at least one feature assigned to the category. Three features were recognized as being
beneficial, including Internet Searches, Apps & Websites, and Reading & Podcasts.

Conducting Internet Searches via a virtual assistant was revealed by the current study to
be a popular practice. With all participants (100.0%) reporting the use of this feature, not only
was it rendered the most frequently reported among academic but across all features identified
within the study. Participants 1 and 3 both focused on using virtual assistants for research. For
Participant 1, using Apple’s Siri to search the Internet for research sources makes traveling on a
paratransit bus more productive. Upon finding articles to read, though, this participant admits
frequently needing to transition to Apple’s screen reader, as this IVA does not often read such
content aloud. Participant 3 illustrated a similar strategy with Google Assistant but mentioned
that “a lot of the stuff it’ll read,” thus often removing the need for a screen reader. Participants 4
and 5, on the other hand, each concentrated more on knowledge acquisition. The former declared
this feature especially useful when engaged in a debate and said that it was “easy and
convenient” to use, regardless of where you are when you need the information. The latter
disclosed that he not only utilizes this feature while completing his homework but also for
personal growth whenever a question pops into his head. Interestingly, two participants addressed their preference for conducting Internet Searches through Google Assistant. Participant 3 stated that:

[Google Assistant] does have a little more depth to it, in a way, because it’s connected to Google, and, of course, Google is a search engine which has a lot of information. So, it does have a little more capabilities [sic].

Participant 7 agreed by sharing that:

I would prefer Google [A]ssistant providing directions over Siri[,] but this is because of the source of information. For general knowledge questions, I prefer Google [A]ssistant over Siri and Alexa as Google seems to produce more accurate verbal results instead of query results.

Through these quotations, the participants conveyed their belief that Google Assistant provides more accurate and in-depth information in a more palatable way due to its connection with the Google search engine.

With six out of seven participants (85.7%) discussing the use of a virtual assistant to access Apps & Websites, this feature follows closely behind the previous as the second most reported academic feature within this study. While this feature may seem similar to Internet Searches, there is a distinct difference. Internet Searches are expected to return data for review, where Apps & Websites refers to merely accessing sources. Participants 1, 2, and 5 agree that using an IVA to open apps is much faster than doing it manually, thus saving them time and diminishing frustration. Interestingly, Participant 5 dubbed using Apple’s Siri to activate the company’s screen reader as “super useful,” mentioning that “there’s not really a good way you can turn on VoiceOver.” When accessing the desired website, Participant 6 may use his IVA,
after which he will use other means to enter data or review content. Again, this may sound very similar to how participants reported using the Internet Searches feature, but there is a difference—this participant does not expect to learn of new sources, but, instead, knows his desired destination.

While Reading & Podcasts, as a feature, was only reported by three participants (42.9%), a majority of the participants in the study communicated an interest in using it in the future. Participant 1, for instance, discussed her preference for reading with Amazon’s Alexa:

I do use Amazon [Alexa] a lot and I read…I don’t usually read my textbooks on there. I can ’cause I can pull them up on Kindle or whatever and put them up on my computer, but if it’s my textbooks, I do prefer to look at them on the computer because that way if I like something or find something that’s important, I can note it…. But what I do use [Alexa] to read to me is the different books that I download that are more like professional development books. So I’m reading three professional development books, right now, and when I’m getting ready, I will often have her just read those to me.

Alternatively, Participant 5 showed interest in using an IVA to read his textbooks but stated that many are PDF documents to which this technology does not have access. Although Participants 2 and 7 have not used this feature, they both expressed an interest in doing so. Participant 7, for instance, was drawn to the idea of being able to read while moving around the house, thus allowing him to multitask. On the contrary, Participant 4 conveyed disinterest in utilizing a virtual assistant to read for her, stating that:

I generally, probably, read faster than I listen and I also find myself getting distracted pretty easily if I don’t have something to fidget with or do. So that was…one of my problems with the Computer Science textbook because I just…I found myself sitting
there listening to it, then I’d be like, “I find it interesting and all, but what if I…I should check my Facebook and see what’s going on…I should check my e-mail…oh, I should get back to this person from my fraternity,” and then, suddenly, before you know it, the chapter’s over and then I don’t know a single thing.

As for podcasts, Participants 5 and 7 affirmed that using virtual assistants to listen to these informative broadcasts—whether assigned by an instructor or to gain knowledge on a topic of personal interest—was easy. Participants 5 shared that:

My teachers will often assign projects on audio podcast, and finding it with the voice assistant makes it really easy.

**Teaching & Presentations.** The fifth and final academic category identified within this study also acts as the only feature reported within it—Teaching & Presentations—both mentioned by two out of seven participants (28.6%). As an academic category, it ranked as the least reported and, as a feature, one of the least. Participant 1 described using a virtual assistant to help her students learn math, as well as to test knowledge through trivia games. Participant 7, on the other hand, explained how he uses IVAs to teach his two-year-old son things like animal sounds. While this participant indicated frequently employing Amazon’s Alexa for such activities, he relayed that this IVA was hit or miss on providing the information. Instead, he boasts that Google Assistant “nails it every time.” The same participant showed interest in using a virtual assistant to help with presentations and speeches, stating that it would be preferable to the mandatory memorization he usually has to do because of his visual impairment.

**Non-Academic Purposes**

More and more, people can read online, see on TV and hear from friends details of the many ways intelligent virtual assistants can be used in their daily lives. Although some of these
uses may help with academic tasks, many are non-academic in nature. As shown in Figure 4, the participants within this study provided information that helped identify five non-academic categories containing fourteen features. The non-academic categories recognized within the study include Communication, Entertainment, Health & Wellness, Daily Living, and Organization.

**Communication.** As social beings, we are nearly always communicating with one another in some way. It seems appropriate, then, that the information proffered within this study indicated the use of intelligent virtual assistants for this purpose. More specifically, five out of

![Figure 4. Frequency of Non-Academic Features by Category](image)
seven participants (71.4%) conveyed that they have used at least one communication-related feature offered by a virtual assistant. Within the category of Communication, three such features were assigned, including Announcements & Calls, E-mails, and Text Messages.

A slight majority—four out of seven participants (57.1%)—confessed their use of intelligent virtual assistants to make Announcements & Calls. Two participants relayed that using Apple’s Siri to place phone calls makes this task both quicker and easier. Participant 5, for instance, mentioned that:

I use a cane when I walk places, so it is hard a lot of times to text while I am walking. Using the [virtual] assistant makes it easy to do the things like texting or calling.

Participant 7 mentioned using a different virtual assistant—Amazon’s Alexa—for making calls and broadcasting announcements to rooms throughout his house even when away from home.

While three of the participants (42.8%) reported using a virtual assistant to compose E-mails, none commented on using this feature to read them. Unlike most of the other features discussed, though, all participants who spoke of utilizing this feature agreed that it was not a particularly helpful one. Participant 1 expressed experiencing inferior performance when composing extended pieces of text via an intelligent virtual assistant, “causing [her] to spend far too much time editing [her] dictation.” Participant 2 explained her aversion to using IVAs for composing e-mails by saying:

I don’t really use [virtual assistants] too often for e-mails. Usually…so my iPad has a Bluetooth keyboard and so I’ll usually use that for e-mails, but sometimes I’ll use the dictate feature on occasion, but, typically, I type out my e-mails… ’Cause with e-mails…usually my e-mails are a lot longer and there’s more formatting involved and so
it’s just harder to be able to use Siri or something like that in order to do that. So it’s just easier to type out those.

Of the participants who mentioned this feature, though, all acknowledged that IVAs might work better for shorter forms of written communication.

Coincidentally, one such type of written communication was discussed by four out of seven participants (57.1%) as being a feature for which they used an intelligent virtual assistant—Text Messages. Participant 2 reported that using an IVA to write and send text messages was faster and easier than doing so with the on-screen keyboard, which she confessed as being a difficult task. Participant 5 agreed that using a virtual assistant can make text messaging much easier when traveling with a cane. As helpful as participants found this feature to be, two mentioned drawbacks related to its use. Participant 2, for instance, lamented the need to “have the whole text message planned out before you say it.” Participant 7, on the other hand, voiced a concern about accuracy:

I’m still not convinced that [Siri’s] gonna say the right thing when I ask her to text message someone, but she does a good job. I’m usually pretty short and quick on the messages, so she does, usually, a good job of doing that.

**Entertainment.** In today’s world of multimedia, it seems that we are constantly searching for engagement through multiple avenues. This sentiment became evident when reviewing the data collected within the current study, as all seven participants (100.0%) reported using an intelligent virtual assistant for features related to Entertainment. Specifically, participants discussed using virtual assistants to interact with Games, Music, and TV & Videos.

Games may fulfill a variety of needs throughout our daily lives, such as providing a temporary escape from reality or a connection with others (Gallagher, 2019). Within this study,
four out of seven participants (57.1%) discussed taking advantage of Games available through their preferred virtual assistant(s). Participant 1, for example, talked about playing trivia games for personal use, as well as to interact with and entertain her students. Participant 2 mentioned enjoying both trivia and interactive fiction games—some of which “could be considered educational”—on Amazon’s Alexa, which she deemed to “have some kind of fun things.” With a young son at home and many visiting nephews, Participant 7 communicated often using a virtual assistant to play games with them, whether for entertainment or educational reasons.

With numerous music services available today, most of which intelligent virtual assistants can stream, people frequently interact with this media format in their daily lives. Perhaps unsurprisingly, then, using a virtual assistant to play Music was one of the most commonly reported features across all identified within this study, as well as those utilized for non-academic purposes. With all seven participants (100.0%) affirming their use of this feature, examples provided were diverse. Participant 4, for instance, discussed controlling music by voice when her hands were dirty or otherwise occupied. She finds this to be very convenient and asserts that “voice control will work just as well” as using the on-screen keyboard. She further declared this feature to be useful for her pet rabbit, as, when listening to oboe music, he becomes “absolutely chilled out beyond belief.” Participant 5 initially stated that he uses an IVA to play music while completing schoolwork, but, upon further reflection, acknowledged that he uses it when he’s doing “pretty much anything.” While Participant 6 confirmed using an IVA for music, he described a time when it repeatedly played the wrong song after requesting it by title. He did, however, mention having more success when using this technology to identify song titles. Though Participant 7 established that he uses virtual assistants to play music, he also revealed utilizing this technology to assist with relaxation by playing ambient noise.
Perhaps a less known capability of virtual assistants is their use in watching TV & Videos. Just under half of the sample within the current study—three out of seven participants (42.9%)—mentioned using an intelligent virtual assistant in this way. Interestingly, some use this feature to watch content directly on their IVA-equipped device, while others use the virtual assistant to control external display devices. Participant 3, for example, described watching content from YouTube and Netflix on her Google Assistant-enabled smartphone, while Participant 7 mentioned that he “used Alexa and Xfinity voice options to pull up the source and show [he] want[ed] to watch pretty frequently” on his television. Although Participant 1 reported having never used this feature, she expressed the desire to achieve a similar scenario as Participant 7. Her reason for this was to minimize the difficulty she experiences when changing channels on the television due to her visual impairment.

**Health & Wellness.** Within our current society, we are frequently reminded to eat right and exercise regularly. In an attempt to achieve such Health & Wellness goals, just over half of the participants (57.1%) in this study expressed using an intelligent virtual assistant to help. Specifically, two features were discussed as being of assistance in this category, including Recipes & Nutrition and Exercise.

Following recipes can be challenging and time-consuming for chefs with any level of expertise when they have a visual impairment. Instead of merely glancing at a traditional cookbook, those with visual impairments must often use alternative formats or assistive devices. Luckily, virtual assistants can be used to help with this and other kitchen-based tasks. In fact, two out of seven participants (28.6%) reported using their IVA to assist with Recipes & Nutrition, while two more mentioned having an interest in doing so in the future. Participant 2 stated that “cooking is difficult if trying to follow a recipe that is in braille,” but that “Alexa
helps with this” by audibly presenting both the ingredient list and the steps, as needed. She also mentioned frequently asking her virtual assistant for nutritional information, such as calories and product ingredients. As Participant 4 currently lives in a dorm without a kitchen, she has not yet used this feature but expressed an interest in doing so when she moves to a fully-equipped apartment in the coming school year. This participant stated that:

Being able to ask, verbally, what to do next and then listen and follow that would be, for me, more peace of mind than trying to manage either my CCTV or my laptop while I’m cooking… I don’t want to get either of them messy. They’re both expensive devices.

At 28.6%, less than a third of the participants (n=2) within this study reported using an intelligent virtual assistant for Exercise. Participant 7, for example, described using Apple’s Siri to start the Strava app on his phone to keep track of his frequent bicycle rides. Participant 1, on the other hand, talked about using a virtual assistant to record her daily steps. Interestingly, while many stationary devices equipped with virtual assistants are capable of helping with Exercise-related tasks, these participants described using smartphone-based virtual assistants for this feature.

**Daily Living.** Throughout our daily lives, we complete innumerable tasks without giving any thought to them. For individuals with visual impairments, though, these tasks may prove a bit more difficult and time-consuming. With six of the seven participants (85.7%) within this study discussing the use of at least one Daily Living feature, this category proved to be a significant one. In total, three features were classified within this category, including Current Conditions, Directions & Locator, and Home Automation.

Every morning we wake up and wonder about the day. Will it rain? Will it be hot? How should I dress for today’s weather? And, by the way, what time is it? Well, no different from
anyone else, many of the participants in this study reported the need to answer such questions. At 57.1%, a slight majority stated that they use a virtual assistant to learn about Current Conditions. Participants 2 and 5 confided that they use IVAs to check the weather forecast in the morning, with the latter asserting that he does this in order “to know what to wear.” In addition to requesting weather reports in the morning, Participant 7 disclosed that he asks Amazon’s Alexa for both the weather and the current time frequently throughout the day.

How many times a day do you lose your keys or have trouble finding your cell phone? How often do you need directions? While these may seem like trivial questions to you, they hold significance for individuals who are visually impaired. In support of this statement, five out of seven participants (71.4%) reported using a virtual assistant for the feature labeled Directions & Locator. More than once, Participant 1 spoke of using an IVA to obtain addresses and directions, stating that it was a “useful option” that she makes use of daily because it provides “easy access to information” needed when on the go. Participant 7 also stated that he acquires addresses from his virtual assistant, but has experienced issues when attempting to procure walking directions from Apple’s Siri. While this participant reported using both Apple’s Siri and Google Assistant for directions, he expressed a preference for the latter due to “the source of information.” When navigating the outdoors alone, Participant 5 mentioned using a virtual assistant to determine his current location through the attainment of street names and building numbers. Using a virtual assistant in this way could prove invaluable for persons who are visually impaired, as road signs and house numbers are often difficult, if not impossible, to see. Not only can a virtual assistant be employed to provide a person’s current location, but it can also be used to locate other items. Participant 4, for example, discussed using her smartphone to ask Google Assistant where she
could find a specific type of food, while Participant 5 mentioned having his IVA locate shipments or lost items, such as his phone.

As a significant feature boasted by virtual assistants, Home Automation is not to be overlooked. Three out of seven participants (42.9%) discussed using this feature, as well as their desire to expand that use. Participant 1 discussed using a virtual assistant to answer the door and confessed that, even though she had purchased smart light bulbs months earlier, they were still in their original packaging due to her lack of knowledge on how to set them up. Participant 7 described the many ways he uses a virtual assistant to interact with his home:

I have [Amazon’s Alexa] for smart home purposes, so I have it controlling many things around my house, so I can turn on lights—on and off. I have finally got functionality for a ceiling fan in my bedroom. I have a few things where I can now interact with her to do that.

He also conveyed an interest in smart home cameras that offer facial recognition, thus allowing an intelligent virtual assistant to determine and announce who is within the camera’s view. Such a capability could prove invaluable to those with visual impairments, since it would deliver additional security and, thus, greater peace of mind.

Organization. Nowadays, most people lead busy lives with multiple schedules to juggle and various responsibilities to fulfill. In light of this, Organization has become paramount to the smooth and efficient running of one’s daily life. As students, teachers, and family members, the participants within this study are no exception. In fact, all seven participants (100.0%) reported using at least one of the three features assigned to this category. Specifically, these include Calendars, Reminders & Lists, and Timers & Alarms.
Regardless of how many busy schedules one must keep track of, it is often easy to forget tasks and events. In an attempt to prevent this from happening, five out of seven participants (71.4%) in the current study mentioned using an intelligent virtual assistant to edit and monitor their Calendars. While Participant 1 spoke of using her virtual assistant to add personal appointments to her calendar, Participant 2 mentioned using it for more work-related events. This latter participant explained her use by saying:

I use Siri all the time with my calendar. That’s another thing I use it for. Especially for work, if I need to schedule when I have kids’ case conferences or when I have staff meetings or professional developments or different things like that. I use Siri a lot to put that in because it’s a lot easier to use Siri to schedule the events than it is to go into the calendar with VoiceOver and do it.

Participants 3 and 5 agreed with this sentiment. The former affirmed that she never does this type of task manually, while the latter confessed that “this is just a really fast, no fuss way to add and read calendar events.” In contrast, Participant 4 mentioned a preference “to write in a physical little book,” which, for her, is a more effective way to commit things to memory.

Another way for individuals to stay organized and keep track of their responsibilities is by using Reminders & Lists. In this study, six out of seven participants (85.7%) admitted to making use of this feature with an intelligent virtual assistant. Participants 1 and 6 mentioned mostly using IVA-based reminders in their personal lives. The former, for example, described setting reminders for appointments and daily tasks, while the latter illustrated value in using them to ensure on-time bill payment. As an explanation for why she used this virtual assistant feature, Participant 4 confessed that she’s “just too lazy to go into the app, itself, and use [her]
fingers.” As for lists, Participant 2 discussed using her virtual assistant to remind her of what items she needs to purchase at the grocery store.

People use Timers & Alarms for many reasons and at many points throughout their daily lives. In this study, five out of seven participants (71.4%) reported using an intelligent virtual assistant to set both. Three participants—Participants 2, 5, and 7—mentioned using a virtual assistant to set timers while cooking. Participant 7 elaborated on his use of this feature:

I have multiple timers—you can name them, now, so that’s awesome—so I have four or five of them going at once. And then we’ll have my daughter do some computer time and stuff and we have timers for her on that.

Participants 5 described similar ways of using this feature:

I use it a lot for setting timers…whenever I’m cooking, I’ll do it then, or if I wanna work for thirty minutes and then take a break, I’ll set a timer or alarm.

When providing a reason for using this feature, Participant 5 pointed to the ease and time-effectiveness of enlisting the help of an intelligent virtual assistant as opposed to completing such tasks manually.

**Experiences in Using Intelligent Virtual Assistants**

Throughout our lives, we are continually experiencing the world around us. While many of us observe the same or similar occurrences, our personal experience is often unique. Research Question 2 in the current study—What experiences are reported by higher education students with visual impairments in regard to using intelligent virtual assistants?—endeavored to learn about the experiences had by each participant while using their preferred virtual assistant(s). In an attempt to organize the data gathered, six themes were identified, including accuracy, convenience, familiarity, helpfulness, outlook, and user-friendliness.
Accuracy

As the main and, sometimes, only mode of communication with intelligent virtual assistants is through verbal commands, most users have thoughts on the listening and comprehension abilities of this technology. Within this study, participants spoke both positively and negatively about these abilities. For example, two participants discussed, to varying degrees, the need to repeat themselves when communicating with a virtual assistant. Participant 2 mentioned this in passing:

I think, generally, it’s pretty good. Sometimes it doesn’t quite understand you correctly and you have to repeat yourself, but, yeah, usually my experience has been okay…pretty good.

Participant 6, on the other hand, conveyed a more urgent frustration when using Google Assistant:

I’d ask it a question and it would go, “I’m sorry, I don’t understand,” “I’m sorry, I don’t understand,” “I’m sorry, I don’t understand.” I’m like, “Then why…am I using you?” So, literally, I’d unplug it and it just, literally, it will sit there.

As Apple’s Siri frequently does a good job with understanding his text message dictations, Participant 7 acknowledged that the way he phrases certain requests may be to blame for the tendency this virtual assistant has for misunderstanding him. Regardless of the reason for such inconsistency, this participant expressed a lack of confidence in persistent accuracy with this virtual assistant. Although Participant 5 shared that his intelligent virtual assistant usually “tends to be pretty accurate, as far as recognizing the numbers and stuff you say,” he also mentioned that the surrounding environment could be cause for misunderstandings and accidental activations.
Convenience

Intelligent virtual assistants are available on a variety of devices, including computers, smartphones, smart speakers, and more. As a result of its mainstream access and hands-free voice control, a large part of the general population utilizes this technology. Several participants weighed in on both of these points, with five speaking about its mainstream presence and all seven discussing its hands-free capabilities. Participant 1 had this to say about the first point:

I find mainstream technology such as [A]lexa and [S]iri the most fun because it is something being used by the general public, and not an assistive technology, even better, the cost is usually more affordable.

Regarding the second point, this participant stated that:

The hands free [sic] solutions are also helpful. I can answer the phone, text, find information, and more while walking. I don’t need to have the ability to type or look at the screen.

She believed that this fact had a positive impact on both her organization and time-management habits. Participant 2 agreed that using an IVA can help “to complete tasks in a more timely and efficient manner,” and allows her to “multitask when [she is] in a hurry to get somewhere.” Also conveying a preference for mainstream virtual assistants over assistive screen readers, Participant 5 admired that this technology often provides more natural interactions that require less effort and produce less stress. He further supported this partiality by stating that virtual assistants are easy to access, whether at home through a smart speaker or away on a smartphone. In light of this seeming omnipresence, Participant 4 felt that virtual assistants were more socially accepted by our diverse society than assistive technologies, as such a significant portion of this population is familiar with and utilizes the former. On the contrary, Participant 3 confessed that, while her
IVA is easy to access from various locations, she mostly uses it at home because she feels that “it’s kind of weird to be, like, yelling at your phone, sometimes, in public.”

Even though all of the participants spoke highly of the convenience intelligent virtual assistants provide, four also discussed drawbacks. Two participants, for instance, shared that there are times they prefer not to use a virtual assistant, such as when they need to type e-mails or other long passages. While Participant 1 cited inaccuracies as her reasoning for this, Participant 2 discussed formatting issues, stating that “there’s more formatting involved and so it’s just harder to be able to use Siri or something like that.” On a different note, Participant 7 complained that Apple’s Siri tends to provide visual sources instead of verbal information, thus requiring extra steps to open the source and read the content manually.

**Familiarity**

When working with technology, there is often a learning curve. Much like a language, one must learn how the technology works before they become truly comfortable with it. Two participants—Participants 2 and 4—believed that it was easy to become familiar with this technology and how to interact with it. The former conveyed that “the commands are simple and easy to remember,” while the latter stated that it has “been easy, really easy to adjust to using.” In contrast, Participant 1 felt that such familiarity took a little time and consistent use, stating that:

> Once AI becomes a part of the daily routine, you begin to understand what tasks are quicker and more efficient and which are better left until you have your actual computer.

While Participant 4 found this technology easy to use, she pointed out that becoming familiar with what it can do is difficult:
I think it’s easy and fun because they’re commonplace enough that people know what they are, but the functionalities they have are so diverse that people don’t really understand the full extent of their capabilities.

While four participants within this study expressed their enjoyment in researching and exploring the functionalities of virtual assistants, many do not have the time or patience to do so. Participant 5 explained that he’s “pretty interested in almost just testing out all the new stuff with it,” but that “you’re not gonna look at the whole list of things you can do” to find features to use. Subsequently, some participants held the opinion that we are not taking full advantage of this technology. For example, Participant 1 articulated her concern that “we have these tools at our fingertips, but we are not maximizing their use by any means.” Similarly, when discussing the potential of this technology, Participant 6 repeatedly stated that he didn’t think “we’re tapping into it as best as we can.”

Helpfulness

As life can be complicated and difficult, individuals frequently welcome tools that may assist in their daily lives. For most of the participants in this study (n=6), intelligent virtual assistants can fill this need. Participant 6, for example, discussed utilizing a virtual assistant to stay organized and on time. Similarly, Participant 1 reported using an IVA to “get things done on the go more easily” and to remain organized. However, this participant also mentioned having a “love/hate relationship” with the technology, as it does not always “work as [she] had hoped.” Three participants noted such issues with consistency. For instance, Participant 7 discussed receiving inconsistent responses when using Amazon’s Alexa:

My son, for example, likes…[virtual assistants] to say the animal noises and stuff. He’s two years old, so we’ll ask [Alexa], “What does the elephant say,” or whatever. Half the
time, she’s like, “Well, I don’t know that one, yet.” We’re like, “Yes you do! You know it.” So we have apps on there, too, that are supposed to help with that, but still, sometimes, she’s just like, “I don’t know that one.” I’m like, “You just made it two seconds ago.”

In this instance, he turned to Google Assistant to gather the desired information and found that this assistant “nails it every time.” Participant 5 verified that, from his experience, “you get different responses between the virtual assistants.” Interestingly, Participant 6 shared the following experience in which Google Assistant responded to his repeated request consistently, but incorrectly:

I was listening to music the other day and I’m like, “Ya know, there’s a song I really wanna hear,” and I was like, “Google, play…” whatever song it was, and it played me something completely the opposite of what I wanted to hear… I repeated it, again, slowly. It played me the same exact thing.

**Outlook**

All seven participants in this study conveyed a positive outlook for intelligent virtual assistants and expressed their intent to continue using this technology for the unforeseeable future. Participant 1 expressed excitement regarding the opportunities created by artificial intelligence such as virtual assistants by stating:

The new and innovative ways AI are being used is creating exciting opportunities for not just individuals with disabilities, but for humans around the globe. As a teacher, I am thrilled to know this type of technology will have the capacity to insure [sic] students can receive an equitable education. Rural and urban students can have access to high quality instruction, English language learners or foreign language programs can provide more
emersive [sic] sessions with more authentic learning, and learning preferences can be expanded to include AI.

Two participants discussed the evolvement of this technology, looking forward to the new features and improvements to come. Participant 7 optimistically stated that “the sky is the limit” for the future use and expansion of this technology, but would like to see the creation of a unified version that combines the strengths of current individual IVAs.

While positive forecasts prevailed among participants, a major cloud was pointed out by four—the concern of privacy and security. Participant 1 communicated that “protecting personal information must be a priority if we are going to continue to depend on technology to manage our home, school, and work lives.” Similarly, Participant 4 conveyed a worry that virtual assistants may listen while not being used, thus increasing the possibility of overhearing and recording sensitive information. For Participant 6, privacy concerns also encompass personal interactions with the virtual assistant, itself, as he expressed feeling uncomfortable having these recorded and saved.

**User-Friendliness**

In the world of technology, user-friendliness is often a significant concern. As the term indicates, *user-friendliness* refers to how easy a device or software is for the user to learn and interact with (Christensson, 2014). In the current study, all seven participants discussed this topic as it pertains to intelligent virtual assistants. Six of the participants mentioned that IVAs were fun to use, with interactions being deemed easy by five. Participant 2 found that virtual assistants could “make tasks much easier to complete” because of the features they offer, while Participant 4 credited their fun and easy nature to the fact that “they’re commonplace enough that people know what they are.” While Participants 6 and 7 agreed that virtual assistants are fun and easy to
use, they each placed conditions on that stance. The former participant found this to be true when “relaxing and looking up silly things or things regarding entertainment,” but stated that “it can be frustrating and challenging” when requesting information related to a specific course. Likewise, the latter asserted that the fundamental features “of these platforms are easy, fun, and not frustrating” to use, while more advanced features could become frustrating. Overall, while acknowledging that it is user-friendly in many ways, Participant 6 declared that this technology needs “more tweaks and stuff to make it…more accessible and work more efficiently.”

Intelligent Virtual Assistant Use to Mitigate Disability-Related Stress

As defined by the ADA Amendments Act (2008), the word disability refers to a perceived or documented physical or mental impairment that causes a significant limitation to at least one major life activity. Due to the presence of such limited functionality in one’s life, individuals with disabilities often experience stress associated with their disability. This stress is, as discussed earlier, in addition to that experienced by their peers and may be the result of various stressors including those presented in Table 6. Although not examined within this study, such stress may be found to vary among individuals based on factors such as diagnosis. Research Question 3—How do higher education students with visual impairments use intelligent virtual assistants to mitigate disability-related stress?—strove to shed light on the ways participants used this technology to lessen such extraneous stress. Responses to this question fell into three major categories: improve accessibility, streamline processes, and manage time.

Improve Accessibility

In an effort to minimize the disability-related stress experienced, participants reported using intelligent virtual assistants to improve accessibility. Specifically, it was noted that this technology could provide content in a more accessible way while decreasing the need for
Table 6. Disability-Related Stressors

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<td>Instructional Materials</td>
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<td>Coddling/Too Helpful</td>
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<td>Effort Put Forth</td>
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<td>Finances</td>
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<td>Giving Presentations</td>
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assistive technology. Participant 7, for instance, identified reading as his “biggest barrier,” explaining that, due to his visual impairment, he “can easily get tired from reading short articles let alone books.” Similarly, Participant 2 expressed that manipulating “the on screen [sic] keyboard of a phone can be difficult” with diminished visual capabilities. In discussing ways of overcoming these disability-related barriers, participants pointed to a diminished requirement for vision when using virtual assistants. Participant 1 was among those who conveyed this belief, boasting that IVA users did not “need to have the ability to type or look at the screen,” as this technology often presented content auditorily.
When attempting to complete tasks, individuals with visual impairments often required the aid of assistive technology. Participant 4 illustrated such an instance when discussing the completion of science lab reports, stating that:

I do those with my laptop and CCTV out, and sometimes it’s really hard to go between all of them, so if I had…if I could just ask like, “What is the specific heat capacity of, say, Aluminum,” and get an answer back, it would be easier than having to go to a new window, Google it, make sure I have the number copied right, go back to my lab book, make sure my data’s right, and then go back into the Word document.

Participant 2 supported this sentiment by saying that using a virtual assistant “definitely makes things a little bit less of a hassle,” whether reading, looking up information, or cooking. As an example, this participant stated:

Trying to have a braille recipe when you’re cooking is just a pain ’cause I constantly have to be washing my hands and so, having [a virtual assistant] be able to tell me the recipe is just so much more convenient.

Participant 4 agreed that using an intelligent virtual assistant to deliver recipes was preferable, saying that:

Being able to ask, verbally, what to do next and then listen and follow that would be, for me, more peace of mind than trying to manage either my CCTV or my laptop while I’m cooking and I don’t want to get either of them messy. They’re both expensive devices.

Participant 7 also acknowledged the benefit of such use in his own life by mentioning how “now we don’t have to go sit here and zoom in,” when needing to use a CCTV to magnify a recipe or other printed text. Due to the stationary nature of this and other assistive devices, users often find themselves tethered to the location where it resides, proving less than ideal in many situations.
Streamline Processes

Being diagnosed with a visual impairment can impact many aspects of one’s life, including the processes implemented when completing activities. For example, one must think ahead when preparing to use assistive technology, as it adds both steps and time required to complete tasks. Participant 6 discussed this when he said:

There have been a couple times where I’ve been in class and I’m like, “Alright, I’ve got the voice reader, it’s ready, and this and that and…” I sometimes forget that my ZoomText is a really large file, so that, when I turn it on, it takes a little bit for it to warm up and actually start working.

Participant 5 expanded on this by discussing the use of a screen reader to view a document and a web browser, simultaneously. He mentioned that “if you can see, you can move windows around the screen,” thus making more than one visible at the same time. In contrast, this participant stated that “you can only kinda do one thing at a time” when using a screen reader, thus adding steps every time a different window needs to be viewed. In light of this, he pointed out that this process could be streamlined by “just ask[ing] the assistant” for certain information, instead of juggling windows.

Participants have encountered similar situations when using smartphones. Participant 1, for instance, stated that “accessing the information on [her] phone by voice, rather than by selecting the folder, then app, saves [her] time and frustration.” Participant 5 conveyed a similar preference, mentioning that “it is just a lot faster a lot of time to have Siri open the app than have to look around and find it.” These examples were summarized by Participant 2 when she said that “using Siri or Alexa reduces the number of steps to complete a task. They help…complete
tasks in a more timely and efficient manner,” thus streamlining processes and minimizing disability-related stress.

**Manage Time**

Discussion among the participants in this study frequently centered around the topic of time-management with many expressing the ability of virtual assistants to help them use their time more efficiently. Specifically, participants mentioned that this technology could help achieve this benefit by improving organization and allowing for multitasking.

When asked how virtual assistants help minimize her disability-related stress, Participant 1 spoke in general terms:

Keeping me organized, I think, is the biggest way that they have helped me initially and then it just started to expand from there… And I also think, the other thing is, it’s helped me to multitask. So organization and multitasking and that goes back, I think, to the time and reducing some of the stress because I’m able to use my time a little bit more wisely.

Participant 7, on the other hand, spoke more specifically about how his virtual assistants decreased stress by helping him stay organized, stating that he would:

Constantly use time checks that help reduce time-related stress when getting ready for the day or ensuring I’m on time for appointments when I don’t have a watch or phone nearby for a quick glance.

The ability to use virtual assistants to multitask provides significant benefits for individuals with visual impairments. Participants 1, 2, and 5 noted that, with the assistance of this technology, they were able to more quickly and easily complete tasks while traveling. Being able to multitask like this was particularly beneficial for Participant 5, as he explained:

I use a cane when I walk places, so it is hard a lot of times to text while I am walking.
Participant 7 also found it advantageous to use virtual assistants to multitask, appreciating that they allow individuals to:

Be able to walk around the house and get chores done while you’re listening to your book and stuff…’cause, ya know, that’s a big area [of disability-related stress] is reading.

Summary

In an attempt to answer the research questions laid out by the current research, a large amount of information was gathered. As the study focused on the lived experiences of online students with visual impairments when using intelligent virtual assistants, relevant aspects were investigated. Specifically, participants were asked to share their thoughts, feelings, and stories regarding what virtual assistant features they used, what experiences they had in using this technology, and how they used IVAs to mitigate disability-related stress.

Intelligent virtual assistants boast many useful features, both academic and non-academic in nature. Examples and detailed information provided by participants assisted in achieving the first objective of this study—to explore what virtual assistant features were utilized by participants and for what reasons. Overall, the study identified twenty-five features within ten categories across both purposes. Of the five academic categories identified, Research & Knowledge Acquisition was mentioned the most, while Teaching & Presentations was the least. Within the features assigned to this purpose, Internet Searches lead the way in usage, while both Historical Information and Commands & Variables fell to the end of the eleven features. The most reported non-academic category out of the five recognized was Organization, with Health & Wellness trailing in last. Among the fourteen non-academic features, Music held the title for most frequently mentioned with Recipes & Nutrition and Exercise wrapping up the list. All of
the features identified within this study were reportedly used regardless of current online education involvement.

As with many events in life, individuals experience things in unique ways. Participants shared stories of their experiences in using intelligent virtual assistants to help accomplish the second objective within this study—to investigate participant experiences with the technology of interest. Speaking from acquired knowledge, Participant 5 stated that virtual assistants “all have their quirks about them.” The rest of the participants supported this statement in various ways by drawing from their own experience. For instance, although every participant reported finding IVAs convenient and helpful, some also mentioned experiencing accuracy issues that reduced these benefits. Virtual assistants were further described as user-friendly by a majority of these individuals, although some expressed concerns regarding familiarity with what this technology could do. While they conveyed a positive overall outlook for IVAs, participants also lamented the lack of knowledge they and others possessed about the complexity and range of capabilities this technology boasts. Even though individuals in this study discussed encountering negative aspects of IVAs, in the end, they expressed that such momentary negative experiences were not enough to tarnish their positive overall experience.

With the negative impact disability-related stress often has on their lives, individuals with visual impairments frequently seek ways to minimize this unnecessary tension. Participants in this study reflected on how they used virtual assistants to mitigate disability-related stress, as was the intent of the third objective within the current research. This reflection revealed three ways in which IVAs were used for this purpose, including to improve accessibility, streamline processes, and manage time. In terms of improving accessibility, participants indicated that content could be provided in a more accessible way while decreasing the need for assistive technology.
Streamlined processes resulted in fewer required steps, decreased juggling of devices and computer windows, and less searching for apps and other information. Managing time, according to the participants, was achieved through improved organization and the ability to multitask. Each of these made completing tasks quicker, easier, and less stressful for participants.

Being aware of the findings, although essential, should not be the final step in a research study. While one can gain some understanding from these nuggets of raw data, further analysis is imperative. Conclusions and interpretations may arise from this process and, as a result, provide a deeper understanding of the phenomenon of study. Chapter 5 will present the results of such an in-depth analysis and examine the impact they may have.
CHAPTER FIVE: CONCLUSIONS AND DISCUSSION

Throughout this study, a large amount of data has been collected and organized. The previous chapter presented this information to begin answering the research questions set forth by the current study. While it is helpful to see statistical representations of what was collected and read participant quotations in support of patterns identified, it is necessary to conduct a profound examination of such raw data. Within this chapter, the findings discussed previously will be scrutinized to determine what they mean, how they fit with existing literature, and how they impact the fields of education and technology. Additionally, limitations within the research will be reviewed, as well as the need for future research.

Interpretations and Conclusions

While one can gain an idea of the tone and content of what participants said by reviewing the findings in their raw format, further examination is required to decipher what they mean. Interpretations furnish such perceptions into the meaning ascribed to these pieces of data. Conclusions further expand on this by determining the significance and impact the findings may have. In playing an active role within the current study, I have become intimately familiar with the data collected, thus uniquely prepared to offer these insights.

Overall, the research suggests that intelligent virtual assistants may be used to assist individuals with visual impairments in reducing the barriers and stress that often deter them from acquiring higher education, whether through traditional or non-traditional means. Each of the
findings presented in the previous chapter provide support for this statement, which will be discussed here in the same order as before. Specifically, interpretations and conclusions will be discussed first in terms of the virtual assistant features used, then experiences had when using this technology, and, finally, how IVAs are used to mitigate disability-related stress.

**Intelligent Virtual Assistant Features Used**

Study findings showed that participants used a variety of virtual assistant features for both academic and non-academic purposes. While features enlisted for non-academic purposes were reported more frequently than academic, this study found that many of the features discussed had dual purposes, meaning that they could be used directly or indirectly for either purpose. For instance, of the four features reported by six or more participants—Internet Searches, Apps & Websites, Music, and Lists & Reminders—only Music was reported as being used for purely non-academic purposes. While adopted for a specific purpose within this study, the remaining three features possessed flexibility in their reason for use. Internet Searches, for example, proved helpful for academic research, as well as daily curiosity. With few exceptions, the majority of participants—four or more—discussed using each feature that qualified as having a dual-purpose. As a result, the research indicated more frequent use of these features, thus suggesting a higher level of familiarity. On the contrary, dual-purpose features mentioned by fewer participants represented tasks less common in everyday life, such as Translations and Calculations & Conversions. While each feature was often better suited for one of the two purposes outlined in this study, the findings implied that a majority could be used for either.

When examining the use of virtual assistant features by higher education students with visual impairments, similar features were reported whether students were enrolled in online or face-to-face courses. This indicates that course delivery mode does not impact the features used.
Regardless of delivery mode, one factor that may have influenced this was the student’s major field of study. The research indicated that those in the fields of education and computer science found virtual assistants more helpful and features more relevant than did those in foreign language and music. Similarly, the study also suggested that course subject and level influenced the use of certain features.

Disability-related needs varied among participants, thus influencing the use and helpfulness of certain features. While many of the features proved helpful to all participants, the individual’s specific disability impacted the benefit of some. For example, participants declared Internet Searches and Apps & Websites to be beneficial, in part, because their use minimized the need to juggle assistive devices or fumble with multiple computer windows. Further, these features reduced the number of steps required to complete tasks, which is desirable for individuals with visual impairments. On the other hand, a few features that would seem useful for individuals with visual impairments, such as Reading & Podcasts, unexpectedly fell short. While some participants found this feature to be helpful, others did not. The findings indicated two reasons for this: visual acuity and propensity for listening to audiobooks. As suggested by the data, individuals with a higher visual acuity preferred to interact with content in a variety of methods. For this reason, these individuals found it difficult to concentrate on large amounts of information presented only auditorily, preferring to receive it visually, as well. Consequently, these individuals placed less value on this feature than did their peers with lower visual acuity and who were comfortable reading audiobooks.

When contemplating the reason participants used intelligent virtual assistants more often for non-academic purposes than academic, product advertising arose as a significant explanation. Specifically, certain IVA features are promoted more than others, including streaming music,
creating shopping and to-do lists, keeping track of calendar events and home automation. As such, users are more likely to be aware of and utilize these features. Unexpectedly, though, participants reported using IVAs for Home Automation at a low rate. Based on statements made, there were three main reasons for this: internet deficiencies, inexperience with setting up smart devices, and expense. If one can triumph over these deterrents, though, participants who used their virtual assistant for Home Automation found it beneficial for several reasons, including overcoming visual limitations or difficulties. Overall, the study findings implied that the most frequently used features were those publicly advertised. As such, features supporting the original intent of this technology—entertainment—were credited as being the best-known, thus often the most used.

As anticipated, study participants detailed using a variety of virtual assistant features, as well as a desire to expand their usage. Regarding the type of features used, the research suggested that most participants utilized principally basic features. Although some did take advantage of more complex features, these instances were minimal. Furthermore, individuals shared an eagerness to use virtual assistants in out-of-the-box ways, yet they did not employ innovative strategies to achieve these goals. Subsequently, these findings illuminated the need for a more comprehensive disbursement of knowledge related to what features are available and how to use them. Moreover, as participants offered some truly inspired ideas for new IVA uses that could be helpful for individuals with disabilities, perhaps it would be beneficial to find direct paths by which to bring these concepts to life. As most individuals with disabilities do not possess the technical skills required to develop new skills or features for intelligent virtual assistants, this would require collaboration.
Concerning the features used by online higher education students with visual impairments when using intelligent virtual assistants, the findings support the theoretical framework laid out for this research. In today's society, home automation is a major current trend. By using this feature, individuals with disabilities can benefit from increased autonomy, independence, and social integration, as well as decreased limitations. Moreover, by using a variety of virtual assistant features, individuals with visual impairments engage in similar practices as their peers. In doing so, these individuals share a hobby and, possibly, some experiences with their non-disabled counterparts, which can ignite interactions and grow friendships that further lead to increased social integration.

Disability-specific needs dictate the value of many features, thus making it essential for individuals with disabilities to research which virtual assistant offers the most features that would help minimize limitations and challenges related to their disability. As visual impairments often make completing tasks more difficult and time-consuming, the ability of virtual assistant features to reduce the number of steps required can be instrumental in building independence and autonomy. For instance, when doing work in a class environment, students with visual impairments may feel self-conscious because their peers are likely to finish tasks before them, thus further making these students feel left out or isolated. Similarly, reading is an arduous process for many individuals with visual impairments, which often causes them to avoid it. Using an IVA to read, then, can help these individuals stay up-to-date with what is happening in the world, as well as what is trending among their peers, thus assisting them to become more socially relevant. Furthermore, reading with this technology can help to dispel disability-imposed limitations that keep students with visual impairments from completing course readings, consequently allowing them to participate more fully and confidently in class discussions.
Finally, the use of virtual assistants and their many features can minimize or even eliminate the need for assistive technology. As such specialized devices often carry a negative stigma with them, utilizing IVAs instead would likely decrease such negative attention and increase social integration and acceptance. Furthermore, the availability of dual-purpose features increases the possible benefit this technology has on minimizing disability-imposed limitations by providing elevated opportunities to interact with these features and increased potential for accommodating disability needs without the aid of specialized equipment. Of course, with the constant evolution of intelligent virtual assistants, this technology will likely grow to provide even more comprehensive assistance to and benefit for individuals with disabilities.

**Experiences in Using Intelligent Virtual Assistants**

Overall, participants reported having positive experiences with intelligent virtual assistants, but also discussed negative aspects that could interfere with their use. For instance, participants often portrayed accuracy issues related to the listening and comprehension abilities of virtual assistants as frustrating. Two factors that may cause such problems are user input and environment. In this instance, user input refers to the audibility and transparency of the words spoken to an intelligent virtual assistant. Although considered smart technology, IVAs can be particular about the wording that is used and may have trouble understanding accented requests. Environment, on the other hand, also impacts IVA comprehension as it may affect the audibility of user queries. When such inaccuracies occur, users are often required to repeat themselves. An adverse impact on the frequency and manner of IVA use may result from such an inconvenience. Furthermore, the likelihood that an individual may discontinue the use of this technology increases if the issue persists. As learning technology, virtual assistants become more familiar with and better equipped to provide accurate interactions with increased use. Knowing this, it
would be advisable, although counter-intuitive, to continue using this technology, thus affording it time to adjust to factors that may impair its understanding. Continued use may also help the user become more familiar with the virtual assistant and its eccentricities, which, in turn, can alleviate accuracy issues.

Convenience represented one of the motivating factors for using intelligent virtual assistants, especially when discussing the mainstream nature and hands-free functionality of this technology. As virtual assistants are well-known among and used by the general population, they are frequently more easily accessible, affordable, and widely accepted than the assistive technology used by individuals with visual impairments. Since virtual assistants are available in both mobile and stationary formats, individuals with visual impairments are released from restrictions often placed on them when utilizing desktop assistive technology. The elimination of such confinement allows these individuals to participate in daily social activities more naturally and without interfering with any of their responsibilities. Furthermore, due to their presence throughout our society, virtual assistants do not have the negative stigma connected with assistive devices, thus allowing individuals with disabilities to perform required tasks in public without drawing unnecessary and unfavorable attention to their impairment. In light of these facts, IVAs have been deemed preferable by participants within this study. The hands-free option offered by this technology further solidified this preference as many participants praised the ability to complete tasks in a more time-efficient manner and without as much manual manipulation of a device. For example, individuals relayed that completing tasks by voice was easier and less stressful than doing so visually. Individuals also conveyed that, with this hands-free function, they were able to multitask, which was, otherwise, frequently difficult to do.
While most participants verified that virtual assistants are easy to become familiar with, some stated that it takes some time and consistent use. Possible reasons for this could be an individual’s age and level of comfort with technology. Whether using terms coined by Marc Prensky—digital native and digital immigrant—or more recent subdivisions—avoiders, minimalists, enthusiasts, and innovators—these are prevalent ideas that convey exactly this sentiment (Ch’ng, 2019). The former focuses on age and early interaction with digital technology, while the latter emphasizes the comfort level a person has with technology (Ch’ng, 2019). Regardless of the reason, the underlying message sent by the participants was that virtual assistants are fun and easy to use, irrespective of age, level of comfort, or the amount of time it takes to become familiar with them. Familiarity extends beyond understanding interactions with a virtual assistant to its possible uses. Somewhat surprisingly, learning about new and different applications for IVAs was found to be challenging and require a lot of time and energy. For example, an official list of Amazon’s Alexa skills exists, but its sheer density acts to deter people from reviewing it for more features to use. Furthermore, as this technology is continually learning and developers are perpetually expanding its capabilities, it would, likely, be an uphill battle to remain up-to-date with such new expansions. Of course, there are a few possible solutions to this dilemma. Word of mouth, for instance, is one powerful method for learning about this technology. Perhaps, though, a well-organized website would be of more assistance with this issue, as individuals could identify the type of task they are looking for and promptly receive targeted suggestions. Community training courses or free public programs may also be immensely helpful, as users may range in age, technology literacy and level of familiarity with virtual assistants and, thus, benefit from one-on-one instruction and guidance.
Even though all of the participants reported that intelligent virtual assistants were helpful, the findings indicated that the nature of this helpfulness was dependent upon each person’s disability. For instance, some found it valuable to have a virtual assistant create and monitor calendar events, while others preferred to write these events down in a physical book. Others benefitted from having a virtual assistant read to them, while others could not concentrate on the content when relayed this way. As mentioned earlier, the research indicated a link between this and visual acuity. User-friendliness, though, was found to depend, in part, on technical knowledge related to virtual assistants. For instance, participants reported that it was fun and easy to use a virtual assistant to perform basic tasks, while more complex tasks became confusing and frustrating for some. Again, this could be addressed through formal or informal training, as discussed previously.

Before conducting this research, the outlook held by participants for virtual assistants was expected to be mostly positive, but, regardless of varied experiences with the technology, it was unexpectedly unanimous. The depth and imagination displayed when participants discussed their forecasts for this technology were astounding and demonstrated their intent to continue using virtual assistants into the future. Such innovative thinking comes, in part, from the need for these individuals to identify alternative options for completing certain activities, thus leading them to exploit mainstream technology for assistive reasons. Interestingly, the way each spoke of virtual assistants made it clear that they believed this technology would remain prevalent for the unforeseeable future, especially if necessary adjustments were made to improve accuracy and user-friendliness. Social infatuation with this technology may provide the basis for this belief or, more optimistically, it may be born from hope. Hope that individuals may, perhaps, be able to break away from the assistive technology that identifies them as visually impaired. Hope that,
instead, they can exploit mainstream technology for assistive reasons, thus loosening the stronghold their disabilities have on their identities. Hope that this will allow them to shed the limitations placed on them by both their impairment and the world around them and, as a result, become fully accepted into and valued by society.

The experiences had by users when interacting with intelligent virtual assistants align in many ways with the theoretical framework. As such experiences were often positive, both initial and continued use of this technology by individuals with visual impairments are likely. The level of enjoyment and value attributed to using virtual assistants further reinforces this statement. Due to frequent and continual use, these individuals are apt to learn of the benefits offered by intelligent virtual assistants that help moderate disability-imposed limitations and promote social integration. Some of these benefits include the reduction of stereotypes that accompany the use of assistive technology, the elevated ability to multitask, and the freedom to complete activities at any time and from any location. As discussed earlier, the use of mainstream technology can be powerful for those with visual impairments. By minimizing stereotypes and negative attitudes within the general public, the use of virtual assistants has the potential to ignite social change. Although individuals with disabilities are accepted into society more easily than in the past, resistance to their full integration still exists. If these individuals could trade the tools that call attention to their disability for those more familiar to their non-disabled counterparts, the general population may begin to acknowledge their true potential and value, thus encouraging such change. By this, I am not proposing that mainstream products could or should replace all assistive tools, but only that the use of technology such as intelligent virtual assistants could fill many needs of those with disabilities, while also removing limitations placed on them by society.
With hands-free functionality, virtual assistants can further help individuals with disabilities overcome limitations by making it quicker and easier for them to perform activities whenever and wherever they’d like. Through streamlining the processes required for many tasks, this technology can diminish difficulties caused by one's impairment or imposed by society. Moreover, by simplifying tasks and improving time-efficiency, IVAs can assist in bestowing a higher level of independence and autonomy upon these individuals. Being better able to multitask with the aid of this technology further supports this.

As each virtual assistant possesses unique strengths, individuals with disabilities need to choose the one that will best fit their needs. Although any virtual assistant is likely to prove helpful to these individuals, the proper alignment of IVA and needs will increase the positive impact this technology has on independence, autonomy, and social integration. To gain the necessary knowledge of what virtual assistants have to offer, these individuals may decide to participate in social opportunities, such as community training or discussions with peers, thus increasing their social integration and acceptance.

**Intelligent Virtual Assistant Use to Mitigate Disability-Related Stress**

Through an examination of the data collected within this study, it was found that participants used intelligent virtual assistants to address challenges faced by students with visual impairments that cause disability-related stress. For example, many of these individuals experience eye fatigue after reading small amounts of content, which forces them to stop this activity until recovered. If, instead, they decide to persist with their reading, the condition often worsens to eye strain, which then extends the time of recovery and further delays the completion of this task. In both of these cases, the task being completed takes longer and becomes disjointed, thus causing discomfort, concern, and decreased comprehension of content. By using a virtual
assistant to complete such a task, though, the possibility of eye fatigue and strain are eliminated as this technology presents content auditorily instead of visually. In this way, IVAs are able to help individuals with visual impairments complete tasks more quickly and without such forced disruptions, which, in turn, minimizes disability-related stress.

Although a wide array of technology specifically created to help mitigate disability-related stress exists, this same technology frequently causes additional, and often unnecessary, frustrations. While all of the participants reported using assistive technology to aid in minimizing this type of stress, they, collectively, voiced a preference for using mainstream technology instead. As assistive devices are commonly created to accommodate a single limitation, they often need to be used alongside other devices. When switching between multiple devices, individuals with visual impairments continually need to find and re-find their place, which both increases the time required to complete the task at hand and the level of frustration experienced. Stationary assistive devices, by nature, remain in one location and often require the user to disrupt the natural occurrence of life activities to gain their assistance, again, requiring extended time to complete such tasks. Use of such technology causes the user to be tethered to one place, thus creating an isolated environment within which they are required to work with these devices. Portable assistive devices, on the other hand, allow individuals to gain assistance within the natural setting of tasks but inflict other drawbacks, including the need to carry extra, often less frequently used equipment everywhere they go and drawing attention to their disability by using devices that are unfamiliar to the general population. Mainstream technology such as intelligent virtual assistants, though, were created with many uses in mind, thus eliminating the need for multiple devices. Furthermore, many versions of this technology can be found on smartphones which can be used in any location and at any time, and are often already being carried by
individuals. Also, as this technology is familiar to the general public, its use will not often draw attention to one’s disability, instead it is more likely to increase social interactions through shared interests. In these ways, virtual assistants were often found to innately accommodate student needs without imposing increased levels of needless stress.

As individuals with visual impairments often require alternative means to observe and interact with the world around them, their hands frequently become instruments of vision, whether reading braille, navigating with a white cane or seeing eye dog, or ascertaining what an object is through touch. As a result, not only do tasks requiring vision become more difficult and time-consuming for them, so do those that require the use of their hands. Participants, for instance, discussed the need to text message or call someone while walking. When using an assistive tool to navigate, one would need to first stop and free their hands before completing these tasks, thus disrupting their progress and causing a delay in their arrival. With the hands-free functionality of intelligent virtual assistants, though, such obstacles can easily be traversed by streamlining the process and allowing for multitasking. As a result, time is more efficiently managed, tasks are more effectively completed, and disability-related stress is decreased.

The use of intelligent virtual assistants to mitigate disability-related stress bolsters the theoretical framework for this research. Mainly, such use helps to improve social integration by minimizing feelings of isolation and stigma caused by one’s disability. For instance, the use of accommodations, such as special equipment, often leads an individual to feel unlike or separated from their peers, while also, sometimes, provoking negative attitudes in others. By using the same technology as their non-disabled counterparts, individuals with disabilities could feel an elevated sense of camaraderie and witness a decrease in adverse attitudes, thus increasing social integration and affecting social change. Also, as smartphone-based IVAs are inconspicuous and
portable, they can provide the flexibility needed to participate in society freely. Overall, the use of virtual assistants to accommodate special needs and minimize disability-related stress can help individuals with visual impairments blend more naturally into the community around them without attention continually being drawn to their disability.

Intelligent virtual assistants used to mitigate disability-related stress also act to minimize limitations and increase independence. Stress connected to a disability may evoke self-imposed restrictions that encourage continued isolation. For example, using assistive technology can leave individuals feeling different from their peers, thus eliciting fear of rejection. In light of this, these individuals may shy away from participating in social activities or engaging with their colleagues. As virtual assistants can be used to reduce such stress, these feelings of inadequacy and exclusion would be lessened, thus decreasing internal limitations and increasing social integration. Furthermore, to maximize the benefit of virtual assistants in diminishing disability-related stress, one must employ both innovation and critical thinking skills. Honing such talents can increase independence, thus supporting individuals with visual impairments in their pursuit of living without assistance as anyone without a disability does.

**Discussion**

As the topic studied within this research continually proves to be relevant in today’s world, it is necessary for those in the fields of education and technology to continually think outside the box when attempting to assist students with disabilities in attaining higher education. While attracting these students is essential, retaining them is even more so. As such, we must try to understand the factors that deter them from attending college, as well as those that derail them from finishing.
As was outlined by the theoretical framework presented in Chapter 1, disabilities are not merely internal but are also imposed by external factors (Brandon & Pritchard, 2011; Disabled World, 2017a; Donaldson et al., 2017; Mitra, 2006). By keeping this in mind, we can, then, begin to determine what some of these factors are. Through this research, we have found that external factors such as stigma, isolation, and negative attitudes of others prove to be limiting for individuals with disabilities, thus further disabling them. While this theoretical framework supports the use of technology to help diminish one’s disability (Conversano et al., 2012), I would speculate, based on the findings of the current study, that mainstream technology is more successful in achieving this goal than assistive technology. In support of this supposition, I point to the current findings that indicate the tendency of assistive devices to elicit such side effects as the disabling external factors just mentioned.

If, then, we examine the theoretical framework set forth for this research with this assumption in mind, it is apparent that the latter endorses the stance taken by the former. Specifically, this study supports the standpoint held by the framework that the utilization of technology can increase social integration and acceptance (Conversano et al., 2012; Disabled World, 2017a; Haegele & Hodge, 2016). Such social change can minimize stereotypes and social isolation often incurred by students with disabilities, especially present when using assistive technology. When socially imposed limitations are removed and students with disabilities are allowed to become more fully integrated into society, they are provided the opportunity to learn how to interact with little consideration for their disability, effectively demolishing the existence of disability-related stress. Furthermore, full integration into society would be accompanied by higher expectations, thus challenging these students to recognize and reach their potential. Through the use of mainstream technology, such as intelligent virtual assistants, students with
disabilities have the chance to not only achieve great independence and autonomy, but also to put these strengths on display for all to see, thus educating the general public and further restructuring the limiting views of these individuals that are held by society. By doing so, the focus will be shifted from one’s disabilities to one’s abilities, thus further decreasing the existence of limitations and minimizing the presence of a learning gap. In this way, mainstream technology can help release students with disabilities from both internally and externally disabling factors at which point the question is no longer if one has the ability to complete college, but rather where they will do so.

The assurance of accuracy and authenticity within any research study is essential in order to properly provide evidence for the integrity of the researcher, findings, and conclusions. Within the current study, the qualitative legitimation model (Onwuegbuzie & Leech, 2007) was applied for this reason, providing validation of the trustworthiness regarding the data collected, analyses conducted, and interpretations made. Based on this model, both internal and external credibility are of the utmost importance. Several practices were implemented to illustrate the required aspects of internal credibility—integrity and dependability—including bracketing, researcher-participant rapport, triangulation, member checking, and the development of an audit trail (Creswell, 2014; Onwuegbuzie & Leech, 2007; Statistics Solutions, 2018b). Similar actions were taken to validate significant traits of external credibility—confirmability and transferability—including member checking, audit trail creation, and researcher reflectivity (Bogumil et al., 2017; Lapan et al., 2012; Onwuegbuzie, 2002; Statistics Solutions, 2018a). Overall, the methods used to verify the trustworthiness of this study demonstrated that participants freely offered open, authentic information that was accurately discerned and represented by the researcher (Creswell, 2014; Moore et al., 2012; Morgan & Guevara, 2008; Onwuegbuzie, 2002; Onwuegbuzie &
Leech, 2007; Statistics Solutions, 2018b; Tufford & Newman, 2012). Furthermore, these efforts allow for the future replication of this study, which could shed additional light on the phenomenon of interest (Onwuegbuzie, 2002).

When evaluating how the current study fits into the existing literature, it was found to expand upon what has already been researched. As Phu et al. (2016) discussed a lack of scholarly studies that examined the use of intelligent virtual assistants in education, it is evident that this research explored mainly uncharted territory. By examining the implementation of this technology in online education and its use by an understudied population, it further broadened the reach of the prevailing literature. The act of gathering data directly from students with visual impairments, instead of the individuals who support them (i.e. teachers and parents), extended the scope of published works by using these individuals as the primary source. Furthermore, this study attended to aspects previously unexamined by scholarly research such as IVA features used, user experience, and use for mitigating disability-related stress.

In reviewing the findings of the current study in order to determine how they corresponded with the literature examined in Chapter 2, it was found that they both agreed with and expanded upon it. First, the findings verified that intelligent virtual assistants are used for both academic and non-academic purposes, while also agreeing with the categories and many of the features previously identified (Christopherson, 2016a; Christopherson, 2016b; Dodson, 2017; Ellis, 2017; Flanagan, 2016; Learning Abled Kids, 2013; Montejo, 2016; Saad et al., 2017; St. John, 2017; Warren, 2016). Second, as the literature reviewed lacked studies of virtual assistant use by higher education students with visual impairments, much less those in online courses, this research provided invaluable data. Such broadened exploration, again, confirmed the features hypothesized by previous literature and expanded upon the population of focus.
Interestingly, the current findings supported much of the literature on the experiences of using virtual assistants. Accuracy, for one, has been called into question by previous research, as was the case with the current study. The existing literature also lauded convenience as a characteristic of IVAs that can facilitate improved productivity, increased efficiency, and time effectiveness, all of which the current study confirmed (Bundy, 2017; Christopherson, 2016b; Learning Abled Kids, 2013; Niveditha & Basavaraj, 2017). Further points of concurrence existed, including those related to familiarity and helpfulness. In the case of the former, Niveditha and Basavaraj (2017) acknowledged a sense of distrust when using virtual assistants, as well as difficulty acquiring support and more in-depth knowledge, both of which were confirmed by the current study. In the latter instance, the study found that IVAs help make completing many tasks quicker and easier, which was a promising aspect also discussed by Learning Abled Kids (2013). Conveyed by both this work and its predecessors, users held a positive outlook that acknowledged the potential of virtual assistants, while also recognizing the need for improvements (Christopherson, 2016b; Saad et al., 2017). Finally, the findings of the current study were in agreement with Christopherson's (2016b) assertion that the overall experience of using intelligent virtual assistants remains positive regardless of reliability and functionality issues. Again, the present findings expanded upon the reviewed research in that they pertained to the experiences of higher education students with visual impairments in using IVAs and their use within the online environment.

As no known previous research on the use of intelligent virtual assistants by students with visual impairments existed, this was an area in which the current findings proffered new data. In the absence of documented research on this topic, non-scholarly articles were reviewed, resulting in the assessment of virtual assistants by one as having the ability to minimize frustrations and
stress levels (Learning Abled Kids, 2013). While this does shed some light on the topic in general, it does not provide substantiated data associated explicitly with disability-related stress.

Limitations are an inevitable aspect of any research. Attempting to identify potential shortcomings before conducting a study is essential, as doing so could, at times, allow for adjustments that render them obsolete. Of course, not all can be controlled for or eliminated. As such, after conducting the study, it is invaluable to review these initial limitations while acknowledging those that were previously unforeseen. A critical examination must then take place to determine how these recognized limitations affected the findings, if at all.

Raised as a concern ahead of time, access to individuals within the specific population of interest proved challenging. Subsequently, the recruitment process took much longer than was expected. The hurdle of reaching higher education students with visual impairments who used intelligent virtual assistants confirmed such difficulty, while the further requirement of online course experience magnified it. An introduction to the Facebook page of the National Association of Blind Students, though, provided the appropriate space for selecting the sample. Overall, this sample was heterogeneous with a few exceptions. While characteristics such as age, gender, level of education, diagnosis, and preferred IVA(s) showed an acceptable level of diversity, other traits did not. For instance, all participants reported being of the same general ethnicity by indicating that they were not Hispanic or Latino on the demographic questionnaire, thus resulting in a high level of uniformity. On the other hand, with each participant attending a unique institution within seven different states, participant location demonstrated too much diversity. Although expected, this is a potential limitation of the sampling strategies used. In future research, the use of random sampling at one institution of higher education may be
advantageous. As a result, the sample may more accurately represent the population of interest, thus increasing the applicability of the findings.

Initial identification of a limitation regarding both familiarity with and literacy in using intelligent virtual assistants elicited unfounded worry within the current study. If relevant, such a limitation could result in the collection of insubstantial data regarding the usage of and experiences with virtual assistants. On the contrary, participants within the current study displayed knowledge of and comfort with this technology through rich and detailed discourse. As conducting research focused on IVA users with different levels of familiarity and literacy was not the aim of this study, this should not be considered a limitation, but could point toward a path for future research.

When examining the findings presented, one new limitation arose. Within this study, patterns and themes were allowed to develop naturally through semi-guided interaction. While this practice often elicits honest accounts of significance to the participant, it could also orchestrate the omission of particular details. For instance, when a participant determines what aspects of a topic they discuss, those not mentioned may be either deemed irrelevant to or overlooked by that individual. In light of this, the totals and percentages given within this research represent approximate indicators, rather than exact tabulations. It may be beneficial, then, for future research to utilize more structured procedures to improve the accuracy and precision of the data collected.

Implications

Most researchers aim to make a significant contribution to both the existing literature and the field(s) within which their research lies. While it is crucial to understand how the current research fits into the body of literature that existed before it, even further examination is
required. Specifically, it is essential to acknowledge who may be interested in applying the findings, as well as any potential impact those findings may have on research and practice.

The findings of the current study may prove impactful on both the fields of education and technology. In education, faculty and staff may learn ways to integrate intelligent virtual assistants into their classroom environment, directly or indirectly. A suggestion by two participants that virtual assistants be able to automatically input course due dates into their calendar and set reminders align with this. Although this is possible, the faculty must first be aware of the desire for such capabilities, then create files compatible with popular electronic calendars, such as Google and Apple. Similarly, faculty could exploit features within the learning management system used by their university to provide content and grades to students through compatible virtual assistants. Again, this would require the faculty and staff to be aware of these capabilities, then have access to training on how to use them.

While this research focused on the use of intelligent virtual assistants in higher education, these implications could apply to all sectors of postsecondary education. For example, faculty and staff in Career and Workforce Education may learn how to integrate this technology into their classrooms and laboratories for students of all ability levels to use for the quick retrieval of important information during sessions of theory or practice. By doing so, the learning gap discussed by the theoretical framework could be minimized as all students would be provided an equal opportunity to consume content in a unified manner without concern for acquiring accessible materials, utilizing assistive technology, taking longer to complete tasks, or other factors that may prove worrisome for students with disabilities. Furthermore, the isolation and limitations of students with disabilities within these academic settings could be diminished, while their integration with peers could become more natural. The use of this technology outside
of the educational environment could also prove beneficial as instructors could communicate with students easily through a variety of methods, provide IVA-implemented flashcards and quiz games to help with the mastery of practical skills, or schedule and track clinical hours achieved by each student.

Based on the current findings, the field of technology may gain new ideas on how to evolve intelligent virtual assistants. Realizing that individuals with visual impairments utilize this technology could assist developers to understand the needs of their audience better and determine how IVAs could address such demands. Subsequently, the effectiveness of virtual assistants could increase due to improved and broadened capabilities. Understanding that many individuals with visual impairments prefer to use mainstream over assistive technology, when possible, developers may be better prepared to outfit IVAs with features that can minimize disability-related limitations. While individuals with disabilities would benefit from such advancements, so would the general population. Finally, the current findings may help the creators of this technology realize the need for training and support. By cultivating such educational opportunities, consumer knowledge regarding the potential benefits of using virtual assistants and how to access those advantages will increase.

When looking at the literature as it already exists, the current study slightly changed the landscape. It, first, added to the minuscule amount of scholarly research that examined intelligent virtual assistants. Second, it endeavored to investigate a specific phenomenon from the perspective of students with visual impairments, themselves. Third, it stood at the cross-section of both topics to illuminate the importance and worthiness of conducting such research. As a result, the hope was that the current research would inspire and encourage others to continue
investigating similar topics that challenge the scope and depth of previous research within this area of interest.

In practice, this research may impact the usage of intelligent virtual assistants. Through reading this report, students with visual impairments may gain knowledge of new ideas on how to use this technology and how it may help assuage some negative aspects of their disability. Teachers, parents, and others involved in supporting students with visual impairments may also learn ways to encourage independence and autonomy through the use of virtual assistants, both inside the classroom and out. One participant, for example, voiced many ways she could use intelligent virtual assistants to help students with varying disabilities stay organized and more conveniently interact with the content presented. In this way, the current research may embolden others to think outside the box when determining how to use virtual assistants.

**Future Research**

While the current study achieved the goals laid out, it also opened many pathways for additional research. Such research could both verify and expand upon the present findings, while providing a deeper understanding of the topic at hand. The accomplishment of these goals could take various forms, including a different research design, alternative procedures, altered recruitment strategies, and a divergent population of interest. Moreover, focused investigations on different aspects of the current study would prove beneficial.

Utilizing a qualitative research design, the current study placed great importance on the words and lived experiences of the participants involved. In support of this, the procedures utilized attempted to provide freedom of discussion. While this is valuable, future research employing a quantitative research design and appropriate instruments could provide a more definitive accounting of specific aspects within this study. For example, it may be helpful to use
a survey instrument to obtain a more accurate evaluation of what virtual assistant features and purposes are utilized by students with visual impairments. By doing so, participants would choose from pre-defined features, then identify their purpose for using each. As this would elicit information on parallel features across the study sample, a clearer picture could arise of the frequency and reason for such use. The current research could supply data for the creation of such a list of features, as it identified many used by this population.

As the current study confirmed that the population of focus was a difficult one to recruit from, it may be advantageous for future research to conduct investigations at a single institution of higher education. As most colleges and universities have an office dedicated to supporting students with disabilities, assistance may be available for recruitment efforts. Further, the removal of the online education requirement may also cause recruitment to become easier, as long as this is not an explicit focus of the research.

A change in the population studied would also prove to be valuable research. For instance, it would be interesting to expand the population being investigated to include both participants with and without disabilities—be it visually impaired or otherwise. Doing so could provide data that would help explore and compare the usage patterns of each group, as well as draw more conclusions regarding the use of intelligent virtual assistants to alleviate extraneous stress due to disability. Similarly, a study examining the use of virtual assistants across different disability types would allow us to understand whether or not this factor—type of disability—effects the way individuals use virtual assistants. Furthermore, such a study may help contribute to understanding how individuals of each disability type may use this technology to mitigate disability-related stress, if at all.
Both the fields of education and technology could benefit from further research investigating various aspects of intelligent virtual assistants. For education, such research could examine what aspects of school cause disability-related stress and if the use of this technology could assist in eliminating such additional anxiety. Studies could also explore the current and potential use of virtual assistants at different academic levels and in varied educational settings by students, as well as teachers. More specifically, research investigating ways in which this technology could be used within the traditional face-to-face classroom, as well as in Career and Workforce Education or science laboratories would be of interest. Such research could focus on how IVAs can be integrated into these educational environments and what role they play in enhancing the educational experience for all. Regarding virtual assistants in online education, scrutiny of details such as course subject and level could provide more insight on how to maximize the utilization of virtual assistants in this environment. For technology, research focused on why individuals choose certain assistants over others would help in the improvement of all IVAs. Moreover, knowing where individuals use their virtual assistants the most—home, school, work, or on-the-go—would impact the evolvement of this technology.

To better understand the specific topics of interest within this study, more in-depth research into the use of and experience with intelligent virtual assistants by this population, as well as its ability to assuage stress caused by their disability is needed. The present study, while examining each of these aspects, provides merely a foundational base upon which future research should build. Continuing this research would further identify ways to improve, expand, and exploit both the capabilities and functionality of virtual assistants, thus increasing their value to those both with and without disabilities. Consequently, we may take a significant step toward
creating a more united society populated by unique individuals that experience all aspects of life more equitably and enjoyably.
REFERENCES


Disabled World. (2017a, December 2). *Definitions of the models of disability.* Retrieved from


Erickson, M. J., & Larwin, K. H. (2016). The potential impact of online/distance education for
students with disabilities in higher education. *International Journal of Evaluation and Research in Education, 5*(1), 76-81.


Graham, J. (2019, March 18). *Hey, Google, Siri or Alexa: Which voice assistant handles these


Moriña, A. (2017). ‘We aren’t heroes, we’re survivors’: Higher education as an opportunity for students with disabilities to reinvent an identity. *Journal of Further and Higher Education, 41*(2).


APPENDIX A:

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE CERTIFICATION

This is to certify that:

Michele Forbes

Has completed the following CITI Program course:

- Human Research
- Social / Behavioral Investigators and Key Personnel
- 2 - Refresher Course

Under requirements set by:

University of South Florida

Verify at [www.citiprogram.org/verify/?wce21de0e-4017-4ace-b9e0-94a92b1bed79-28609863](http://www.citiprogram.org/verify/?wce21de0e-4017-4ace-b9e0-94a92b1bed79-28609863)
APPENDIX B:

NATIONAL INSTITUTES OF HEALTH CERTIFICATION

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Michele Forbes successfully completed the NIH Web-based training course "Protecting Human Research Participants."

Date of Completion: 09/09/2018

Certification Number: 2917033
APPENDIX C:
INSTITUTIONAL REVIEW BOARD APPROVAL

4/3/2019

Michele Forbes
L-CACHE - Leadership, Counseling, Adult, Career & Higher Education
Tampa, FL 34612

RE: Expedited Approval of Amendment
IRB#: Amc2_Pro00037488
Title: Experiences of Using Intelligent Virtual Assistants by Visually Impaired Students in Online Higher Education

Dear Ms. Forbes:

On 4/3/2019, the Institutional Review Board (IRB) reviewed and APPROVED your Amendment. The submitted request and all documents contained within have been approved, including those outlined below, as described by the study team.

The study procedures have been adjusted to better fit the data needed and the needs of potential participants. The length of the study has been shortened to lessen the burden placed on subjects. Compensation rates have also been adjusted to better reflect the time commitment required.

Approved Item(s):
Protocol Document(s):
Study Protocol v3_3.19.19 (clean)

Consent Document(s)*:
Study Protocol v3_3.19.19 (clean)**

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab on the main study's workspace. Please note, these consent/assent document(s) are valid until they are amended and approved. **Online consents are not stamped.

The IRB does not require that subjects be reconsented.
As the principal investigator of this study, it is your responsibility to conduct this study in accordance with USF HRPP policies and procedures and as approved by the USF IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) business days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Melissa Sloan, PhD, Vice Chairperson
USF Institutional Review Board
APPENDIX D:

CONSENT FORM

Informed Consent to Participate in Research
Information to Consider Before Taking Part in this Research Study

Pro #: 00037488

Researchers at the University of South Florida (USF) study many topics. To do this, we need the help of people who agree to take part in a research study. This form tells you about this research study. We are asking you to take part in a research study that is called *Experiences of Using Intelligent Virtual Assistants by Visually Impaired Students in Online Higher Education*. The person who is in charge of this research study is Michele Forbes. This person is called the Principal Investigator.

Purpose of the Study

This study will explore the experiences of students with visual impairments in using intelligent virtual assistants, such as Amazon’s Alexa, Apple’s Siri, and Google Assistant. Topics of specific interest include features used, driving factors for use, and overall experience in using this technology.

Why are you being asked to take part?

You are being asked to take part in this study because you are a part- or full-time higher education student who has been diagnosed as blind or visually impaired by an accredited physician or agency. You have also taken or are currently taking at least one online course—synchronous or asynchronous.

To determine your eligibility, you will be asked to complete a short Demographic Questionnaire. This will request information pertaining to age, gender, ethnicity, academic level and enrollment status, disability, and preferred intelligent virtual assistant. If you are found to be eligible, you will be contacted by the researcher to schedule your preliminary interview. If you are not found to be eligible, you will receive e-mail notification stating this.
Study Procedures
If you take part in this study, you will be asked to complete the following:

- A demographic questionnaire (five minutes)
- An interview (one hour and fifteen minutes)
- A follow-up journal entry guided by questions (fifteen minutes)

Each task will be completed at your leisure via the Internet or telephone, thus the time commitments stated above are approximate. All interviews will be recorded. Assistance and accommodations are available upon request.

Alternatives/Voluntary Participation/Withdrawal
You should only take part in this study if you want to volunteer; you are free to withdraw at any time without penalty.

Benefits and Risks
We are unsure if you will receive any benefits by taking part in this research study.
This research is considered to be minimal risk, which means that there is no additional risk to participants than would be experienced in normal day-to-day activity.

Compensation
You will receive compensation for your time and participation in the form of Amazon gift cards. Upon completion of each study-related task, a gift card will be sent to the e-mail address provided in the demographic questionnaire. The total possible compensation for participation will be $15, awarded as follows:

- A $10 Amazon gift card will be awarded after the completion of the interview.
- A $5 Amazon gift card will be awarded after the completion of the journal entry.

Privacy and Confidentiality
We must keep your study records as confidential as possible. It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online. Precautions have been taken to safeguard against this, such as the assignment of unique, randomly generated six-digit Participant Identification Numbers (PINs), which will be used in place of your name when submitting information.

Certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are:

- It is possible, although unlikely, that unauthorized individuals could gain access to your responses. Confidentiality will be maintained to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet. However, your participation in this online study involves risks similar to a person’s everyday use of the Internet.
• The research team, including the Principal Investigator and the faculty advisor.
• The USF Institutional Review Board (IRB) and related staff who have oversight responsibilities for this study, including staff in USF Research Integrity and Compliance.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything that would let people know who you are.

Contact Information

If you have any questions about your rights as a research participant, please contact the USF IRB at (813) 974-5638 or by email at RSCH-IRB@usf.edu. If you have questions regarding the research, please contact the Principal Investigator at mrforsbes@mail.usf.edu.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are. You can print a copy of this consent form for your records.

I freely give my consent to take part in this study. I understand that by proceeding I am agreeing to take part in research and I am 18 years of age or older.

If you agree to the above, please click below to fill out a short questionnaire.

http://mrforsbes.myweb.usf.edu/study/quest.html
APPENDIX E:

DEMOGRAPHIC QUESTIONNAIRE

Please provide the following information. Your information will be kept private and will be used to determine your eligibility for the study. Be sure to complete all items.

**Personal Information**

<table>
<thead>
<tr>
<th>Full Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail:</td>
<td></td>
</tr>
<tr>
<td>Gender:</td>
<td>○ Male ○ Female ○ Undisclosed</td>
</tr>
<tr>
<td>Age:</td>
<td>○ 18 ○ 22 ○ 26 ○ 30-34 ○ 50-54 ○ 19 ○ 23 ○ 27 ○ 35-39 ○ 55-59 ○ 20 ○ 24 ○ 28 ○ 40-44 ○ 60 or older ○ 21 ○ 25 ○ 29 ○ 45-49</td>
</tr>
<tr>
<td>Ethnicity:</td>
<td>○ Hispanic or Latino ○ Not Hispanic or Latino</td>
</tr>
</tbody>
</table>

**College Enrollment**

<table>
<thead>
<tr>
<th>Enrolled in College?:</th>
<th>○ Yes, part-time ○ Yes, full-time ○ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of College:</td>
<td></td>
</tr>
<tr>
<td>Year in School:</td>
<td>○ Undergraduate – 1st year ○ Undergraduate – 2nd year ○ Undergraduate – 3rd year ○ Undergraduate – 4th year ○ Undergraduate – 5th year or later ○ Graduate – Masters ○ Graduate – Doctorate ○ Other</td>
</tr>
</tbody>
</table>
Enrolled in online courses?
- Yes, with set meeting times
- Yes, with no set meeting times
- Not currently, but I have been before
- No

Disability and Accommodations

Diagnosed as:
- Totally blind
- Partially/legally blind
- Other visual impairment
- No visual impairment

Diagnosed by:
- Accredited physician
- Accredited agency
- Both
- Neither

Requesting Accommodations?
- Yes, please contact me
- Not at this time
- No, I don’t need any

Intelligent Virtual Assistant

Access to Intelligent Virtual Assistant (choose all that apply)
- Smartphone
- Tablet
- Smart Speaker
- Computer
- Other
- None

Preferred Intelligent Virtual Assistant:
- Amazon’s Alexa
How did you learn about this study?

Other

Add any other information you’d like to share with the research team.
## APPENDIX F:

### SEMI-GUIDED INTERVIEW PROTOCOL

<table>
<thead>
<tr>
<th>Category</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>• Before we jump into the main part of the interview, I’d like to make sure that you understand what will be asked of you during this study. When you read the consent form, what questions or concerns did you have, if any?</td>
</tr>
</tbody>
</table>
| **Online Higher Education**   | • Approximately how many online courses have you taken?  
• Overall, how has your experience been in these online classes?  
• What accommodations do you normally use in your classes?  
Online and face-to-face? |
| **Disability-Related Stress** | • As you probably know, stress is a normal part of life. How would you define stress?  
• What kinds of things normally stress you out?  
• Do you think your disability affects the stress you experience? If so, in what way?  
• In terms of school, what do you feel causes you stress?  
• How do you deal with this stress? |
| **Intelligent Virtual Assistants** | • An intelligent virtual assistant, or IVA, is basically software installed on a device that we can interact with through normal language and conversations. Some common examples are Amazon’s Alexa, Apple’s Siri, and Google Assistant. How familiar are you with using an IVA?  
• Which IVA(s) have you used? Why?  
• What have you used an IVA for?  
• What did you think about using an IVA? Can you describe your experience?  
• How have you used an IVA to help with school? Can you think of other ways you could use it for in this environment?  
• Do you feel that using an IVA affects your stress? How?  
• Did you use your IVA to complete tasks that are more difficult because of your visual impairment? If so, how?  
• Do you feel that using an IVA can help you overcome disability-related stress or obstacles? |
| Features and Uses | • What concerns do you have about using an IVA, if any?  
• What tasks have you used an IVA for?  
• When using an IVA, what features have you used? Which ones do you find most and least helpful? |
| Closing | • Do you think you’ll use an IVA in the future? Why or why not?  
• Is there anything else you’d like to discuss that we have not already addressed? |
APPENDIX G:
SEMI-STRUCTURED JOURNAL

After completing the interview, you will be asked to fill out this follow-up journal entry. Please take time to reflect on your use of and experience with your chosen IVA(s). It is asked that you answer each question with as much detail as possible.

Some terms used below may be unclear. To view their definitions, click on the word. For any other assistance, please contact the principal investigator directly.

PIN ____________________

1. Which intelligent virtual assistant(s) do you use?
   - Amazon’s Alexa
   - Apple’s Siri
   - Google Assistant

   a. Approximately how often do you use an intelligent virtual assistant?
      - Several times a day
      - Once or twice a day
      - A few times a week
      - Once a week
      - Not at all

   b. What specific features do you use (i.e. reading, taking notes, managing your calendar, etc.)? Why did you decide to use each feature?
c. Does using these features affect how you completed tasks (i.e. steps taken, whether or not you procrastinated, whether or not you enjoyed completing them, etc.)?


d. Does using these features make completing tasks easier/harder, quicker/slower, less stressful/more stressful, etc.? Please explain.


2. How was your overall experience with the intelligent virtual assistant(s)?
   
   - Excellent
   - Good
   - Okay
   - Not good
   - Really bad
a. Do you feel that using an intelligent virtual assistant is easy and fun, hard and frustrating, or something else? Please explain.

b. Have you used an intelligent virtual assistant to help minimize stress or overcome a barrier? If so, please explain.

3. Do you feel that using an intelligent virtual assistant was or would be helpful when taking an online course? If so, how?

4. Do you have any suggestions for or concerns about future use of an intelligent virtual assistant?