EXAMINING THE DIGITAL DISABILITY DIVIDE IN HIGHER EDUCATION

by

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List of Abbreviations

Americans with Disabilities Act .... ADA
Assistive Technology .... AT
Federal Communication Commission .... FCC
Information Communication Technology .... ICT
Technology Attitude, Use, and Learning Environment Preference .... TAUP
Learning Environment Preference .... LEP
Educause Center for Analysis Research .... ECAR
Universal Design for Learning .... UDL

Abstract

EXAMINING THE DIGITAL DISABILITY DIVIDE IN HIGHER EDUCATION

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The number of students with disabilities pursuing higher education is increasing (Madaus, Kowitt, & Lalor, 2012; Sachs & Schreuer, 2011). However, the research related to this population is sparse (Peña, 2014), particularly regarding technology (L. Newman, Browne-Yung, Raghavendra, Wood & Grace, 2017). The current study examines the technology attitudes, technology usage, and learning environment preferences of students with disabilities, as well as their perception of institutional support for accessible technology. This study was a secondary analysis using data from the 2016 Educause Center for Analysis and Research (ECAR) Student and Technology survey. A point biserial correlation analysis was conducted to establish the relationships between technology attitude, usage, and learning environment preference. A discriminant analysis was used to compare students with and without disabilities on these variables. Finally, a hierarchical regression was used to examine which student characteristics contribute to the ratings of institutional support for accessible technology by students with disabilities. Results of the study showed that students with disabilities differ from students without disabilities in terms of learning environment preferences, the use of technology as a distraction, and attitude toward technology. The hierarchical regression indicated that gender, ethnicity, declared major, technology attitude, social and academic technology use, and learning environment preference contribute to predicting students’ ratings of institutional technology support.

Chapter One

This study offers a unique investigation into the digital disability divide in higher education by examining the attitudes toward technology, technology usage, learning environment preferences, and perceptions of institutional support of postsecondary students with disabilities. Chapter One begins with an introduction to this study and background information about disability studies, including a review of prevailing models of disability and a discussion of appropriate language. Additionally, this chapter provides a statement of the problem, the purpose of the study, and the research questions.

Introduction

The proliferation of information and communication technology (ICT) has changed the way students interact with others, complete academic and personal work, and spend their leisure time (Atwater, 2014; Giannetto, Chao, & Fontana, 2013; Mardis, 2013). The number of classes using email at colleges and universities increased significantly from only 4% in 1994 to 44% in 1998 (Hu & Kuh, 2001). In 2011, 90% of students reported using email regularly for both school-related and personal communications (Gosper, Malfroy, & McKenzie, 2013), and 85% of students surveyed in 2016 reported using a laptop in most of their courses (Dahlstrom, Brooks, Pomerantz, & Reeves, 2016). Usage of other types of ICT has also risen quickly. When the Pew Research Center first began tracking social media use in 2005, 5% of American adults had at least one social media account. In 2018, 69% of adults and 88% of those between the ages of 18 and 29 used social media (“Social media fact sheet,” 2018). Given their popularity among traditional college-age adults, social platforms (e.g., Twitter) are being used in classrooms as well (Junco, Heiberger, & Loken, 2011). The number of students taking at least one online course has also grown rapidly, outpacing increases in overall college enrollments, with an estimated 5-7 million students enrolled in online education in 2013 (Allen & Seaman, 2015).

Technology often appears ubiquitous, and many take for granted the ability of "digital native" students to understand and adapt to the use of such tools (Goode, 2010a; Prensky, 2001; Ziegler & Sloan, 2017). However, research suggests that there are still significant gaps in access, as well as differences in the way people use and understand technology, particularly along the lines of race, gender, ethnicity, education, and disability status (Cohron, 2015; Dobransky & Hargittai, 2016; Parkes, Stein, & Reading, 2015; Tsatsou, 2011; van Deursen, van Dijk, & Peters, 2011; Waycott, Bennett, Kennedy, Dalgarno, & Gray, 2010). Wicker and Santoso (2013) argued that internet access is a basic human right because it is "directly tied to a set of human capabilities that are considered fundamental to a life worth living...one cannot deny rights status to internet access without diminishing or denying the associated capabilities" (p. 45). It is a critical resource that has been shown to contribute to political and community engagement, health, and other positive outcomes (Robinson et al., 2015).

Technology proponents expected advances in ICT to open new opportunities by allowing people to communicate with each other and access information in ways that were previously unavailable (Fruchterman, 2017; Manzoor & Vimarlund, 2017; Moser, 2006). Many hoped these advances would help alleviate inequality as technology became increasingly affordable and information more accessible (Adam & Tatnall, 2017). Unfortunately, access to technology and experience with how to use it mimics existing patterns of privilege and inequality (Gorski, 2009). Some research has shown that technology can even create additional barriers, such as for people with disabilities who may need expensive assistive technology in addition to the technology needed for basic access (Dobransky & Hargittai, 2006).

Disability

It is important to examine the history of disability research and the implications of the language around disability to better understand the context and to avoid unintentional harm. There are two overarching views of disability — individualistic models and the social model — both of which are discussed here.

Individualistic models focus on the impairments of individuals as disabling rather than on external factors (Seale, 2014). One example of this is the medical model, which comes out of medical treatment and views disability as a bodily deviance that needs to be cured (Kafer, 2013). The medical model focuses on the disability itself rather than any external factors, such as social perception or environmental inaccessibility (Shakespeare, 2010). Kafer (2013) described a disability awareness event on her campus where students without disabilities were blindfolded to experience what it would feel like to have a visual impairment as an example of the focus in this model. The students who participated may have gained a better understanding of the physical experience, but the activity fails to account for any social or environmental challenges individuals with disabilities may encounter and research has shown several negative consequences resulting from these types of simulations (Nario-Redmond, Gospodinov, & Cobb, 2017). Indeed, some followers of the medical approach argue that such context is unimportant because the problem lies not in the language used to describe disability or the context but the medical condition itself (Dutton, 1996).

Other individualistic models include the charity model and the administrative model. Historically, the charity model displayed people with disabilities as incapable and "in need of care and protection" (Seale, 2014, p. 22) and used language that elicited pity, such as describing someone as "suffering" from autism. As will be discussed in more detail later, language plays a role in how people think about and act toward others, and this type of language can infantilize people with disabilities (Clarke, Embury, Knight, & Christensen, 2017). Administrative models often use rigid definitions of disability that focus on the impairment to establish eligibility for legal protections. For example, the Americans with Disabilities Act applies to anyone who has "a physical or mental impairment that substantially limits one or more major life activities" (ADA, 1990, sec. 12102). While the charity model has recently begun a shift to more positive portrayals of individuals with disabilities, administrative definitions continue to be strict and non-inclusive (Seale, 2014).

Conversely, the social model emphasizes the role of social barriers in the lives of people with disabilities (Oliver, 2013). This approach changes the perspective of disability from a focus on individual deficits to a problem of social exclusion

(Shakespeare, 2010). The social model distinguishes between impairment and disability: "*impairment* should be used to refer to the physical or cognitive condition, and *disability* should refer to the social construction of exclusion or oppression resulting from the impairment" (Jaeger, 2012, p. 22). In the social model, a person may have a visual impairment, but it is the lack of accessible material, such as online images without descriptive alternative-text (alt-text), that causes disability (Kent, 2015). Freund (2001) noted the way a small village in Egypt adapted to a high rate of trachoma, a visual impairment. The small village did not often need to add new homes or other buildings, so those with limited vision were able to navigate the relatively consistent environment more independently than they could in a rapidly changing location. The work of the villagers, plowing and harvesting, could also be done by those with limited vision. Individuals in this village with trachoma did not consider themselves disabled because the social construction in their community did not exclude them due to their impairment (Freund, 2001).

While the social model has been a positive force in the lives of many with disabilities (Tregaskis, 2002) and can serve to improve the self-esteem of people with disabilities (Shakespeare, 2010), some researchers argue that the social model has similar limitations to the medical model in its singular focus (Kafer, 2013; Shakespeare, 2010). Here, the focus is solely on the social and environmental factors, completely ignoring the physical challenges that can be presented by impairments (Kafer, 2013). While it is important to acknowledge the impact of societal factors, critics note that no amount of societal acceptance or changes in design will cure a terminal disease or prevent the physical discomfort that accompanies some impairments (Freund, 2001). The intense focus on societal factors in this model can marginalize people who would welcome medical intervention; an improved model would encompass all aspects of disability (Kafer, 2013). The original author of the social model agrees with these limitations and argues that the model was never intended to be all-encompassing but merely to expand the conversation beyond the medical focus (Oliver, 2013).

Language. These approaches demonstrate the difficulty of conceptualizing disability and, with that, the difficulty in identifying appropriate language when discussing disability. Paul Jaeger (2012), the author of one of the most comprehensive reviews of the disability divide (Goggin, 2017), argues that individuals with disabilities, even those with similar impairments, are unique and may experience disabilities differently, further complicating the attempt to identify common language. The scope of what can encompass disability adds additional complexity. People with visual, mobility, or cognitive impairments are all considered to be individuals living with a disability, yet their experiences will be vastly different. Even people with distinct types of impairments within each category can have different experiences. Consider, for example, someone with full paralysis compared to someone who has lost a limb, another mobility impairment. The cognitive impairment aphasia causes "issues with the use of language" (Eckes & Ochoa, 2005, p. 14), which would have different implications on a person's life than other cognitive impairments, such as autism. Even within the categorization of autism, there is a spectrum where individuals will differ significantly regarding their experiences and needed support (Jaeger, 2012).

There has been a varied history of terminology used to describe people with disabilities. For example, the term "handicapped" came from the phrase "cap in hand" which was "based on the fact that persons with disabilities in England were long permitted to support themselves exclusively through begging" (Jaeger, 2012, p. 21). Gallaudet University, the only liberal arts institution for students with hearing impairments, was initially called the Columbia Institution for the Deaf and Dumb (Madaus, 2011). The word “retarded” was once a medical term corresponding to IQ scores but became so connected with derogatory connotations that healthcare professionals developed new classifications (Jaeger, 2012). However, such language was still present in many official documents, including the definition of intellectual disabilities in the Higher Education Opportunity Act of 2008 that referred to “a student with mental retardation” (HEOA, 2008, p. 3361). The discriminatory language was in place until Congress passed Rosa’s Law in 2010, which removed references to mental retardation in favor of the term “intellectual disability” in federal laws related to health and education (Mikulski, 2010). These are just a few examples of the problematic language that has been used to refer to people with disabilities present even in official documents intended to support this population.

There are different perspectives on how to use language to empower individuals with disabilities. Europeans often place the disability first, a “disabled person,” to maintain focus on social discrimination (Jaeger, 2012). Conversely, North Americans and people with disabilities across cultures tend to use person-first language, “a person with a disability,” which is intended to emphasize the person rather than the disability

(Jaeger, 2012). However, there are also individuals with disabilities who prefer to self-identify based on their disability, such as those who identify as a part of the Deaf community (Clarke et al., 2017). Clearly, there is no simple answer to the question of appropriate language. However, for the sake of consistency and in keeping with the wording most often used by people with disabilities, this study will use person-first language.

Purpose of Study

The purpose of this study was to examine how students with disabilities experience technology in higher education. It primarily focused on examining how disability status influences students' technology use, preferences regarding learning environment, and attitudes toward technology, as well as student perceptions of institutional support for accessible technology.

Statement of Problem. Access to and the ability to use ICT is vital for success in the current connected environment. ICT knowledge has been shown to contribute to lifetime earning potential, work-life quality, political influence, and community engagement (DiMaggio, Hargittai, Celeste, & Shafer, 2001; Robinson et al., 2015). Despite improvements, access to ICT remains uneven, and individuals with disabilities are especially impacted (Duplaga, 2017).

Knowledge of ICT has become an unspoken prerequisite for success in higher education (Goode, 2010b), which may result in students with disabilities missing out on access to essential services and opportunities. A growing number of university services are being moved online, with 90% of schools reporting that some student services (e.g., course registration) were available only online (Erickson et al., 2013). There is little published research examining the accessibility of such university services, perhaps because registration and similar activities are typically available behind login credentials, limiting the ability for a comprehensive review by researchers. There have been, however, several studies examining institutional websites or accessibility policies that have identified multiple concerns (Bradbard, Peters, & Caneva, 2010; Curl & Bowers, 2009; Edmonds, 2004; Erickson, Trerise, VanLooy, Lee, & Bruyère, 2009; Ringlaben, Bray, & Packard, 2014), suggesting larger accessibility problems in higher education.

While there was significant research on the digital divide from the late 1990s through the early 2000s, the attention on this topic has lessened since then. Research on the digital divide typically focused on race, gender, location (urban or rural), or socioeconomic status (SES) but rarely considered disability. Students with disabilities in general have not been a focus in higher education research. One meta-analysis reviewed disability research in postsecondary education over a 20-year period in four respected higher education journals. The authors found only 25 articles out of over 2,300, or just over one percent, directly addressed students with disabilities, and primarily focused on academic performance, disability services, student needs, and attitudes of peers and faculty (Peña, 2014). Dedicated examinations around the digital disability divide are on the rise (Goggin, 2017); however, the topic of students with disabilities and technology remains under-researched (L. Newman, Browne-Yung, Raghavendra, Wood, & Grace, 2017). Some researchers consider all students to be proficient with technology, calling them “digital natives” (Prensky, 2001), which includes an assumption that access is not an issue. However, the recent research that does examine this area has found continued inequity in access and understanding of technology for individuals with disabilities, women, and minorities (Dobransky & Hargittai, 2016; Gonzales, 2016; Horrigan, 2016; Horrigan & Duggan, 2015).

There is a mistaken assumption that disability is the problem of a minority. In fact, impairment will impact most people eventually through "sickness, accident, war or...age" (Gallegos, 2017, p. x). Research focused on individuals with disabilities is a critical area of study that will benefit from increased attention.

Research Questions

This study will expand the disability divide literature by examining the perceptions and use of technology in higher education by students with disabilities. The research questions are as follows:

1. What is the relationship between technology attitude, usage, and learning environment preference (TAUP) among students with disabilities?
2. Is there a difference in TAUP based on disability status?
    a. Is there a difference in technology usage among students based on disability status?
    b. Is there a difference in attitude toward technology among students based on disability status?
    c. Is there a difference in learning environment preferences among students based on disability status?

3. What impact do student characteristics and TAUP have on the ratings of institutional support for accessible technologies by students with disabilities?

Organization

This dissertation includes five chapters and references. Chapter One provides a brief introduction to the topic as well as the rationale for the proposed study and the research questions. Chapter Two presents a comprehensive review of the literature around the digital divide and the disability divide with a focus on higher education. Chapter Three presents the research methodology, and Chapter Four details the results. Finally, Chapter Five discusses the findings and makes recommendations for future research.

Chapter Two

Chapter Two provides a review of the literature relevant to this research. The chapter begins with a brief look at challenges faced by people with disabilities in society, followed by an overview of laws designed to ensure equal access for this group. Next, the researcher discusses literature around the digital divide, including the progression from simple access to more complex concepts around the ability to use technology. This section also includes a general review of the digital divide in the context of education. The chapter ends with an examination of the digital disability divide, particularly in the area of higher education.

Disability in Society

The cart icon used to check out on an online retailer's website may not appear to be a symbol of discrimination, but websites often display such icons as images. If those images do not have a label that screen reader technology can recognize, individuals with visual impairments are effectively prohibited from using the site (Vicente & López, 2010). While most such scenarios likely occur through a lack of understanding rather than hostility toward individuals with disabilities, the consequences are the same (Blanck, 2014).

Deal (2007) noted that while individuals with disabilities are less likely now than in the past to experience blatant discrimination, they are still subject to subtle prejudice.

The author explained that subtle prejudices can be more challenging to cope with because they "may not even be recognized by the holder or others as being negative, but may still have a significant impact upon the lives of disabled people as more blatant forms" (Deal, 2007, p. 95). He gave the example of people who, with apparent positive intentions, support policies that result in further segregation of individuals with disabilities. People who support separate special education classrooms in K-12 are one example. They argue a distinct learning space can offer better support for students with disabilities, but this also means these students spend less time in inclusive classroom settings, losing opportunities to interact with classmates without disabilities (Deal, 2007).

Some common activities can result in challenges for people with disabilities. A case study participant with a visual impairment notes how difficult it is for her to pay for things with cash. She must prepare how much she plans to spend before going out, folding each denomination in a certain way so she can tell the difference, and place an increased level of trust in salespeople who return change that she is not able to count in the moment (Schillmeier, 2008). Traffic signals can also be problematic when the walk sign in crosswalks changes too quickly for slower-moving pedestrians to safely cross the street (Freund, 2001). In a study reviewing 95 instruments designed to assess the walkability or bikeability of built environments, 81% included some element of universal design (UD). However, only 27% of instruments had items explicitly relevant for people with disabilities, and 11% of those instruments were specifically created to determine accessibility for people with disabilities (Gray, Zimmerman, & Rimmer, 2012).

The goal of UD is to create products, environments, or services that are accessible to a broader range of users without adaptation (Hersh, 2014). This does not mean that the designer should create one solution for all users but emphasizes the need for flexibility and multiple means of access. This flexibility could mean including text transcripts for audio content. This is important for people with hearing impairments but can also be useful for people who are in a location with significant background noise where they cannot hear audio content and for non-native speakers (Simoncelli & Hinson, 2008). Ellcessor (2012) argues that because UD tries to accommodate so many potential use cases, it is not focused enough for true accessibility. However, technology not designed with accessibility in mind can take years to be adapted (Jaeger, 2012), so incorporating UD principles from the start can improve usability for people with disabilities.

Disability law. The United States federal government has implemented several laws since the early 1970s to offer general protections to people with disabilities as well as to improve internet accessibility and help students with disabilities achieve academically. While a comprehensive review is outside the scope of this research, the following section offers an overview of legislation relevant to people with disabilities and its implications for ICT access in education to provide an introduction to the complex legal environment.

The Rehabilitation Act of 1973 was one of the first laws passed that focused on codifying improvements for individuals with disabilities related to technology. Section 508 of this act requires the federal government to use accessible technology, which means companies interested in providing technology to the U.S. government must meet this requirement (Yang & Chen, 2015). Section 504 of the Rehabilitation Act prohibits any organization that receives financial support from the federal government from discriminating against individuals because they have a disability (Yang & Chen, 2015). In 1998, Congress approved amendments to the Rehabilitation Act that authorized the creation of accessibility guidelines, including web accessibility (WebAIM, 2013). Since most colleges and universities receive financial support from the federal government, they are responsible for providing accessible websites and technology based on Section 504. Unfortunately, research has shown that compliance with these accessibility standards is not always high (Bradbard et al., 2010; Erickson et al., 2013; Ringlaben et al., 2014).

The Individuals with Disabilities Education Act (IDEA) of 1975 focuses on K-12 education and is "aimed at helping [students with disabilities] achieve academically to the best of their ability" (Cawthon & Cole, 2010, p. 113). Under IDEA, schools are responsible for identifying students who may need additional services, providing appropriate accommodations at no cost to the students' families, and creating transition plans to help students as they prepare to leave the K-12 environment (Cawthon & Cole, 2010). With a direct focus on the education of children and teenagers at the primary and secondary school levels, students have significant support and guidance when covered under IDEA. This level of assistance is valuable to young students who are still learning about the accommodations that will best serve them. However, many students experience challenges shifting from the comparatively straightforward regulations of IDEA to broader disability rights laws that become applicable when they leave high school (Eckes & Ochoa, 2005).

One of the most comprehensive laws to protect individuals with disabilities was the Americans with Disabilities Act (ADA), initially passed in 1990 (Jaeger, 2012). The ADA does not deal directly with internet accessibility, perhaps because the impact of this technology was not clear when Congress initially created the law. However, some sections in the ADA can be interpreted as relating to internet accessibility, specifically Title III and Title IV (Yang & Chen, 2015). Title IV requires closed captioning for television programming and services that improve telephone accessibility for people with hearing or speech impairments (Yang & Chen, 2015). The Federal Communications Commission (FCC) oversees compliance with Title IV but has historically had little authority over the internet (Yang & Chen, 2015). While net neutrality regulations approved in 2015 opened up Internet Service Providers (ISP) to some oversight by the FCC, the FCC recently voted to end those regulations, removing their authority over ISPs and reducing recourse for people with disabilities to address accessibility concerns (Snider, 2017).

Title III of the ADA "covers places of public accommodation...for instance, restaurants, auditoriums, bakeries, parks, zoos, amusement parks, homeless shelters, bowling alleys, and many more" (Yang & Chen, 2015, p. 856). The language does not mention the internet as a place of public accommodation, and courts have provided different interpretations as to whether websites are covered under Title III of ADA. Some courts have ruled that only access to physical structures is protected, while others have included websites tied to organizations with a physical location as a public accommodation under ADA (Wolk, 2015). For example, a court ruled that because Target's website was closely related to the physical store experience, the company's website should be considered a place of public accommodation and must be accessible (Jaeger, 2012). A more recent case against Netflix over the inaccessibility of their streaming video content due to a lack of captioning resulted in a ruling that ADA legislation did apply to Netflix even in the absence of a physical location (Yang & Chen, 2015). Currently proposed legislation could change the way ADA is enforced, requiring a written notice within 60 days for a business to acknowledge the accommodation complaint with an additional 120 days for the business to make progress on addressing the issue before initiating any legal action (Poe, 2018). Proponents of the proposal believe this change will prevent frivolous lawsuits and provide businesses a chance to implement changes. Opponents counter that since most states do not allow monetary damages in ADA lawsuits, there is little incentive for frivolous suits and believe the protection against legal action will result in businesses dealing with accommodation in a reactive rather than a proactive manner (Novic, 2018).

In addition to a lack of clear guidance on how, or even if, ADA includes protection for internet accessibility, there are several other limitations. First, there is no precise definition regarding what is considered a disability. Disability under ADA is defined as "a physical or mental impairment that substantially limits one or more major life activities of such an individual" (Poe, 2018, sec. 12102). It can therefore be unclear what impairments are eligible for protection under the ADA (Blanck, 2014).

Additionally, students starting college can experience an abrupt transition from the highly structured support offered under IDEA to the broader ADA. Throughout K-12, the responsibility lies with schools to identify students who may need assistance under IDEA and to provide reasonable accommodations to those students (Eckes & Ochoa, 2005). ADA, however, prohibits directly asking if someone has a disability. Once students enter college, they must self-identify to receive accommodations, and those accommodations cannot result in an undue burden on the institution or require changes that threaten the academic integrity of a program (Eckes & Ochoa, 2005). Students may be hesitant to disclose disabilities to their institutions, which means they are not eligible for accommodations that could help them succeed in school (Cawthon & Cole, 2010).

The Higher Education Opportunity Act (HEOA) is a result of the 2008 extension and amendment of the Higher Education Act of 1965. The primary focus of the HEOA is the financial affordability of higher education, including programs such as the federal Pell Grants and Stafford loans, but some provisions of the act do center on students with disabilities. Congress introduced several initiatives that would encourage research into best practices in helping students with disabilities succeed, including an emphasis on universal design for learning (UDL), which encourages flexibility in course design to accommodate diverse student abilities (Houston, 2018). The HEOA also expanded financial support for students with intellectual disabilities, including those who were eligible for assistance under IDEA. However, many of these initiatives remained underfunded or without funding entirely for years after enactment (Madaus, Kowitt, & Lalor, 2012).

There have been several other laws aimed at improving the accessibility of technology for individuals with disabilities. The Telecommunications Act of 1996 "promotes the development and implementation of accessible technologies in communication systems, including the Internet" (Jaeger, 2012, p. 47). The Assistive Technology Act provides financial assistance to states to support technology-related assistance. This law codified the legal definition of UD, though it did not require the use of UD for funding (Myhill, Cogburn, Samant, Addom, & Blanck, 2008). The Hearing Aid Compatibility Act requires hearing aid compatibility with telecommunications devices, though newer internet-based Voice over Internet Protocol (VoIP) technologies were not included until recently (Snyder, 2017).

While not all of these laws were specifically designed to improve the education experience for students with disabilities, they can have implications for higher education when students bring lawsuits against their universities for lack of compliance. One student sued her law school for failure to provide promised transcriptions of taped classroom lectures (Kaplin & Lee, 2014). Courts have traditionally been reluctant to question the institutional determination of what is a reasonable academic accommodation but refused to dismiss the student's claim in this case, likely because the school offered transcripts as an accommodation but never delivered (Kaplin & Lee, 2014). Students sued a group of universities working to use Amazon's Kindle e-reader for textbooks because the text-to-speech feature was disabled on the device and when re-activated the settings to control the feature were not accessible (Kent, 2015). The Department of Education and the Department of Justice issued a joint statement in response declaring that use of inaccessible e-reader technology in education was a violation of Section 508 and ADA (Lazar & Jaeger, 2011). The Department of Justice intervened in a case against Miami University in Ohio brought by an individual student. The consent decree required the university to make a significant investment in the accessibility of their website and other technology, as well as pay compensation to several students with disabilities (Department of Justice, 2016). The university also reached a separate settlement with the student for over $200,000 for tuition and expenses at another school as well as pain and suffering the student experienced at Miami University (Edwards, 2016).

Despite the numerous laws designed to support accessibility for people with disabilities, this group still faces significant challenges. People with disabilities use technology and the internet at lower rates than people without disabilities (Anderson & Perrin, 2017). Other groups also continue to experience unequal access to technology; this persistent lag in access is commonly referred to as the digital divide (Chaudhuri, Flamm, & Horrigan, 2005; Hargittai & Hinnant, 2008; Jones, Johnson-Yale, Millermaier, & Pérez, 2009; Mardis, 2013; Ono & Zavodny, 2008).

Digital Divide

Historically, research on the digital divide focused on access to computers and the internet, the "haves" versus the "have-nots" (Dolan, 2016), though the concept has expanded to include inequality beyond simple access (Hargittai & Hinnant, 2008). Researchers have identified differences in access by race (Hoffman, Novak, & Schlosser, 2000; Jones et al., 2009), gender (Ching, Basham, & Jang, 2005; Hargittai & Hinnant, 2008), socioeconomic status (SES; Bucy, 2000; Chinn & Fairlie, 2010; Mardis, 2013), immigrant status (Ono & Zavodny, 2008), education level (Chaudhuri et al., 2005), and disability status (Dobransky & Hargittai, 2016). Several large-scale studies were undertaken during the height of research in this area to examine its scope and the impact of different levels of internet access (Clinedinst, 2004; Hoffman et al., 2000; Ponder, Freeman, & Myers, 2000).

Access. The concept of the digital divide has expanded to include more than just access to ICT; however, the access divide remains an issue for many Americans. Despite improvements, there continue to be reduced levels of access for individuals with low SES or education levels (Carlson & Goss, 2016), as well as individuals with disabilities (Brewer, 2017). Results from several surveys have continued to show gaps in levels of access. A 2012 census report showed that only 61.9% of African Americans and 64.3% of Hispanics had access to internet at home, compared to 78.6% of non-Hispanic Whites (U.S. Census Bureau, 2014). Only 60% of respondents in Louisiana, Mississippi, and West Virginia reported access to the internet at home compared with 79.5% of residents in New Hampshire, the state with the highest levels of home internet (U.S. Census Bureau, 2014). The three states with low home internet access also had the lowest reported percentages of internet use from any location, 66.2% for Louisiana and Mississippi and 70.6% in West Virginia (U.S. Census Bureau, 2014). Fewer than 48% of people with disabilities reported using the internet in one study compared to 80% of those without disabilities (Dobransky & Hargittai, 2016). Of those who reported using the internet, 67% of people with disabilities had access to a high-speed connection while 78% of people without disabilities reported having a broadband connection (Dobransky

& Hargittai, 2016). Expanding the results of Dobransky and Hargittai's (2016) representative sample of U.S. adults means that of the approximately 56 million Americans who reported having a disability (Anderson & Perrin, 2017), almost 30 million do not use the internet and about 9 million of those who do go online do so with slower connection speeds. Thus, while the digital divide has improved in the United States in the past decade, all people do not have equal access.

The binary way in which researchers have traditionally measured internet access obscures broader issues of the divide. The proliferation of smartphones has helped to reduce the underlying problem of access to some extent (Stiles, 2013). About 64% of Americans reported owning a smartphone (Smith, 2015), but only 44.9% of individuals with intellectual or developmental disabilities reported owning any cellphone (Tanis et al., 2012). Feature phones, also referred to as dumb phones, are increasingly difficult to find as major service providers advertise phones that require expensive data plans (Bogost, 2017). As less expensive connection options diminish, low-income families may end up without devices or with devices they cannot afford (Gonzales, 2016). A Pew survey found that 19% of Americans are at least partially reliant on their smartphones to connect to the internet and that 49% of smartphone users had trouble viewing some content on these devices (Smith, 2015). More low-income households were smartphone-dependent than households making over $75,000 a year (Gonzales, 2016), so those low-income households are again more likely to miss out on many of the benefits of being connected to the internet. Additionally, families with lower SES often have trouble with technology maintenance costs, such as paying monthly bills and replacing broken hardware (Gonzales, 2016). These individuals may report that they have access to such technology and the internet but are more likely than families with a high SES to experience frequent breaks in use, a distinction that binary reports on access rarely capture (Gonzales, 2016).

Beyond access. Some researchers have suggested that the metaphor of a stark divide is no longer appropriate and instead prefer the term "digital inequality" (Hargittai & Hinnant, 2008). While most Americans do have some access to technology, there are several areas where inequalities persist:

- Technical means: the quality of hardware, software, and connection available;
- Autonomy of use: convenient access (e.g., not traveling far to access), online activities not restricted (e.g., as they might be on a work or public computer in what users can do or when the machine is available);
- Use patterns: using the internet primarily for constructive purposes, such as to support learning or apply for jobs, or for entertainment;
- Social support: having others available who are familiar with technology and can support and encourage its use;
- Skill: ability to use technology effectively (DiMaggio et al., 2001).

Due to the increasingly prominent role ICT plays in our society, individuals without access to technology or sufficient technical skills are at a significant disadvantage. Figure 1 shows a model developed by DiMaggio and colleagues (2001) that demonstrates the impact internet access has on life chances. The authors posited that the increase of social (e.g., political agency) and human capital (e.g., educational attainment) is directly related to the extent and quality of ICT use which is indirectly related to individual characteristics, hardware, software, skill, and social support. ICT usage has also been shown to contribute to improved earning potential and work-life quality as well as increased political influence and community engagement (DiMaggio et al., 2001). Another study showed that individuals with higher SES were more likely to use ICT for "capital-enhancing" activities (Zillien & Hargittai, 2009, p. 287). This can include economic capital, such as education or employment-related activities, or political capital, such as reading the news, or social capital, such as making connections online. These findings further support the positive impact technology can have on quality of life and the potential exacerbation of inequality for those without the access or knowledge to take full advantage of it.

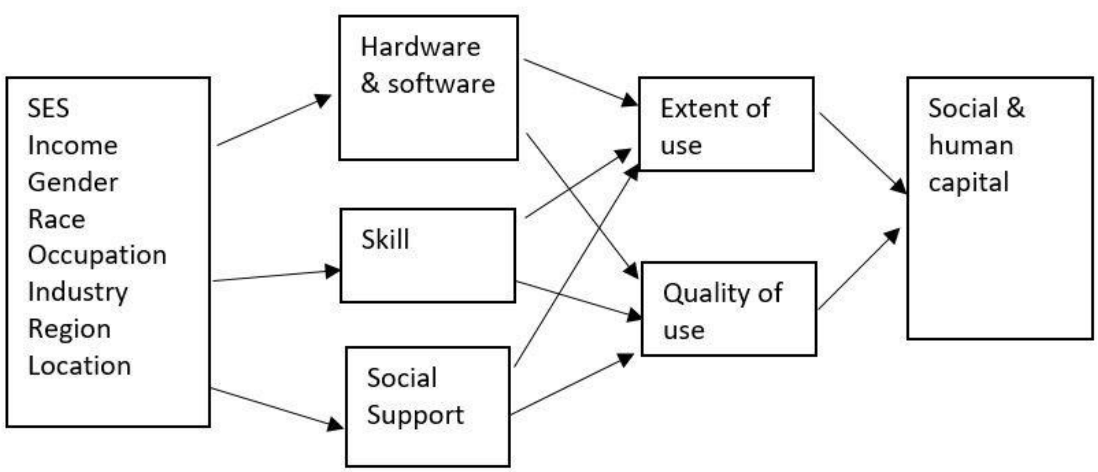

Figure 1. Impact of internet access on life chances adapted from DiMaggio et al. (2001)

Recent literature on the digital divide focuses more on skills gaps than straightforward access, though groups traditionally at risk for lack of internet access are also most liable to experience a lag in digital skills (Horrigan, 2016). Only 17% of adults between 18 and 65 years of age were identified as “digitally ready” for online learning. This group showed confidence "in their online skills, display[ing] little hesitation about finding information that they trust, [were] familiar with the emerging 'ed tech' world, and [had] the technology assets to take advantage of it" (Horrigan, 2016, p. 11). Children who grow up without a strong support network may not develop the same proficiency with technology as those who do have access to such support (Hargittai & Hinnant, 2008). The small percentage of adults considered digitally confident points to an increasing gap in digital skills - a gap that colleges and universities, designed to promote learning and prepare students to be contributing citizens of an increasingly technological world, should be working to help close.

Education. Much of the research on the digital divide in education has focused on the K-12 environment. While this study focuses on higher education, the K-12 research provides essential context for students' experiences with technology before they begin college. State legislatures passed hundreds of laws between the late 2000s and early 2010s related to digital learning at the K-12 level (Digital Learning Now, 2014), but there is still evidence of differences based on location. Digital Learning Now's (2014) report card graded each state on the quality of their digital learning experience for K-12 students. The report gave 28 states a grade of C or better on students having access to quality digital content. However, only nine states earned a C or higher for student eligibility to participate in online learning, and only 12 earned high scores on providing sufficient infrastructure for online learners (Digital Learning Now, 2014). The Digital Learning Now criteria included quality of online learning and student access but did not include any metrics specifically on the accessibility of these online opportunities for students with disabilities (Digital Learning Now, 2014).

The patterns of school access often mimic larger, problematic societal patterns. A study in California showed that high schools in predominately White middle-class areas had a higher computer-to-student ratio and better equipment than schools in lower income and minority communities (Goode, 2010a). Another study conducted across 67 K-12 districts in Florida over four years found that high-SES schools had increased access to software, better technology support, and greater teacher use of technology than at low-SES schools (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008). More recently, teachers cited access to and ability to use equipment as a more challenging obstacle to implementing technology in classrooms than pedagogical concerns indicating continued issues with technology in schools (Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017).

Aesaert and van Braak (2015) worked to develop a test of ICT competency that would examine both technical skills and higher-order thinking skills, including the ability to search for, process, store, and create digital information and to understand how to use ICT safely and effectively. The final test, given to 358 sixth graders, covered 15 basic technical skills and 19 higher-order skills that were split into different tasks which simulated scenarios for students to demonstrate their ICT competency. The authors found that while most students, regardless of SES or gender, could find information using simplistic terms in a search engine, they had "a lot of problems with assessing and judging the relevance of information...and synthesizing information" (Aesaert & van Braak, 2015, p. 17). Students with higher SES (measured by mother's education level) showed stronger basic ICT skills as well as a better ability to judge "the reliability and relevance of digital information" among other competencies (Aesaert & van Braak, 2015, p. 17). Other research found similar results where students displayed low levels of skill when searching for information online, and almost no participants in the study evaluated the legitimacy of sources they found (van Deursen & van Diepen, 2013). The lack of sufficient preparation at home or in lower school settings could cause challenges for students as they move into higher education.

Higher education. While there have been fewer studies directly reviewing the digital divide in higher education in the United States, it does appear to remain an issue at colleges and universities. The two large-scale studies on this topic were conducted more than 15 years ago and focused explicitly on minority-serving institutions (MSIs) (Clinedinst, 2004) and historically Black colleges or universities (HBCUs) (Ponder et al., 2000). The studies were published only a few years apart and reported similar findings. Most HBCU and MSI campuses had access to the internet, but there were other areas of concern such as student access to computing resources and lack of faculty utilization of internet technology in classrooms (Clinedinst, 2004; Ponder et al., 2000). Several case studies have examined this topic more closely. Redd (2003), for example, reported that English faculty at Howard University did not have access to computers in their offices for months. Faculty at another HBCU had access to computers, but the equipment often barely met minimum standards (Snipes, Ellis, & Thomas, 2006). Howard eventually made a substantial investment in campus technology but had to take on significant debt on top of a National Science Foundation grant to achieve this upgrade (Redd, 2003). A decade later, some HBCUs reported still not having wireless access across campus due to limited equipment budgets and historic buildings that would be very expensive to equip for connectivity (Stuart, 2010).

The number of devices students bring to campus has increased, bringing new challenges to colleges and universities. In one survey, 52% of students reported having a laptop, tablet, and smartphone, requiring increased wireless capacity on campuses (Dahlstrom et al., 2016). However, institutions must also support their students' use and understanding of technology to help them succeed. Students across several universities reported access problems and a lack of understanding about how to use some academic technologies as key limitations in their learning (Waycott et al., 2010).

There is some evidence that college students believe themselves more digitally competent than faculty and staff perceive them to be. In one study, college students, chosen for their experience with e-learning, self-reported their levels of competence in several areas, including traditional educational skills such as reading and writing ability, as well as digital competency (Parkes et al., 2015). Faculty responded to the same survey ranking students in general. Students gave themselves higher rankings than the faculty reported on 15 out of 18 measures (Parkes et al., 2015). Faculty provided rankings for students in general, not this specific group, so it is possible these students were better prepared than the general population because of their prior experience with online learning. Additionally, the study had a small sample size for the quantitative methodology used with only 35 total participants, 20 students and 15 faculty (Parkes et al., 2015). Despite these limitations, the study raises important questions about how educators can help students become more digitally literate when the students may not see themselves as needing to improve those skills.

With online education on the rise (Allen & Seaman, 2015), researchers have worked to identify the key components necessary for effective e-learning environments. Referred to as critical success factors (CSF), these should be a short list of measurable items that are considered minimum requirements for success (Selim, 2007). One such work identified several factors needed for e-learning: human factors, technical competency, mindset, level of collaboration, and IT infrastructure (Benson Soong, Chuan Chan, Chai Chua, & Fong Loh, 2001). The human factors focus on the course instructors, their time and effort in creating the online course, and their ability to guide and motivate students to use the class technology appropriately. Technical competency and mindset encompass both the students and professors; both groups should have a constructivist conception of learning and be technically capable of performing in the online environment. The course must be set up to encourage collaboration between students. Finally, there must be technical support for students and instructors, and students must see the online resources as useful (Benson Soong et al., 2001).

Similarly, Selim (2007) identified the following critical success factors: "instructor characteristics (attitude towards and control of the technology and teaching style), student characteristics (computer competency, interactive collaboration, and e-learning course content and design), technology (ease of access and infrastructure), and support" (Selim, 2007, p. 409). Another study examined critical success factors from the perspective of what is needed in an instructor to create a positive e-learning environment. The authors focused on the importance of faculty understanding technology, particularly being able to apply appropriate pedagogies based on the technology used (Sridharan, Deng, & Corbitt, 2010). These studies all point to the importance of student preparation for online learning as well as the vital role faculty and universities play in supporting this type of learning. While accessibility considerations could logically be included within other critical success factors, such as student characteristics or course design, none of these researchers explicitly mentioned accessibility. Such oversight is unlikely to be a deliberate exclusion of students with disabilities, but rather a lack of knowledge or awareness of the needs of this population. Regardless of the intention, the omission results in disadvantages for students with disabilities in online learning (Blanck, 2014).

Disability Divide

Technology advocates have praised the internet as having the potential to dramatically improve the lives of its users, particularly those with disabilities (Adam & Tatnall, 2017). However, internet usage of people with disabilities is lower than that of those without disabilities (Dobransky & Hargittai, 2006). In one survey, 54% of people with disabilities reported using the internet compared to almost 81% of people without disabilities (Fox, 2011). More than half (57%) of participants with disabilities in another study reported that technology had not improved their lives compared to only 33% of the control group who reported a similar perception regarding the impact of technology (Macdonald & Clayton, 2013). This difference remains even in more recent surveys such as the 2016 Pew Research Center survey (Anderson & Perrin, 2017) with more people with disabilities reporting they never go online (23%) compared to people without disabilities (8%). People with disabilities who do use the internet were less likely to engage daily compared to their non-disabled peers with 50% and 79% reporting using the internet daily respectively (Anderson & Perrin, 2017). The disability divide, also called the digital disability divide, can also overlap with other types of divides, compounding the potential challenges for people with disabilities (Sachdeva, Tuikka, Kimppa, & Suomi, 2015).

There are many obstacles to internet access and use for people with disabilities, including financial and economic barriers. The ADA's requirement that accommodations not create an undue burden presents people with disabilities with a "Goldilocks" dilemma — they must be considered disabled enough to qualify for accommodations under the law but not so disabled that the necessary accommodations could be considered burdensome (Shallish, 2015). The low employment rate of individuals with disabilities (41%) compared to those without (79%) (Bernstein, 2012), certainly suggests significant challenges for this population. In 2010, the U.S. Census Bureau found the levels of persistent poverty to be 10.8% for individuals with a severe disability, 4.9% for individuals with a non-severe disability, and 3.8% for those with no disability (Bernstein, 2012). Individuals with lower SES have consistently been found to have less access to technology and the internet (Bucy, 2000; Chinn & Fairlie, 2010; Mardis, 2013). With lower employment rates and higher levels of poverty among people with disabilities, this is just one example of the compounding digital divides for this population (Sachdeva et al., 2015).

Even when people with disabilities have beaten the first level divide of access, they also have the second level to contend with. In such cases, individuals have physical access but are not able to take full advantage of the benefits technology has to offer due to accessibility issues (Burgstahler, 2015). Practically, online accessibility is complicated by the fact that a website can be made sufficiently accessible for people with one type of impairment while it remains entirely inaccessible for individuals with a different impairment (Bray, Flowers, & Gibson, 2003). Legally, requirements for internet accessibility may not be clear, and laws such as the ADA do not always apply to online environments (Wolk, 2015). There is also a distinction between accessibility and usability, though the line is often blurred. Hollins and Foley (2013) describe usability as "characteristics of a website that make it effective, efficient and satisfying to the user…regardless of ability" (p. 610). Accessibility is specific to users with disabilities, and a lack of accessibility can prevent these users from accessing information and services (Hollins & Foley, 2013).

Higher education. The number of students with disabilities pursuing higher education is increasing, making it more important than ever to ensure our institutions are appropriately serving this group. Only about 3% of first-time college freshman reported having a disability in 1978, but that number rose to 11% in 2007 (Madaus et al., 2012), with some estimates up to 14% and continuing to rise (Sachs & Schreuer, 2011). As many as 70% of postsecondary students choose not to disclose this information to their schools (L. A. Newman & Madaus, 2015), so these estimates are likely lower than the actual enrollment (Leake, 2015; Seale, 2014).

Even with legal protections in place, students with disabilities may have difficulty accessing technology at their colleges and universities. One review of 20 college websites found that fewer than 1% of the pages were fully compliant with Section 508 accessibility guidelines (Erickson et al., 2013). Of the schools reviewed, 13 said there were state regulations, institutional requirements, or both that their schools were bound by in addition to federal requirements. More than half of the institutions also reported that someone at the school was responsible for checking institution websites for compliance, but those schools performed no better than the others in the accessibility review (Erickson et al., 2013). Another survey of web accessibility looked specifically at the websites of university special education departments. The researchers identified 51 websites via online searches and analyzed them using online accessibility checking tools. They found errors on 97% of special education department web pages, with 39% of those issues rated as severe (Ringlaben et al., 2014). A longitudinal comparison of baccalaureate social work program websites did show increased accessibility in 2008 compared to the earlier measurements from 2003; however, 34 out of 45 websites reviewed still had at least one accessibility issue (Curl & Bowers, 2009). Many of the web accessibility studies used various automated validation tools, but Foley (2011) found that online validation tools missed some features that made institutional webpages inaccessible so the number of accessible pages may be even lower than it appears from the available research.

University policies, staffing, and lack of training may contribute to accessibility problems. A review of the web accessibility policies of 50 land-grant universities found that, while almost all the institutions had policies in place, the majority of these policies were severely lacking. More than half of universities failed to provide clear guidance regarding who the policy covered and clear definitions of accessibility requirements (Bradbard et al., 2010). The majority also did not provide information about training, approval processes, enforcement procedures, or consequences for policy violations (Bradbard et al., 2010). In a survey of community colleges, 55% of schools reported having no staff dedicated to assistive technology (Lokken, 2017). Only 33% of administrators surveyed in 2017 believed their institution's online courses were mostly or entirely compliant with Section 504 and 508 standards (Lokken, 2017).

As universities increasingly move toward offering services online, sometimes solely in this format, students with disabilities will be at a further disadvantage if their institutions do not consider accessibility. It is important for these institutions, where sufficient funding is a constant concern, to address accessibility early in setting up online processes as it is more costly to make adjustments after the fact (Foley, 2011). Students with and without disabilities have similar levels of computer ownership; however, students with disabilities reported less experience with the devices (Sachs & Schreuer, 2011). One study asked 16 students with disabilities to attempt eight tasks that the authors deemed common online activities for students. The tasks primarily focused on academics, such as finding a journal article, the online course schedule, or a professor's email address, with one social task in which the researchers asked students to find the date and time for an athletic event on campus. These tasks are certainly things students could be expected to do while in college, but only 4 participants completed all eight tasks successfully, with half of the students unable to find a journal article on a topic of their choosing (Hollins & Foley, 2013). The authors noted that the students said they would ask for help if they encountered difficulties. This can be a positive strategy for dealing with difficulty, but the authors argued "it also most likely comes at a cost of time, effort and perhaps self-esteem and confidence…the more students need to rely on external support, the less accessible that environment should be considered" (Hollins & Foley, 2013, p. 613). Reliance on this type of external support may lead to an other-oriented stance regarding ICT that can reduce creativity and result in students resorting to non-technical approaches (Robinson, 2014).

Some technology is specifically designed to support individuals with disabilities in a variety of ways. Assistive technology (AT) is "any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability" (IDEIA, 2004, p. 118). Bouck, Maeda, and Flanagan (2012) analyzed the relationship between AT in high school and after high school. They found that few students reported recent use of AT in high school (7.8%) and even fewer after leaving school (1.1%), but that the graduation rates were significantly higher for students who used AT (Bouck et al., 2012). Unfortunately, AT is often costly and schools may not provide support in using it (van Dijk & van Deursen, 2014). Students in one study reported receiving requested voice-to-text software only days before an examination, so they did not have time to become proficient with the tool (Hanafin, Shevlin, Kenny, & Neela, 2007). One student, attending a school that required training for students to receive their AT through the institution, commented that he felt he was taking an extra course and put off learning the new technology. However, he also noted how helpful the technology was once he did take the time to learn it (Wald, Draffan, & Seale, 2009). Research also suggests that students may abandon the use of AT for various reasons, including excessive maintenance expenses, feeling that the tools are too complicated to learn or use, a desire to be self-sufficient, and embarrassment (Lyman et al., 2016; Mull & Sitlington, 2003; L. Newman et al., 2017; Seale, Draffan, & Wald, 2010).

Students with disabilities may have to work harder to achieve the same outcomes as their non-disabled peers. Students with learning disabilities reported spending days on a paper that their classmates finished in hours. These students also expressed concern that despite the extra work, the finished product was not the same quality as their peers and feared faculty seeing them as lazy as a result (Denhart, 2008). While this research did not follow up to see if the participant fears were justified, the fact that they felt such concerns demonstrates the challenges students with disabilities can encounter. Research does suggest that students with disabilities have lower course grades (Richardson, 2016) and lower overall GPAs (Sachs & Schreuer, 2011) in online classes. However, neither study examined possible differences based on different types of impairments or if outcomes differed based on use versus non-use of accommodations. While technology, such as hearing aids, speech to text, and text messaging can facilitate communication, there are still challenges and shortcomings (Noble, 2010). Students who are deaf or hard of hearing must contend with potential environmental factors such as any echoing effects in a large classroom or placement of lighting that could interfere with the student's ability to lip-read or view sign language.

Faculty and administrators can cause additional challenges for students with disabilities (Claiborne, Cornforth, Gibson, & Smith, 2011). Almost 10% of students who experienced barriers accessing service at their university pointed to faculty as the primary problem (Cawthon & Cole, 2010). One student, "Maggie," explained that the administrator in her department seemed to have a one-size-fits-all model for students with visual impairments that did not pertain to Maggie's situation. She had additional challenges advocating for her unique needs due to her administrator's static mindset (Claiborne et al., 2011). Some students, particularly those with learning disabilities, have reported feeling concerned about faculty pushing back regarding accommodations because their disability is not immediately apparent (Cole & Cawthon, 2015). One student said that a faculty member questioned what she was doing in higher education because of her request for access to lecture notes, while another was told he could not have access because he would share the information with his classmates (Hanafin et al., 2007).

These barriers are especially problematic considering the positive outcomes that researchers have found related to using ICT to support students with disabilities. High school students with physical or cognitive disabilities in one study were able to overcome some of the challenges of their impairments and increase their independence with the use of ICT (Adam & Tatnall, 2017). Through classroom observations and interviews with students, the principle, and teachers, the authors asserted that "ICT clearly has the power to interest, enthuse and inspire these students" (Adam & Tatnall, 2017, p. 2726). Technology tools have also been used to facilitate mentoring opportunities for students with disabilities, allowing them to communicate more easily with their mentors (Khalil, 2008).

University mission statements often mention a focus on student success or serving a diverse community (e.g., Boise State University, 2012; Clemson University, 2018; University of Central Florida, 2018), but the preceding section shows that those goals are not always evident for students with disabilities. While some institutions, faculty, and administrators are working to offer support to students with disabilities, there are several examples of these groups creating additional barriers. Inaccessible institution websites, lack of institutional support for AT, inflexible faculty, and uninformed administrators are just some of the challenges students with disabilities experience in traditional higher education.

Online education. Online or internet-enhanced courses can offer various advantages for students with disabilities; however, they can also pose unique challenges. Online education can allow students to work from their own home and at a more flexible pace than a traditional classroom, which can be beneficial for students with various impairments. For example, students with mobility impairments do not need to struggle to get around an inaccessible campus, and students with learning disabilities can move through the material at their own speed (Case & Davidson, 2011). Online environments also offer students with visible impairments the choice of whether to disclose this information to their instructor and classmates. While not being forced to disclose disability status can be a benefit, students who choose not to disclose to their school and instructors are not able to receive any accommodations (Kent, 2015). In a study with participants from five institutions with national reputations for online programs, just over 9% of the population reported having a documented disability. Almost 70% of these students reported that they did not disclose their disability in online courses, but 46% reported that their disability caused challenges with classes in that format (Roberts, Crittenden, & Crittenden, 2011).

The technology used in online education can also pose challenges. Ellucian's Blackboard is one of the most common learning management systems (LMS) in higher education. It is also the only one to have earned recognition for its inclusive design, though it took thirteen years after the system was created to reach that point (Kent, 2015). However, even the best designed LMS is unlikely to account for all types of disabilities fully, and instructors can render accessible features useless if they do not create their materials appropriately (Case & Davidson, 2011). For example, presenting information in one format (e.g., only video or only text) can prevent students with difficulties in that medium from accessing the content (Ziegler & Sloan, 2017). Interactive content that requires a point-and-click device such as a mouse can pose problems for students with mobility impairments, while complex pages can be challenging to navigate for students with certain learning disabilities (Ziegler & Sloan, 2017). Online courses using web-conferencing technology can also be problematic. Researchers found that WebEx video conferencing was accessible for certain types of disabilities but not for others. Individuals with visual impairments had significant challenges with the WebEx system as screen reader technology was not able to pick up messages sent via the chat feature or content written on the virtual whiteboard (Myhill et al., 2008).

With so many potential challenges, several researchers have examined best practices for online accessibility. A review of this literature points out that while there are multiple guides for how to make specific technology accessible, it is rarely as simple as following a static set of guidelines (Seale, 2014). In one small case study, researchers interviewed students with and without disabilities to determine the students' perception of an online course created with UD principles (Simoncelli & Hinson, 2008). The UD principles used included regular assessments, multiple means to deliver course content (e.g., audio lectures and readings), and large fonts with contrasting colors. The students did not find all these features helpful, but their disability status did not appear to play a role in their preferences. One of the students with a disability was unable to access the audio content due to a slow internet connection, and she eventually dropped the course in week 5 of 7 due to a fear of failure and frustration with this and other aspects of the course. However, this student was on track to earn a passing grade. This raises important questions about the perceptions of students with disabilities regarding their ability to succeed using technology in higher education.

Technology Usage, Attitudes, and Learning Environment Preferences

There is a robust collection of research examining how and why people use, or choose not to use, technology. Several studies have used the Technology Acceptance Model (TAM) to investigate technology use. The TAM predicts that people are more likely to accept technology if they perceive it as useful and easy to use (Joo, Lim, & Kim, 2011). Perceived usefulness refers to whether a person sees the technology as contributing to beneficial outcomes, while perceived ease of use is how difficult the person feels the technology is to learn or use (F. Davis, 1989). Perceived ease of use is related to perceived usefulness (Mohammadi, 2015), both of which have been shown to impact attitude toward technology (Roca, Chiu, & Martínez, 2006). Attitude, in turn, influences technology use (Jan & Contreras, 2011). TAM assumes that technology use is voluntary (Y.-C. Lee, 2008), which is not the case in higher education (Goode, 2010b). However, several studies have applied TAM concepts successfully in higher education (Alsabawy, Cater-Steel, & Soar, 2016; Jan & Contreras, 2011; Mohammadi, 2015; Ozkan & Koseler, 2009; Sahin & Shelley, 2008) showing that perceived ease of use and usefulness influence how students use technology for education.

Other studies have looked at how people use technology. Reisdorf and Goselj (2017) identified participants as either non, low, regular, or broad internet users based on the time they reported spending online and the breadth of their use. The authors found that positive attitudes reduced the likelihood of being a non-user of the internet, even when considering socio-economic factors. A study in the Netherlands examined how socio-demographic variables impacted the amount and type of internet use of the groups (van Deursen & van Dijk, 2014). Traditionally disadvantaged groups, such as those with lower levels of education and individuals with disabilities, were more likely to use technology for entertainment rather than beneficial activities that offer “more chances and resources in moving forward in their career, work, education and societal position” (van Deursen & van Dijk, 2014, p. 509). Disability in this study was classified under employment status, with the other options being employed, retired, housemen or -wives, unemployed, or student. It is unlikely that individuals who identified as disabled in this context would meet the authors’ conceptualization of beneficial activities which had a focus on employment, so additional investigation is warranted.

In studies comparing student attitudes toward technology, students with disabilities have consistently reported feeling less comfortable or familiar with several types of technology. In Parker and Banerjee’s (2007) study comparing students with learning disabilities (LD) and attention-deficit/hyperactivity disorder (ADHD) to students without disabilities, the authors distinguished between comfort and fluency with technology as well as core and supplementary technology skills (Parker & Banerjee, 2007). Comfort dealt with student attitudes regarding technology, asking respondents to rank how comfortable they felt using particular technologies. The authors defined fluency as knowledge about technology and the ability to complete technology related tasks independently. The authors defined core skills as “skills required for (a) basic computer operations, (b) word processing, (c) Internet-Web basics, and (d) electronic communications. Supplementary skills were identified as knowledge and use of (a) spreadsheets and (b) databases” (Parker & Banerjee, 2007, p. 7). The study compared

142 undergraduate students with 44 of the participants identifying as LD or ADHD. Students with disabilities reported lower levels of comfort with communications technologies, such as email and instant messaging, multitasking, and searching library databases for literature. Students with disabilities did report higher levels of comfort than students without disabilities on questions related to trying new technology (Parker & Banerjee, 2007). This study provides useful insight into the attitudes toward technology of students with disabilities, but the small sample from a single university is a substantial limitation.

Vicente and López (2010) conducted a secondary analysis of a survey conducted across ten European countries with about 9,800 randomly sampled participants who were at least 18 years old with a land-line phone connection. The original survey was designed to examine users' attitudes toward ICT as well as usage. The survey also asked if participants had any "illness, disability or infirmity that limits your activities in any way" (Vicente & López, 2010, p. 51); 20% of participants responded yes to this question. Vicente and López's (2010) analysis determined that individuals with disabilities reported significantly more negative attitudes than those without disabilities. The authors found that 25% of participants with disabilities reported that computers were intimidating to use and 40% believing that keeping up with new technology was not worth the time compared to 16% and 31.4% respectively of respondents without disabilities. Disability remained a significant indicator of negative attitudes toward ICT even after controlling for socioeconomic differences, though higher incomes and education levels reduced the effect. Gender was also found to be a significant factor, with women being more prone to negative attitudes toward ICT. The size of this study addresses one of the key limitations of Parker and Banerjee's (2007) work; however, the focus of Vicente and López (2010) was not on a student population, so further exploration of student perceptions is warranted.

Another study in a European context surveyed 175 higher education students with disabilities and conducted follow-up interviews with 22 participants (Seale, Georgeson, Mamas, & Swain, 2015). The results were highly positive, with no evidence of issues with physical access and the average level of confidence for students with disabilities in using technology was a 7.42 on a 10-point scale. While students said ICT training did not improve their ability to use school-related technology, the fact that almost 90% of survey respondents participated in some sort of formal ICT training could contribute to the atypical results (Seale et al., 2015). The mixed-methods approach in this study modeled an innovative examination of the topic; however, the sample size was small, and the authors only surveyed students at European schools. A larger scale study in the United States focused on students with disabilities would be a valuable addition to the literature.

Researchers have examined a variety of factors in connection with student preferences for learning environments. Students in one study were more positive about the benefits of online education when they had more positive evaluations of their own computer knowledge (Sahin & Shelley, 2008). Another study showed a relationship between the institutional infrastructure services and system quality on student perceptions of online learning (Alsabawy et al., 2016). Chen, Lambert, and Guidry (2010) looked at how student and institutional characteristics impacted the likelihood of students enrolling in online courses. Institutional characteristics included control (private or public), Carnegie classification, and location (e.g., rural, city). Gender, enrollment status (full or part-time), race/ethnicity, first-generation status, major, and class year (first-year or senior) were the student characteristics examined. They found that institutional characteristics had a small impact on first-year students but no impact on seniors. In the first-year group, racial and ethnic minorities and students enrolled part-time participated in online courses more often (Chen et al., 2010). Chen and colleagues' (2010) research provided valuable insight into student course-taking behaviors. This study provides additional information by examining the reported preference for learning environments of students with disabilities.

This study examined the relationship between disability status, technology attitude, usage, and learning environment preferences (TAUP) among undergraduate students at institutions in the United States. Figure 2 shows the proposed relationship between these variables based on the previously discussed research.

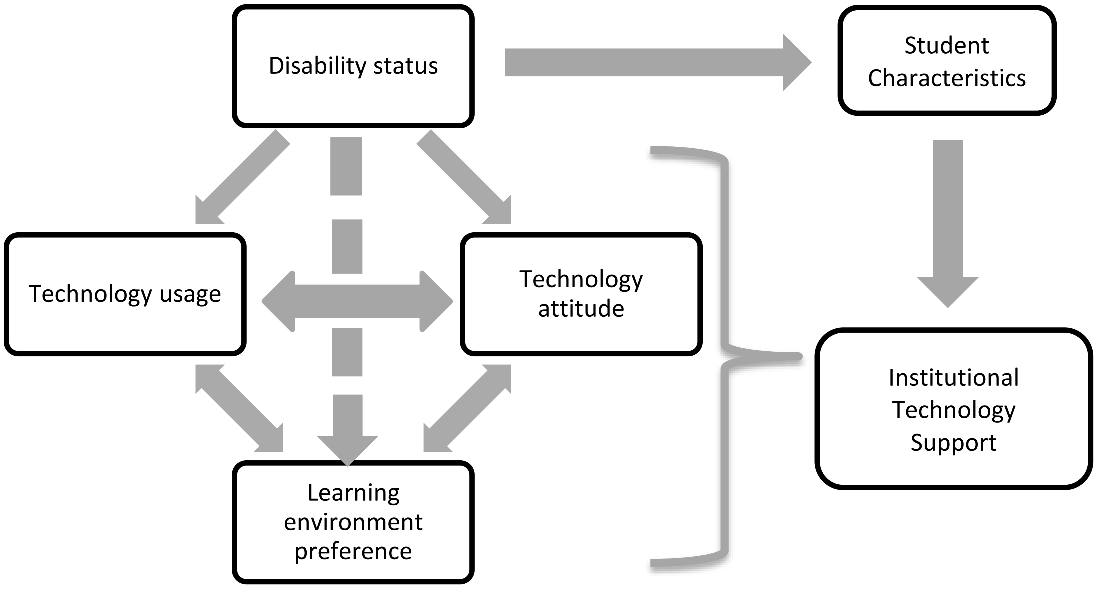

Figure 2. Proposed model of disability status influence on TAUP

Several studies have found relationships between technology usage and attitude (Jan & Contreras, 2011; Mohammadi, 2015; Roca et al., 2006). Other research has connected attitudes toward technology with learning environment preferences in general student populations (Alsabawy et al., 2016; Sahin & Shelley, 2008). Additionally, disability status has been associated with technology usage and attitudes (Anderson & Perrin, 2017; Parker & Banerjee, 2007; Vicente & López, 2010).

Conclusion

Researchers have identified benefits to technology in general and in education for individuals with disabilities. However, people with disabilities have often been shown to have less access to technology than those without disabilities (Dobransky & Hargittai, 2006, 2016; Macdonald & Clayton, 2013). Furthermore, though there are laws in the U.S. protecting these individuals from discrimination, research has identified several areas where people with disabilities experience unique challenges (Erickson et al., 2013; Hanafin et al., 2007; Lokken, 2017; Vicente & López, 2010). Researchers and technology proponents have touted the benefits of technology and online learning for students with disabilities; however, few studies have examined this population's attitudes toward technology or their learning environment preferences. Those studies that have delved into the perceptions of students with disabilities have typically been small and conducted at only one institution thus limiting their generalizability. This study examined a much larger sample across more than 150 institutions in the United States. This review has identified several areas where a lack of understanding regarding the needs of people with disabilities can result in unintended hardships. That lack of understanding needs to be reduced by better understanding the perspective of college students with disabilities regarding their experiences with technology in education.

Summary

This chapter provided a brief overview of challenges people with disabilities face daily in society and with technology and laws in the United States intended to improve equity for this population. The chapter also reviewed research on the general digital divide, from the historical definition of access through the more recent conception of digital inequality. The review continued to focus on the general digital divide in the context of education, before taking a more in-depth look at the disability divide in the context of higher education as well as online learning. Chapter Three discusses the methods used to investigate student perceptions of technology.

Chapter Three

This chapter outlines the research methodology, including the research questions and design of the study. A description of the survey items, participants, and procedures are included.

Research Questions

This study examines the experiences and attitudes of students with disabilities related to technology for educational purposes as well as their perceptions of institutional support through the following research questions:

1. What is the relationship between technology attitude, usage, and learning environment preference (TAUP) among students with disabilities?
2. Is there a difference in TAUP based on disability status?
    a. Is there a difference in technology usage among students based on disability status?
    b. Is there a difference in attitude toward technology among students based on disability status?
    c. Is there a difference in learning environment preferences among students based on disability status?
3. What impact do student characteristics and TAUP have on the ratings of institutional support for accessible technologies by students with disabilities?

Research Design

The current study employed a cross-sectional research design. This secondary data analysis used correlational analyses to examine differences in attitudes toward technology, technology use, and preferences regarding learning environment between students with and without disabilities. Additionally, the study explored the perceptions of students with disabilities regarding institutional support of their needs related to accessible technology. The study used data from the Educause Center for Analysis and Research's (ECAR) Student and Technology survey.

Procedures

ECAR has conducted annual surveys focused on students and technology use since 2003 (Dahlstrom et al., 2016). There is no fee for institutions to participate and ECAR provides the schools with the anonymous, raw data for their students as well as aggregated data for students at similar institutions. Each participating group submitted a sampling plan and proof of the necessary internal approvals (e.g., institutional review board) to ECAR before collecting data between February 15 and April 24, 2016. Institutions sent a link to the survey to enrolled undergraduate students. Student participants were given an opportunity to opt-in to a drawing to win an Amazon gift card (Dahlstrom et al., 2016). ECAR randomly selected 39 participants to receive gift cards.

The George Mason University Institutional Review Board approved this study using ECAR data in October 2017, and ECAR provided the data in November 2018. IRB approval is included in

Appendix A, and the data agreement with ECAR is available in

Appendix B.

Participants

The current study focused on the U.S. sample of ECAR's survey that includes a total of 153 institutions and 55,411 student participants (Dahlstrom et al., 2016).

Table 1

Demographic Frequencies for Full U.S. Sample

Demographic Variable	*N*	Percent (%)
Disability Status		
No disability	50,738	91.6
Physical disability	859	1.6
Learning disability	1,788	3.3
Physical & learning	361	0.7
Class Standing		
First-year	13,491	24.3
Second-year	12,565	22.7
Third-year	13,181	23.8
Fourth-year	11,004	19.9
Fifth-year+	3,074	5.5
Other Undergrad	2,093	3.8
Gender		
Female	34,125	62.4
Male	19,363	35.4
Other	484	0.9

Race		
American Indian/ Native American/Alaskan native	338	0.7
Asian/Pacific Islander	5,113	9.3
Black/African American	2,756	5.0
Hispanic/Latino	7,293	13.3
White	32,395	59.2
Other/Multiple	4,680	8.5
Campus Residency		
On-Campus	16,221	29.7
Off-Campus	38,439	70.3
Age		
18 – 24 years old	42,674	77.0
25+ years old	12,734	23.0
First-generation		
No	38,924	70.2
Yes	14,799	26.7
Enrollment Status		
Full-Time	45,598	16.6
Part-Time	9,079	83.4

The response rate for U.S. institutions was 7%. Most respondents were in the traditional college age range of 18 to 24 (77%). More than half (62.4%) of respondents were female, and 59.2% were White. Other ethnicities were represented in much lower percentages with about 5% Black/African American, 13.3% Hispanic, 9.3% Asian/Pacific Islander, and 8.5% reporting other or multiple races/ethnicities. A total of 5.6% (n = 3,008) of participants reported having a physical disability, learning disability, or both, with 1.6% reporting a physical disability, 3.2% a learning disability, and 0.7% reporting both physical and learning disabilities. Table 1 provides additional information on the full U.S. sample of participants while Table 2 provides information on the U.S.

respondents with disabilities.

Instrument

In 2016, the most recent survey for which ECAR had data available when this study began, 183 institutions from 12 countries participated in the survey, for a total of over 70,000 participating undergraduate students (Dahlstrom et al., 2016). The current study focused on respondents from U.S. institutions and is described in more detail later.

Table 2

Demographic Frequencies for Students with Disabilities

Demographic Variable	*N*	Percentage
Class Standing		
First-year	736	24.5
Second-year	690	22.9
Third-year	705	23.4
Fourth-year	576	19.1
Fifth-year+	186	6.2
Other Undergrad	115	3.8
Gender		
Female	1,653	55.7
Male	1,080	36.4
Other	123	4.1
Race		
American Indian/ Native	34	1.1
American/Alaskan native	224	7.5
Asian/Pacific Islander	183	6.2
Black/African American	275	9.2
Hispanic/Latino	1780	59.9
White	339	11.4
Other/Multiple		
Campus Residency	760	25.6
On-Campus	2,212	74.4
Off-Campus		
Age		
18 – 24	2,109	68.4
25+	974	31.6

First-generation		
No	1,909	64.3
Yes	965	32.5
Enrollment Status		
Full-Time	2,236	75.5
Part-Time	728	24.6

ECAR 2016 included seven sections administered entirely online. The first and last sections consisted of demographic questions, for example, age, class year, and ethnicity. Section Two asked students for details on personal device and ownership, while Section Three focused on student experiences with technology at their institution. Section Four covered students' preferred learning environments. Section Five asked students to report if they have a disability and to rate institutional support for and understanding of their accessible technology needs. Section Six focused on student engagement and efficacy with technology in academic settings. Most items provided a 5-point Likert scale with the statements varying based on the question. For example, question 2.4 asks "How important is each device to your academic success" and then lists laptop, tablet, smartphone, and wearable technology. This scale ranged from 1 (*Not at all important)* to 5 (*Extremely important*). Question 4.4 required students to report the extent to which they agree with several statements related to technology use in classes, such as "I get more actively involved in courses that use technology." Response options ranged from 1 (*Strongly agree*) to 5 (*Strongly disagree*) and included a "Don't know" option. The full ECAR 2016 survey is available in

Appendix C.

Using data from the ECAR 2016 survey provided a unique perspective on the digital disability divide in higher education. The original report examined four primary areas: the importance of technology, technology experiences, technology preferences, and the effects of technology on students. ECAR analyzed the data based on traditional digital divide designations such as gender and ethnicity (Dahlstrom et al., 2016). However, the report did not include any analysis of students with disabilities.

Technology usage. Technology usage has been examined in different ways such as measuring discrete tasks such as email and search engine use (Vicente & López, 2010), or categories, including social, leisure, academic, and information exchange (van Deursen & van Dijk, 2014). Questions such as "Technology helped me ask my instructors questions" and "Technology helped me complete case studies" from the ECAR survey were expected to measure an academic technology usage factor.

Technology attitudes. Researchers have conceptualized attitudes towards technology in a number of ways. Perceived ease of use and perceived usefulness have been related to attitude toward technology (Roca et al., 2006). Vicente and López's (2010) study used questions such as "computers are intimidating to use" and "keeping up with computer developments takes too much time" (p. 54) to assess technology attitudes among individuals with disabilities. Other studies have examined attitudes about a specific system or software, with survey items such as "U-Link improves my success in the module" (Ozkan & Koseler, 2009, p. 1294). ECAR survey items that were expected to measure technology attitude included questions related to how technology has, or has not, contributed to students' learning. Examples include "Technology used in my courses has enriched my learning experiences" and "Technology used in my courses contributed to the successful completion of my courses."

Learning environment preferences. Some researchers have used qualitative methods to explore students' feelings towards online learning (Simoncelli & Hinson, 2008; Verdinelli & Kutner, 2016) while others have examined course-taking behaviors (Chen et al., 2010). Several studies found that perceived quality of instruction or perceived quality of technology impacts students' interest in online learning (Alsabawy et al., 2016; Ozkan & Koseler, 2009). Therefore, items in the ECAR survey related to instructor technology proficiency were expected to be related to learning environment preference.

Data analysis

An exploratory factor analysis (EFA) was used to help reduce and organize the large number of survey items into underlying factors (Meyers, Gamst, & Guarino, 2017). This study used principal axis factoring (PAF) to examine the items due to the expected shared variance between them.

Assumptions and data cleaning. Several assumptions must be met to conduct parametric analyses including linearity, multivariate normality, homogeneity of variances, and independence of errors. The Kolmogorov-Smirnov test, histograms, Q-Q plots, skewness, and kurtosis values were used to verify normality. Linearity and lack of extreme outliers were checked using scatterplots and z-scores. Frequencies and histograms were used to determine univariate distribution. Univariate outliers were checked by confirming that z-scores were within the standard range and were considered for removal when appropriate. Multivariate normality was checked by calculating the Mahalanobis distance. Box's *M* is recommended to test for homogeneity of variances, but this test is more sensitive to violations when using a large sample. A lower alpha level was used to compensate for this sensitivity (Warner, 2013). The Durbin-Watson Statistic was used to verify the independence of errors.

Research question one. The first research question examined the relationship between technology usage, attitude, and learning environment preference among students with disabilities. This question was answered using a point biserial correlation analysis. Based on previous research with other populations, there was expected to be a correlation. The extent of the correlation found in this analysis determined how the second research question was evaluated.

Research question two. The second research question asked if there was a difference in TAUP based on students' disability status. The correlations were not all over the $r \geq .4$ threshold set by the researcher to run a canonical correlation analysis; therefore, a descriptive discriminant analysis (DDA) was used. After confirming that the discriminant function indicated a significant difference between groups, the researcher examined the structure coefficients, the standardized function coefficients, and the group centroids to determine where differences existed. Standardized coefficients provide information about the importance of variables, though it does not distinguish the unique contribution of individual variables, therefore it is important to include the structure coefficients in the analysis to relay the relative strength of the relationship between the predictor and discriminant variables (Finch, 2009). Once the variables responsible for group differences were identified, the final step in analyzing the DDA was to review the group centroids which provide information about how the variables differ between the groups examined (Sherry, 2006).

Research question three. The final research question aimed to investigate how demographic characteristics and TAUP scores of students with disabilities impact their rating of institutional support for accessible technology. The independent variables examined for this research question were student characteristics and the TAUP constructs identified through the factor analysis. The student characteristics examined included age, gender, ethnicity, class year (i.e., Freshman, Sophomore, Junior, Senior, Fifth year, Other), enrollment status (full-time or part-time), living on or off campus, and major (i.e., Agriculture and natural resources; Biological/life sciences; Business, management, marketing; Communications/journalism; Computer and information sciences; Education, including physical education; Engineering and architecture; Fine and performing arts; Health sciences, including professional programs; Humanities; Liberal arts/general studies; Manufacturing, construction, repair, or transportation; Physical sciences, including mathematical sciences; Public administration, legal, social, and protective services; Social sciences; Other major; Undecided). Hierarchical regression was used to investigate this research question.

Summary

Chapter Three provided an overview of the research methods used to examine the technology attitudes, usage, learning environment preferences of students, and ratings of institutional support of students with disabilities. The study used secondary data collected by a non-profit association dedicated to education and technology. Over 150 institutions across the United States collected data for this survey. The first research question used a point biserial correlation to determine if there is a relationship between student technology usage, attitude, and learning environment preference. The second research question compared students with disabilities to students without disabilities on those variables using a discriminant analysis. Hierarchical regression was used for the final research question which explored which student characteristics influence students with disabilities' perception of institutional support for accessible technology. While there are limitations to any research, this study will provide a unique and valuable perspective on the topic of the disability divide.

Chapter Four

Chapter Three focused on the methodology of the study and outlined the proposed research questions. Chapter Four presents the results of three research questions. The questions guiding this research were:

1. What is the relationship between technology attitude, usage, and learning environment preference (TAUP) among students with disabilities?
2. Is there a difference in TAUP based on disability status?
    a. Is there a difference in technology usage among students based on disability status?
    b. Is there a difference in attitude toward technology among students based on disability status?
    c. Is there a difference in learning environment preferences among students based on disability status?
3. What impact do student characteristics and TAUP have on the ratings of institutional support for accessible technologies by students with disabilities?

Data preparation

Prior to analysis, the variables were examined through IBM SPSS version 24 for the accuracy of data entry and fit with the assumptions of multivariate analysis, including linearity, multivariate normality, homogeneity of variances, and independence of errors.

Frequencies were used to identify potential univariate outliers. No correlations were over .8, indicating a lack of multicollinearity (Tabachnick & Fidell, 2013). Histograms and Q-Q plots reflected largely normal distributions.

Missing data analyses were conducted. The missingness in the survey was identified as not missing at random (NMAR) ($p < .01$). Therefore, *t*-tests were run to identify problematic variables. The percentage of missing values ranged from 0 to 14%. The items with the highest percentage of missingness were at the end of the survey, suggesting attrition as a reason for the missing data. Differences between the two samples were examined using *t*-tests, and effect sizes were calculated to identify the magnitude of the differences between respondents with and without missing data. Effect sizes were small enough to proceed with the analysis using only complete cases.

Preliminary data analysis

An exploratory factor analysis was performed to uncover the underlying factor structure of the measures of interest. The Kaiser-Meyer-Olkin measure of sampling adequacy was .974, indicating that the data were suitable for factor analysis. Similarly, Bartlett's test of sphericity was significant [$\chi^2(435) = 814723.17$, $p < .001$], indicating sufficient correlation among the variables to proceed with the factor analysis.

Table 3

Factor Loadings and Communalities for Exploratory Factor Analysis

	Factor				
Item	1	2	3	4	Communalities
6.1 Technology helped me…					
Engage in the learning process	**.49**	.32	-.03	-.05	.48

Develop a personal relationship with other students	-.07	**.70**	.018	.06	.50
Ask other students questions	.00	**.83**	.00	-.08	.60
Discuss course topics with other students	.03	**.78**	-.01	-.03	.61
View other students as approachable	-.00	**.72**	.01	.03	.56
Get feedback from other students in a timely manner	.05	**.69**	.013	.00	.52
Explain course ideas or concepts to other students	.05	**.61**	-.01	.13	.55
Learn something from other students	.03	**.73**	-.01	.03	.60
6.2. Technology used in my courses…					
Enriched my learning experiences	**.87**	.00	.00	-.07	.68
Was relevant to my achievement of course learning objectives	**.85**	-.03	-.01	-.05	.65
Contributed to the successful completion of my courses	**.84**	-.03	-.00	-.08	.60
Connected course materials and real-world experiences	**.66**	.04	.02	.09	.56
Helped me understand fundamental concepts	**.82**	-.04	.01	.02	.65
Built relevant skills that were useful outside courses	**.70**	.04	.01	.05	.57
Helped make connections to knowledge obtained in other courses	**.69**	.02	.01	.10	.61
Helped me understand hard-to-grasp concepts or processes	**.75**	-.01	.02	.03	.58
Was appropriate to the content being delivered	**.78**	-.00	-.01	-.05	.55
Helped me think critically	**.66**	.01	-.00	.14	.59
Helped me focus on learning activities or course materials	**.75**	.01	-.02	.03	.60
6.3 Technology used in my courses enabled me to…					
Understand what other people were trying to communicate	.15	.09	.00	**.61**	.61
Explain my ideas in specific terms	.14	-.04	-.00	**.74**	.65
Help others learn from me	-.01	.16	-.01	**.69**	.65
Clearly explain new concepts I've learned to others	.05	.03	-.01	**.79**	.71

Persuade my classmates why my ideas are relevant	-.07	.12	.01	**.75**	.63
Explain my thought process from start to finish	.03	-.01	-.00	**.82**	.69
6.4 I get distracted during classes because I…					
Use social media	-.01	.03	**.84**	-.01	.71
Text	.01	.02	**.78**	-.03	.61
Read e-mail	.03	.01	**.79**	-.02	.70
Read websites not related to class	-.01	-.03	**.83**	.02	.70
Surf the Web	-.01	-.02	**.85**	.03	.73

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

Principal axis factoring was used to determine the best factors for analysis, as this method is recommended for examining latent constructions (Thompson, 2004). Oblique rotation strategies are recommended for factors with moderate to strong correlations; therefore analyses were generated using promax rotations (Thompson, 2004). All communalities under .5 were considered for removal. A four-factor solution was determined by examining eigenvalues greater than 1.00, the scree plot, and running a parallel analysis (Henson & Roberts, 2006). The four-factor solution accounted for 61.12% of the total variance. Table 3 provides the structure loadings and communalities for each item. Factor One was determined to distinguish Technology Attitude, Factor Two items related to Technology Use: Social, Factor Three to Technology Use: Distraction, and the Factor Four to Technology Use: Academic. The survey item that specifically asked participants for their preferred learning environment was nominal and not suited to inclusion in a factor analysis. Other items that were expected to measure learning environment preference did not emerge as a factor and question 4.1 “In what type of learning environment do you tend to learn most" was used as a singular item in later analyses.

Table 4

Scales Developed from the Factor Analysis and Reliability Analysis

Scale	Item Number and Exact Wording
Technology Attitude	6.1 Technology helped me… Engage in the learning process 6.2. Technology used in my courses… Enriched my learning experiences Was relevant to my achievement of course learning objectives Contributed to the successful completion of my courses Connected course materials and real-world experiences Helped me understand fundamental concepts Built relevant skills that were useful outside courses Helped make connections to knowledge obtained in other courses Helped me understand hard-to-grasp concepts or processes Was appropriate to the content being delivered Helped me think critically Helped me focus on learning activities or course materials
Technology Use: Social	6.1 Technology helped me… Develop a personal relationship with other students Ask other students questions Discuss course topics with other students View other students as approachable Get feedback from other students in a timely manner Explain course ideas or concepts to other students Learn something from other students

Technology Use: Distraction	6.4 I get distracted during classes because I… Use social media Text Read e-mail Read websites not related to class Surf the Web
Technology Use: Academic	6.3 Technology used in my courses has enabled me to… Understand what other people were trying to communicate Explain my ideas in specific terms Help others learn from me Clearly explain new concepts I've learned to others Persuade my classmates why my ideas are relevant Explain my thought process from start to finish
Learning Environment Preference	4.1 In what type of learning environment do you tend to learn most?

The items associated with each scale are listed in Table 4. The internal consistency of the subscales as assessed by Cronbach's alpha was .941 for Technology Attitude, .896 for Technology Use: Social, .908 for Technology Use: Distraction, and .916 for Technology Use: Academic.

Data Cleaning

The factors retained from the EFA were reviewed for potential assumption violations. While the Kolmogorov-Smirnov test was significant ($p < .01$), indicating the sample does not meet the normality assumption, this test is sensitive with large sample sizes (Tabachnick & Fidell, 2013). The results of other normality tests, including histogram and Q-Q plot examination, as well as skewness and kurtosis values within $\pm$ 1, revealed sufficient univariate normality (Morgan, Griego, & Gloeckner, 2001).

Z-scores were calculated for all continuous variables and used to identify possible outliers. When less than 2% of z-scores are outside the acceptable range of ± 2.5 with no extreme values, it is recommended to retain the cases (Cohen et al., 2002). Multivariate outliers were detected using Mahalanobis distance with a chi-square value of 16.266, resulting in the removal of 775 cases (Tabachnick & Fidell, 2013).

Linearity was examined using scatterplots, and the assumption was met. Box's *M* was statistically significant, F (21, 38402547) = 24.80, $p < .001$, suggesting a violation of the sphericity assumption. Box's *M* is a highly sensitive test, particularly for large sample sizes (Sherry, 2006). DDA is robust to violation of this assumption when there are no extreme outliers in the sample, and the log-determinants from the analysis show relatively small differences between the covariance matrices of the groups; therefore the homogeneity assumption was considered acceptable (Meyers et al., 2017). The Durbin-Watson test was used to determine the independence of errors. Scores below one or over three are cause for concern but between 1.5 and 2.5 are considered normal (Field, 2009). The Durbin-Watson statistic was 1.95, indicating that the independence of errors assumption was met.

Research Question One

Research question one examined the relationship of TAUP variables for students with disabilities. A point biserial correlation analysis was conducted for the technology use and technology attitude composite scores along with the dummy coded learning environment preference (LEP) variable. The correlations, seen in Table 5, were statistically significant at $p < .001$ except between Use: Social and LEP: Face-to-face, which was significant at $p < .05$, and both LEP categories which did not have statistically significant correlations with Use: Distraction. The correlations did not all meet the $r \geq .4$ criteria set by the researcher to use a canonical correlation analysis for research question two; therefore, discriminant analysis was used.

The highest correlations were between technology attitude and the positive uses of technology, social and academic. Preference for a face-to-face learning environment had small, negative correlations with technology attitude and the two positive technology use variables. Preference for online learning environments had small, positive correlations with social and academic technology use but no correlation with distracting use or technology attitude.

Table 5

Correlation among TAUP for Students with Disabilities

Variable	1	2	3	4	5	6
1. Technology Attitude	—					
2. Use: Social	.69*	—				
3. Use: Academic	.73*	.73*	—			
4. Use: Distraction	.07*	.16*	.14*	—		
5. LEP: Face-to-Face	-.12*	-.08*	-.09*	-.01	—	
6. LEP: Online	.03	.05**	.07*	.00	-.11*	—

Note. * $p < .001$, two-tailed; ** $p < .05$, two-tailed

Research Question Two

The second research question examined if there was a difference in TAUP based on student disability status. Based on the correlations from the first research question, a discriminant analysis (DA) was used. Learning Environment Preference (LEP) was dummy coded with the face-to-face learning environment preference used as the reference group. Due to minimal information regarding the type of disability available in this survey, the three categories of disability (learning disability, physical disability, and both learning and physical disability) were combined resulting in two groups for the analysis, students with disabilities and students without disabilities, producing one function. The decision to combine the categories has benefits and challenges; the limitations of the selected approach are discussed in more detail in Chapter Five.

In examining the canonical discriminant functions, there was a small canonical correlation (R_c = .058) on Function 1 with an effect size of R_c^2 = 0.34%, the function was statistically significant at $p < .001$. The canonical correlation was R_c =.058, Wilks's Lambda was .997, and χ^2 (6) = 127.36.

Standardized discriminant function coefficients and structure coefficients were examined to determine which variables contributed to the group differences. Table 6 provides both sets of coefficients. Preference for online learning environments was primarily responsible for group differences, with preference for a partially online learning environment, technology attitude, and distracting technology use also contributing.

Regarding the group centroids, students with disabilities (-.253) scored lower than students without disabilities (.013). Specifically, students without disabilities were more likely to prefer an online learning environment. Students with disabilities also had less positive attitudes towards technology and were less distracted by technology. Higher scores on Use: Distraction represents higher levels of distracting technology use, so the negative centroid for students with disabilities indicates this group engages in less distracting usage of technology than their peers.

Table 6

Standardized Discriminant Function and Structure Coefficients

Scale	Coefficient	r_s	R_c^2
Attitude	.892	.512	26.21%
Use: Social	-.020	.196	3.84%
Use: Academic	-.496	.112	1.25%
Use: Distraction	.361	.377	14.21%
LEP: Partial Online	.626	.568	32.26%
LEP: Online	-2.17	-.612	37.45%

Research Question Three

The final research question examined how students' characteristics and TAUP scores impact the ratings of students with disabilities on institutional support for accessible technologies. Preferred learning environment was coded for face-to-face preference as the reference variable, as it was in research question two. The data provided by Educause had age broken into two categories, under or over 24 years old; the 24 and under category was set as the reference group. Business majors were the largest group in the sample (13%) and therefore were set as the reference. Similarly, White was the most common ethnicity (59%), female (55%) the most common gender, freshman

(24%) the most common class level, students residing off-campus (73%) were more common than students living on campus, and full-time students (74%) were more common than part-time students. The largest group in each respective category was used as the reference group.

A two-stage hierarchical linear regression analysis was used to predict the ratings of institutional support for accessible or adaptive technology as reported by students with disabilities. The first block consisted of age, class level, major, ethnicity, gender, campus resident status, time-status, and first-generation status. The second block included the technology attitude, use, and learning environment preference variables.

Results of the regression analysis are presented in Table 7. Structure coefficients provide the bivariate correlation between the independent variable and the predicted score (Courville & Thompson, 2001). Dividing the Pearson correlation between the predictor and measured dependent variable by the multiple correlation provided the structure coefficient values (Courville & Thompson, 2001). The student characteristics entered in the first block were statistically significant, F (33, 1756) = 1.62, p = .015, but accounted for only 3% of the variance of institutional support ratings (R^2 = .03, adjusted R^2 = .01). The second block was also statistically significant, F (39, 1750) = 5.19, p < .001 (R^2 = .10, adjusted R^2 = .08), and accounted for 10.4% of variance in institutional support ratings.

Students who identified as a gender other than male or female reported lower levels of university support of accessible technology than female students. Students with multiple ethnicities rated institutional support lower than White students. Among different majors, health sciences and liberal arts majors reported higher support than business majors, while biological or life sciences majors reported lower levels of support. The unique variance explained by each of the variables at this stage was low.

Table 7

Hierarchical Regression Results

Block	***R^2***	***R^2 Change***	**Model**	**b**	**SE-b**	**Beta**	**Pearson *r***	**sr^2**	**Structure coefficient**
1	.029	.029	(Constant)	3.12	.136				
			Age	-.056	.083	-.018	-.009	.000	-.052
			Sophomore	-.024	.106	-.007	-.005	.000	-.029
			Junior	-.012	.108	-.003	.002	.000	.014
			Senior	-.086	.116	-.023	-.011	.000	-.066
			5th Year	.067	.158	.011	.008	.000	.047
			Other Class	.056	.202	.007	.009	.000	.051
			Male	.088	.08	.028	.029	.001	.172
			Other Gender*	-.55	.223	-.059	-.075	.003	-.433
			Off Campus	-.072	.09	-.021	-.007	.000	-.044
			Full-Time	-.166	.089	-.046	-.037	.002	-.215
			First-Gen	-.001	.002	-.006	-.009	.000	-.051
			Native Amer	-.195	.322	-.014	-.012	.000	-.069
			Asian	.042	.15	.007	-.006	.000	-.036
			Black	-.003	.153	.000	.006	.000	.033
			Hispanic	.051	.127	.010	.010	.000	.058
			Other Ethnicity	-.214	.266	-.019	-.017	.000	-.101
			Multiple*	-.315	.128	-.059	-.056	.003	-.332
			Agriculture Major	.134	.253	.013	.001	.000	.008
			Bio Major*	-.36	.173	-.058	-.086	.003	-.505
			Comm Major	-.054	.182	-.008	-.037	.000	-.215
			CS Major	.085	.162	.015	-.009	.000	-.054
			Education Major	.25	.167	.042	.018	.001	.107
			Engineering	.245	.177	.038	.027	.001	.157
			FA Major	-.061	.214	-.007	-.026	.000	-.154
			HS Major*	.291	.134	.070	.041	.003	.241
.			Humanities	.092	.235	.010	-.006	.000	-.037
			LA Major*	.592	.206	.076	.057	.005	.336

			M/C Major	-.115	.359	-.008	-.011	.000	-.064
			Science Major	.507	.341	.036	.027	.001	.156
			PA Major	-.027	.229	-.003	-.020	.000	-.120
			SS Major	.258	.153	.050	.018	.002	.109
			Other Major	.248	.148	.050	.023	.002	.134
			Undecided	.27	.248	.028	.012	.001	.071
2	.104	.074*	(Constant)	1.49	2.34				
			Attitude*	.029	.006	.173	.235	.013	.734
			Use: Social*	.052	.009	.204	.246	.019	.768
			Use: Distraction	-.006	.006	-.023	.017	.001	.053
			Use: Academic*	-.028	.011	-.093	.171	.003	.534
			Partial Online*	-.208	.092	-.062	-.026	.003	-.080
			Online	-.242	.141	-.047	-.011	.002	-.035

Note. Native Amer = Native American, American Indian or Alaskan; Asian = Asian or Pacific Islander; Black = Black or African American; Multiple = Multiple Ethnicities; Bio Major = Biological or Life Sciences; CS Major= Computer Science; FA Major = Fine and Performing Arts; HS Major = Health Sciences; LA Major = Liberal Arts or General Studies; M/C Major = Manufactoring or Construction; Science Major = Physical Sciences; PA Major = Public Administration; SS Major = Social Sciences.
sr^2 is the squared semi-partial correlation. R^2 Change = .074. $F (6, 1750) = 24.13$, $p < .001$
* $p<.05$

The second model resulted in technology attitude, social use, academic use, and a preference for partial online learning environments significantly contributing. Technology attitude and both social and academic uses of technology related to more positive ratings of institutional support, while students with a preference for partial online learning environment rated institutional support lower than those with a preference for face-to-face learning environments. Technology attitude accounted for about 1.5% of the variance, social use for 2%. Preference for a partially online learning environment and academic technology use each accounted for less than 1% of the variance.

Summary

Chapter four provided the results of the three research questions guiding this research. These questions explored technology attitude, technology use, learning environment preference, and ratings of institutional support of students with disabilities from over 150 institutions from across the United States. An exploratory factor analysis, point biserial correlation, discriminant analysis, and hierarchical regression were used to analyze the data. Results indicate that there are differences in technology attitudes, usage, and learning environment preferences between students with and without disabilities. Additionally, gender, ethnicity, major, technology attitude, social and academic technology usage, and learning environment preference contributed to predicting student ratings of institutional support for accessible technology.

Chapter Five

This chapter provides a brief review of the study's purpose, research questions, and methodology. It also further explores the research questions by providing a summary of the findings, discussing the implications and limitations, and providing recommendations for future research.

Overview

While research attention on students with disabilities and technology has increased, there is still a need for additional examination in this area (L. Newman et al., 2017). This study contributes to the literature in higher education by expanding the knowledge about the relationship students with disabilities have with technology, with a focus on technology attitudes, usage, and learning environment preferences. Prior research has shown relationships between technology attitudes and technology usage; technology usage has also been related to student success and engagement in education (Buckenmeyer, Barczyk, Hixon, Zamojski, & Tomory, 2016; Gunuc & Kuzu, 2015; Huffman & Huffman, 2012; Jan & Contreras, 2011; Mohammadi, 2015; Roca et al., 2006). These concepts were examined in this study using the following research questions:

1. What is the relationship between technology attitude, usage, and learning environment preference (TAUP) among students with disabilities?

2. Is there a difference in TAUP based on disability status?
    a. Is there a difference in technology usage among students based on disability status?
    b. Is there a difference in attitude toward technology among students based on disability status?
    c. Is there a difference in learning environment preferences among students based on disability status?
3. What impact do student characteristics and TAUP have on the ratings of institutional support for accessible technologies by students with disabilities?

Methodology

A factor analysis was run to identify the constructs within the ECAR survey. This analysis resulted in four factors: Technology Attitude, Technology Use: Social, Technology Use: Distraction, and Technology Use: Academic. No factor emerged for learning environment preference, therefore the single item "In what type of learning environment do you tend to learn most?" was used in subsequent analyses.

The first research question consisted of a point biserial correlation analysis of the TAUP factors. The second question was examined using discriminant analysis to compare students with disabilities and those without disabilities on TAUP. Finally, a hierarchical regression was used to investigate how student characteristics and TAUP factors impact ratings of institutional support.

Summary of Findings

The findings in this study are discussed in more detail in this section. The expected results for students with disabilities were predominantly met, though some differences did emerge.

RQ1: Correlation of TAUP. The first research question examined the correlation between academic, social, and distracting uses of technology, technology attitude, and learning environment preferences among students with disabilities. As expected, there was a strong connection between the positive uses of technology and technology attitude. Social and academic use of technology also had a strong correlation. Using technology as a distraction had extremely low levels of correlation with the other variables and no correlation to the learning environment preference variables. These findings are in line with other studies that have shown relationships between technology attitudes and use (Jan & Contreras, 2011; Mohammadi, 2015; van Deursen & van Dijk, 2014).

Preference for a face-to-face learning environment had small, negative correlations with the technology attitude and positive technology use variables. This aligns with prior research that suggests negative attitudes toward technology are related to negative views regarding online education (Sahin & Shelley, 2008). Conversely, preference for an online learning environment did not correlate with technology attitude among students with disabilities. Much of the research in education has focused on faculty attitudes toward technology (Celik & Yesilyurt, 2013; Motshegwe & Batane, 2015; Selim, 2007; Sridharan et al., 2010; Villalon & Rasmussen, 2017). However, results have consistently related positive technology attitude with increased likelihood to use technology and more positive views of online learning (Celik & Yesilyurt, 2013; Mohammadi, 2015; Motshegwe & Batane, 2015; Sahin & Shelley, 2008; Villalon & Rasmussen, 2017), so the lack of relationship in this study is surprising. Online education can offer multiple benefits to students with disabilities they may not have in a face-to-face environment, such as being able to choose whether or not to disclose a visible disability and allowing students with learning disabilities to work at their own pace (Ziegler & Sloan, 2017). It is possible that technology attitude has less of a relationship with learning environment preference for students with disabilities than groups studied in prior research due to these unique benefits.

RQ2: Differences in TAUP. The second research question focused on differences among the constructs, technology attitude, technology use (social, distraction, and academic), and learning environment preference for students with and without disabilities. Students with disabilities were more likely to prefer a fully online learning environment than students without disabilities. This is consistent with prior research pointing out the benefits of online education for this group (Ziegler & Sloan, 2017). Students with disabilities also reported less positive attitudes toward technology than their peers, which is consistent with existing research (Vicente & López, 2010). However, negative technology attitudes have typically been related to less favorable views of online education in prior research (Sahin & Shelley, 2008), which is counter to the findings here. It appears that the benefits of online learning are sufficient for students with disabilities to compensate for less positive attitudes towards technology.

Students with disabilities in this study also engaged in distracting uses of technology less than students without disabilities. Disadvantaged groups, including individuals with disabilities, tend to use technology more for entertainment than for productive work or learning purposes (van Deursen & van Dijk, 2014). Level of education also contributes to higher levels of technology access and usage (Carlson & Goss, 2016; Chaudhuri et al., 2005; McCoy, 2010). The fact that participants in this study were enrolled in higher education may play a role in their productive use of technology.

Previous studies have consistently shown differences between individuals with disabilities and those without, but the differences in this study were small. There are a few possible explanations for why this is the case. First, by focusing on higher education, a sizable portion of the sample was within the traditional college age of 24 or under (77% of all participants). Research has shown differences in technology access and use based on age and education level (Carlson & Goss, 2016; McCoy, 2010); therefore the large number of participants under 24 may have influenced the results. Additionally, students with disabilities drop out of high school (10%) at a higher rate than students without disabilities (3.2%) (Stark, 2015). Productive forms of technology use have been related to student success (Buckenmeyer et al., 2016; Huffman & Huffman, 2012) and engagement (Gunuc & Kuzu, 2015). Students with disabilities who complete high school and choose to enroll in higher education may have more positive attitudes toward technology than the general population of people with disabilities.

RQ3: Institutional Support. The third research question examined how student characteristics, technology attitude, use, and learning environment preferences predicted how students with disabilities rated institutional support for technology. It was expected that groups historically identified as being on the "wrong" side of the digital divide would rate institutional support lower as these groups would be more likely to need higher levels of support to be successful. Gender has been examined extensively in relation to technology attitudes, self-efficacy, and competency, and findings have generally shown an advantage in these areas for males (Cai, Fan, & Du, 2017; Ching et al., 2005; Correa, 2016; Hargittai & Hinnant, 2008). The difference between male and female students was not statistically significant in this study; however, students who responded to the question regarding gender as "other" scored institutional support lower than females. It is difficult to estimate the population of individuals who do not identify with binary gender labels as little research exists and official population surveys have not included gender-identity (Meerwijk & Sevelius, 2017). However, one study estimates that there are almost one million adults in the United States who identify as transgender (Meerwijk & Sevelius, 2017). Research on intersectionality in disability studies has shown that individuals with disabilities face increased challenges when they are also a member of other marginalized groups (Liasidou, 2013; Sachdeva et al., 2015). The results of this study are in line with those findings, though little, if any, prior research exists examining gender outside the binary classification related to technology attitudes or use.

Students who reported multiple ethnicities rated support lower than White students. Past research has identified African Americans and Hispanics as having less access to technology (U.S. Census Bureau, 2014). While neither of these groups emerged as statistically significant in this study, the results do align with research that has identified minority groups as at risk on various aspects of the digital divide (Hoffman et al., 2000; Jones et al., 2009).

As the largest group, business students were identified as the reference category for majors. Health sciences and liberal arts majors reported higher levels of support than business majors, while biological or life sciences majors reported lower levels of support. Some majors may require higher levels of technology use or specialized technology, and the level of departmental support for such systems may influence overall support ratings. Several studies have examined students within specific majors in relation to various ICT uses, such as on-campus internet use with biomedical majors (Judd & Kennedy, 2010), the relationship of perceived support on online course satisfaction and outcomes for public health majors (S. J. Lee, Srinivasan, Trail, Lewis, & Lopez, 2011), and student learning and satisfaction with online MBA courses (Arbaugh & Duray, 2002). Fewer studies have examined differences between students across majors, but Chen and colleagues (2010) did identify a relationship between online-course taking and student majors. They found majors in professional fields and first-year business students enrolled in online courses more often than other majors, though it is unclear if this is due to differences in the make-up of the programs or the characteristics of students who chose to enroll in those programs.

In the second model, the social use of technology contributed the most to the rating of institutional support. Students with disabilities who used technology to connect with their classmates academically rated institutional support of accessible technology higher than those with less social usage. Students have identified social aspects of technology as beneficial in helping them learn (Jefferies & Hyde, 2009). Most studies on social uses of technology have connected social technology use with social media or leisure activities and not academics (Dolan, 2016; van Deursen & Helsper, 2018), though some research has identified social support networks as important in learning to use technology (DiMaggio et al., 2001). More positive attitudes toward technology were also related to higher support ratings. Positive technology attitudes have been related to increased technology use and skill (Jan & Contreras, 2011; van Deursen & van Dijk, 2014). Students with positive attitudes toward technology are likely more comfortable and skilled in using it and therefore less reliant on institutional support.

While statistically significant, none of these differences explained a large amount of the variance. The researcher expected students from groups typically associated with the digital divide to report lower levels of support as they are likely to need the most guidance in working with technology, but that was not entirely the case. It is likely that the institution plays a role in perceived levels of support (Chen et al., 2010), but the researcher was unable to obtain institutional level data for this analysis.

Discussion

Research has shown positive results in the use of technology in education for students with disabilities (Adam & Tatnall, 2017). However, the results of this study show that students with disabilities have more negative attitudes toward technology than students without disabilities. Research has related differences in technology attitudes to differences in technology behavior and use (Jan & Contreras, 2011).

Institutions of higher education must ensure that all technology used meets accessibility standards. Not only is this legally required (Yang & Chen, 2015), it is also vital for institutions to meet their educational missions and support diverse student populations. The results of this research show that some students do not feel their institutions support their accessible technology needs, particularly members of other potentially disadvantaged groups, such as minorities and individuals who did not identify with a binary gender classification. Additionally, other studies showing numerous accessibility issues with university webpages (Curl & Bowers, 2009; Erickson et al., 2013; Ringlaben et al., 2014) and the multiple lawsuits against schools for problems with accessibility (Kaplin & Lee, 2014; Kent, 2015; Lazar & Jaeger, 2011) demonstrate that institutions are not doing enough to support their students with disabilities.

As technology continues to increase in complexity, institutions of higher education need to be proactive in ensuring the accessibility of technology as it can be costly and take years to make existing technology accessible (Jaeger, 2012). Ensuring accessibility from the outset reduces costs and can benefit students across the spectrum of abilities; incorporating Universal Design for Learning (UDL) is one way to do this. UDL focuses on multiple means of representation, expression, and engagement to be appropriate for diverse learner preferences and abilities (Rose & Gravel, 2012). Figure 3 presents the UDL guidelines, which can be time-consuming to fully implement (Al-Azawei, Serenelli, & Lundqvist, 2016). However, implementation of even some aspects of UDL can improve learning for students (Houston, 2018) and has been shown to enhance the learning process for students with and without disabilities (Black, Weinberg, & Brodwin, 2015; Capp, 2017). UDL methods have also been shown to improve student attitudes toward technology and the perceived usefulness of e-learning (Al-Azawei, Parslow, & Lundqvist, 2017). Unfortunately, many faculty are unaware of these principles (Al-Azawei et al., 2016; Black et al., 2015). Students have reported that faculty who lack knowledge of accommodations, accessibility, and supporting students with disabilities can impede student learning (Morgado Camacho, Lopez-Gavira, & Moriña Díez, 2017). Given the multitude of benefits for diverse types of students, institutions of higher education need to provide training to faculty on the UDL guidelines and offer incentives for implementing UDL.

Universities are increasingly focusing on serving diverse students (e.g., Boise State University, 2012; Clemson University, 2018; University of Central Florida, 2018). The idea of diversity on campus should include students with disabilities. Changing the perspective on disability from one of individual accommodation to one that focuses on the cultural and contextual issues creates a more inclusive environment for students (Cory, 2011; Hadley, 2011). Incorporating UD and UDL is one way to accomplish this; considering the needs of all students rather than an idealized average improves the educational experience for everyone. Technology can allow additional flexibility in the delivery of educational materials to support a diverse array of learning preferences and abilities but only if students and faculty use it effectively.

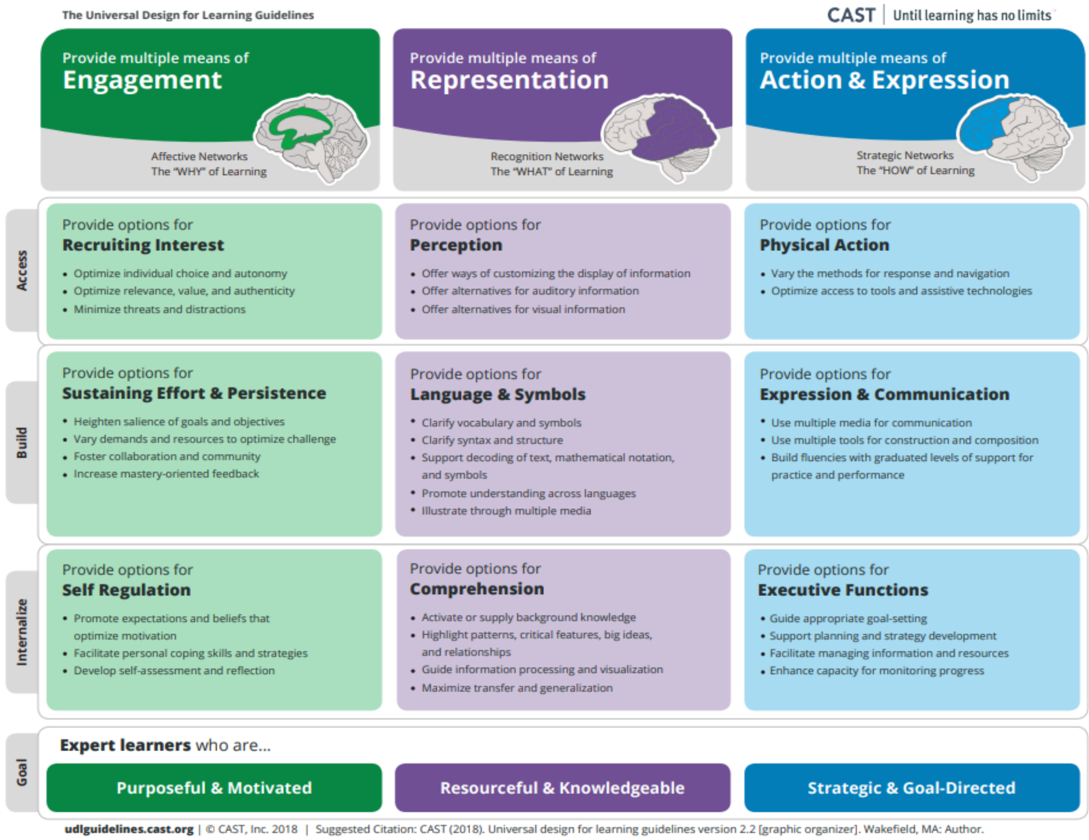

Figure 3. Universal Design for Learning Guidelines v2.2

Students with disabilities who reported higher levels of social use of technology for educational purposes also had higher levels of satisfaction with institutional support of accessible technology. Considering the limited resources facing many institutions (K. Lee, 2017), offering increased opportunities to use technology to connect and work with classmates could provide a low-cost means of improving student experiences with technology. Outside of education, social support has been shown to improve technology attitudes and proficiency (DiMaggio et al., 2001; Tsetsi & Rains, 2017). Peer support has also been tied to the retention of students with disabilities in online courses (Opie, 2018; Verdinelli & Kutner, 2016).

Limitations

As with any study, there are several limitations to this research. The first limitation deals with the use of secondary data. Using secondary data removed control of the survey questions, design, and collection methods from the researcher. The questions were not created specifically to understand students with disabilities and may have missed important aspects of their experiences. Questions about assistive technology and accessibility of course materials, for example, could have added useful context. The results of this study were statistically significant but small. A survey designed from the start to examine these constructs could more clearly reveal differences.

A related limitation is the source of the data. Educause is a non-profit association, comprised of almost 2,000 colleges and universities and over 350 corporations which focuses on the "use [of] information technology to shape strategic IT decisions at every level within higher education" (Educause, 2017, p. Who we are). The organization offers multiple resources to members including professional development, conferences, research, and advocacy. Educause is active in their advocacy role through policy initiatives, with one of their two offices housed in Washington, D.C. The unique make-up and goals of the organization likely played a part in the formulation of questions for their surveys. Additionally, institutions had to opt-in to participate in the survey. Schools willing to commit resources to this survey may have a different relationship to technology than schools that did not choose to participate.

Another limitation is the way the survey conceptualizes disability status. The survey asked if students have a "physical or learning disability that requires accessible or adaptive technologies for your coursework." The possible answers were (a) No; (b) Yes, I have one or more physical disabilities; c) Yes, I have one or more learning disabilities; (d) Yes, I have both physical and learning disabilities; (e) Prefer not to answer. The general nature of these questions may make comparisons with other studies using different conceptions of disability difficult. Additionally, the broadness of the questions limits the analysis that can be done to understand the experiences of students with specific impairments. However, some researchers have critiqued current research for "allow[ing] particular kinds of disability, construed often in narrow ways, to stand in for the complex whole…people may have a combination of different impairments and that disability is dynamic, changing over time, life course, and with distinct implications for people in different locations and sociodemographic groups" (Goggin, 2017, p. 68), so this broader examination could also be considered a strength.

Finally, the use of an online survey to ask questions about technology proficiency is a serious limitation. Individuals from digitally disadvantaged groups may be less comfortable with technology and therefore less likely to respond to web-based surveys (Robinson et al., 2015). Administrating surveys related to technology solely online may result in excluding students who experience the most problems.

Recommendations for Future Research

Students with disabilities have received comparatively little focus in existing higher education research (Peña, 2014), and several areas warrant additional investigation. First, many studies on students with disabilities have had small sample sizes (e.g., Cole & Cawthon, 2015; Denhart, 2008; Hollins & Foley, 2013; Simoncelli &

Hinson, 2008; Verdinelli & Kutner, 2016). While these provide valuable insight into individual experiences, additional large-scale studies focused on students with disabilities would be valuable. However, there are several limitations common to larger scale studies, including this one, that would need to be addressed. Including more fine-grained classification of types of disabilities could allow researchers to better understand how students with different impairments experience higher education and technology. Many large scale surveys are delivered only online, which can be problematic for groups that are digitally disadvantaged (Robinson et al., 2015). Surveys should be offered in multiple formats to ensure diverse levels of participation. Additional technology-related variables, such as motivation for use, digital competencies, and the impact of assistive technology (AT), should be further investigated for students with disabilities.

Further research is also needed to identify methods that can help combat inequalities in technology use. For example, an examination of whether specific types of technology are more useful than others could help institutions decide which systems are worthwhile investments. Research on AT has also not kept pace with rapid advancements (Okolo & Diedrich, 2014). Updated investigations on AT and institutional support are needed to provide practitioners with best practices in identifying and training students to use assistive technology that will allow them to engage more fully in educational opportunities.

The results from this study suggest that students with disabilities prefer online learning environments even though they have less positive attitudes towards technology than students without disabilities. While research has identified benefits to online learning for students with disabilities (Case & Davidson, 2011), other studies have suggested students in general are more likely to view online education favorably when they have more positive attitudes about technology (Sahin & Shelley, 2008). Additional research is needed to clarify this difference and further examine learning environment preferences of students with disabilities.

Conclusion

Increased understanding regarding the attitude students with disabilities have toward technology and how they use it will help institutions enhance their support of these students, improving their educational experiences. The results of this study show that there are small but statistically significant differences in technology attitude and learning environment preferences among students with and without disabilities. Due to the secondary data used in this study, future research is needed to explore these differences further to verify and strengthen the findings. However, it is important for institutions to recognize the potential for different technology attitudes and use patterns for students with disabilities and to work proactively to ensure technology is accessible to them.

Appendix A

IRB Approval Letter

Office of Research Development, Integrity, and Assurance

Research Hall, 4400 University Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-5445; Fax: 703-993-9590

DATE:	October 24, 2017
TO:	Kelly Schrum
FROM:	George Mason University IRB
Project Title:	[1142864-1] Examining the Digital Divide in Higher Education
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF NOT HUMAN SUBJECT RESEARCH
DECISION DATE:	October 24, 2017

Thank you for your submission of New Project materials for this project. The Institutional Review Board (IRB) Office has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

Please remember that if you modify this project to include human subjects research activities, you are required to submit revisions to the IRB prior to initiation.

If you have any questions, please contact [redacted]
Please include your project title and reference number in all correspondence with this committee.

Please note that department or other approvals may be required to conduct your research.

GMU IRB Standard Operating Procedures can be found here: http://oria.gmu.edu/1031-2/?_ga=1.12722615.1443740248.1411130601

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.

Appendix B

Educause Data Use Agreement

EDUCAUSE

November 9, 2018

Requestor
Meghan Arias
Associate Registrar
[redacted]
Leah Lang
[redacted]

Dear Meghan:

Please review and approve the following proposal for EDUCAUSE Custom Analysis Services.

Project Overview

Meghan Arias, a doctoral student at George Mason University, is interested in comparing EDUCAUSE Technology Research in the Academic Community (ETRAC) responses between U.S. students with disabilities to U.S. students without disabilities. By accepting the terms of the MOU, Meghan will be classified as an EDUCAUSE "research affiliate."

Deliverables

EDUCAUSE will provide Meghan with a data file from the 2016 ETRAC Student Technology Study. Items from the following survey sections are requested:

- Section 1
- Section 2 – 2.1, 2.2a, 2.2b.1, 2.3, 2.4, 2.5
- Section 3 - 3.1, 3.4, 3.6, 3.7
- Section 4 - 4.1, 4.2, 4.4
- Section 5 - all questions
- Section 6 - 6.1, 6.2, 6.3, 6.4
- Section 7 - all questions

The data will be de-identified, but include a unique response ID. Only variables that preserve the anonymity of the respondents will be included in the deliverable. Deliverable will be provided in Excel with an associated SPSS syntax file.

1150 18th Street NW, Suite 900, Washington, DC 20036
Main 202.872.4200 / Fax 202.872.4318

282 Century Place, Suite 5000, Louisville, CO 80027
Main 303.449.4430 / Fax 303.440.0461

EDUCAUSE

EDUCAUSE staff will not provide analysis, statistical support, or interpretation for any projects that use these data. However, we reserve the right to verify the accuracy of any published results of the analysis. Meghan is responsible for documenting analysis methodology with enough detail to allow an EDUCAUSE researcher to replicate the results.

Timing

EDUCAUSE assumes a maximum of 10 hours to complete this effort. EDUCAUSE will deliver agreed upon data file within one week (5 working days) of a signed agreement.

Pricing and Contract Terms

All fees will be waived for this project if the requestor submits a 1,000-1,600-word research summary to EDUCAUSE that captures the most meaningful, interesting, and actionable research findings by November 1, 2019. This summary should answer the following questions:

- What is your research project?
- What data did you use from EDUCAUSE?
- How did you use these data?
- What did you find?
- What are the implications of your findings?

While we don't guarantee publication of this material, we may use the results in other EDUCAUSE publications or presentations.

If a research summary is not delivered by the requestor after November 1, 2019, requestor will be billed for actual time EDUCAUSE staff worked to prepare the shared data files. All EDUCAUSE hours associated with the project will be billed at an hourly rate of $230. If necessary, an invoice will be provided on November 1, 2019 and payment will be due within 30 days of invoice.

Requestor will act in accordance with the EDUCAUSE Analytics Services License Agreement and Acceptable Use Policy (Appendix A).

[redacted]
EDUCAUSE
11/7/18
Date

Meghan Arias
[redacted]
11/11/18
Date

EDUCAUSE Analytics Services License Agreement and Acceptable Use Policy

This License Agreement and Acceptable Use Policy ("Agreement") sets forth the principles and terms that govern the use of data contained in EDUCAUSE Analytics Services, including, but not limited to the following services:

- Core Data Service (CDS)
- EDUCAUSE Technology Research in the Academic Community (ETRAC)
- Research data generated by the EDUCAUSE Center for Analysis and Research (ECAR) or other areas

Users who access any EDUCAUSE Analytics Services are deemed to have agreed with the terms and conditions of this Agreement.

Definitions

The following definitions are used in this Agreement:

- **Core Data Service (CDS)**: CDS is a repository of data about institutions and their information technology environments and practices; it consists of a set of annual surveys and a web-based data benchmarking system by which institutions—both campuses and multi-campus systems—can update and track their own institution's data and retrieve and benchmark against data from other institutions of interest. Users retrieve data through a self-service web-based tool that enables institutions to create custom peer groups of other institutions, interact with CDS data in dashboards and graphs, and review metrics on IT staffing, funding, and services.
- **EDUCAUSE Analytics Services**: EDUCAUSE Analytics Services consists of any EDUCAUSE service, tool or research that uses institutional data and provides identified, de-identified, and/or aggregate data back to institutional members. EDUCAUSE Analytics Services includes, but is not limited to, CDS; ETRAC; data collected via ECAR; and any custom analytics research provided as part of a consulting contract.
- **EDUCAUSE Analytics Services Data**: EDUCAUSE Analytics Services Data means the Institutional and the EDUCAUSE Derivative Works.
- **EDUCAUSE Center for Analysis and Research (ECAR):** ECAR promotes informed decision-making and a culture of evidence in higher education IT through a program of quantitative research publications and collaborative working group reports. ECAR identifies issues of pressing concern to CIOs and other higher education executives and addresses them through diverse research activities including in-depth analyses, shorter reports, and case studies. In some cases, ECAR research comprised of identified, de-identified, and/or aggregated institutional data, such as the ETRAC research series, is provided directly to participating institutions through web-based reporting tools.
- **EDUCAUSE Derivative Works**: EDUCAUSE Derivative Works are works created by EDUCAUSE and/or its relevant Service Providers derived from Institutional Data.
- **Institution:** An institution is any higher education institution eligible to participate in any EDUCAUSE Analytics Service, as well as any institutional staff member or designated third party acting on the institution's behalf.
- **Institutional Data**: Institutional Data is data contributed to any of the EDUCAUSE Analytics Services by an Institution for any purpose whatsoever.

- **Service Provider:** Any person or entity working on behalf of EDUCAUSE to analyze data, develop derivative works, or establish data services that are deemed by EDUCAUSE to be in the best interest of the EDUCAUSE community.
- **Third Party Designee:** Any person or entity existing apart from an Institution of higher education that has been appointed by or is formally acting on behalf of that Institution and has been expressly granted authority to access that Institution's EDUCAUSE data or service.

License to EDUCAUSE

Each Institution who contributes Institutional Data to any of the EDUCAUSE Analytics Services hereby grants to EDUCAUSE a perpetual, unlimited, sub-licensable right to those data. EDUCAUSE may create derivative works based upon such Institutional Data and license and otherwise exploit such derivative works to third parties for a fee. EDUCAUSE acknowledges that the Institutional Data is the property of the Institution that provided such Institutional Data, and that all right, title, and interest in and to such Institutional Data, including associated intellectual property rights, are and shall remain with the relevant Institution.

Rights and Responsibilities of EDUCAUSE in Connection with Institutional Data

In addition to the restriction set forth above, the following policies govern the access and use of Institutional Data by EDUCAUSE staff members and relevant Service Providers:

- Accessing and storing data:
  - EDUCAUSE, its staff, and relevant Service Providers will access Institutional Data using individually unique credentials that they must not share.
  - EDUCAUSE, its staff, and relevant Service Providers will store Institutional Data and provide access to it, as appropriate, in a secure manner.
- Sharing data:
  - EDUCAUSE, its staff, and relevant Service Providers will limit disclosure and use of Institutional Data obtained from EDUCAUSE Analytics Services to EDUCAUSE staff and consultants with formal responsibilities related to the use of such Institutional Data. This limitation applies to both institutionally identifiable and aggregated data. This limitation does not apply to any derivative work that EDUCAUSE may create from the Institutional Data, any of which can be licensed or sub-licensed to third parties.
  - Except as otherwise provided in EDUCAUSE Analytics Services where individually identifiable Institutional Data is specifically offered to members of the EDUCAUSE community as part of the underlying service, EDUCAUSE and its Service Providers release institutionally identifiable information to third parties only in conjunction with valid subpoenas or other valid, legal requests and in compliance with other applicable laws. EDUCAUSE will not provide any institutionally identifiable information other than that information which is publicly available without a legal obligation to do so. See the EDUCAUSE privacy policy at: http://www.EDUCAUSE.edu/privacy-policy
- Publishing and presenting data:
  - Aggregated data: EDUCAUSE reserves the right to use aggregated survey data obtained from EDUCAUSE Analytics Services in professional publications, public documents, public

presentations, or other forms or forums that serve its members' needs and interests, or the needs and interests of the larger higher education and IT industries, so long as that data has been sufficiently aggregated to prevent re-identification of participating institutions.
    - Identifiable data: Should EDUCAUSE staff find that the best interests of the EDUCAUSE membership would be appropriately served by using institutionally-identifiable survey data obtained from EDUCAUSE Analytics Services in professional publications, public documents, or public presentations, that staff member will request permission from the president of EDUCAUSE, as well as the relevant institution(s), prior to doing so and abide by any terms specified for such use.
- Establishing data services: EDUCAUSE also reserves the right to establish other data services, both stand-alone and collaborative, involving Institutional Data when such services would best advance the overall interests of the EDUCAUSE community. Such services are subject to the approval of the EDUCAUSE president and will be pursued with the utmost sensitivity to the security and confidentiality principles inherent in this policy.

Sub-License to Institutions

EDUCAUSE hereby grants to each Institution accessing the EDUCAUSE Analytics Services a limited, revocable, non-sub-licensable right to view and use the EDUCAUSE Analytics Services Data. Institutions acknowledge that the EDUCAUSE Derivative Works are the property of EDUCAUSE, and all right, title, and interest in and to such derivative works, including associated intellectual property rights, are and shall remain with EDUCAUSE. EDUCAUSE may immediately terminate this license upon notice to an Institution, without judicial notice or resolution, in its sole discretion.

Rights and Responsibilities of Institutions

In addition to the restriction set forth above, the following policies govern the access and use of Institutional Data and any related derivative work created by EDUCAUSE by an Institution:

- Accessing and storing data:
    - Institutions acknowledge that some EDUCAUSE Analytics Services allow access to the individually identifiable information of other institutions and that accessing and viewing such data is part of a trust relationship created between EDUCAUSE and institutions participating in EDUCAUSE Analytics Services.
    - Institutions will grant access to EDUCAUSE Analytics Services Data only to institutional staff members with formal responsibilities related to the use of such data (e.g., executive, pertinent business area and academic leadership, IT oversight committees, and senior staff of cognizant IT organizations) and Third Party Designees. This limitation applies to both institutionally identifiable and aggregate data.

- Institutions and those staff members and/or Third Party Designees acting on the institution's behalf will have access to EDUCAUSE Analytics Services Data using individually unique credentials that they must not share.
- Institutions may browse and search EDUCAUSE Analytics Services Data and may download digital copies of data and data visualizations from EDUCAUSE Analytics Services Data for institutional purposes only.
- Institutions will store EDUCAUSE Analytics Services Data and provide access to such stored data, as appropriate, in a manner at least as secure as the institution protects its own institutionally identifiable data.

- Sharing data:
  - Third Party Designees: Institutions may not use any EDUCAUSE Analytics Services Data in conjunction with any relationship in which EDUCAUSE Analytics Services Data are made accessible to a Third Party Designee, including but not limited to designated contractors, without prior written approval from EDUCAUSE and appropriate acknowledgment.
  - Peer review and reaccreditation exception: Institutions are permitted to provide EDUCAUSE Analytics Services Data to reviewers not affiliated with the underlying Institution, so long as (1) a copy of this Agreement accompanies the data provision, (2) this Agreement is understood to govern the use made of such data, and (3) appropriate acknowledgment is given to EDUCAUSE, for the purposes of reaccreditation, peer review, or similar studies being conducted on behalf of the underlying institution.
- Publishing and presenting data:
  - Aggregated data: Institutions may use aggregated survey data obtained from EDUCAUSE Analytics Services in professional publications, public documents, and public presentations so long as that data has been sufficiently aggregated to prevent re-identification of participating institutions and appropriate acknowledgment of EDUCAUSE Analytics Services is included.
  - Institutional data: Institutions will not share or make public (including publication in professional resources, presentations, or public documents) any EDUCAUSE Analytics Services Data about another Institution, in identified or unidentified form, without prior written approval from EDUCAUSE and appropriate acknowledgment.
- Commercial use of data:
  - Institutions may not engage in bulk reproduction, sell, or otherwise redistribute EDUCAUSE Analytics Services Data. Third Party Designees may only access and mine data relevant to the Institution with which they are in formal collaboration. Third Party Designees may not gather or export data for other beneficiaries or uses outside of the scope of their work with an Institution.
  - Institutions may not use EDUCAUSE Analytics Services Data for commercial research or other commercial purposes, without prior written approval from EDUCAUSE.

Violations

Violations of this Agreement could lead to immediate loss of an institution's right to participate in, access, and use EDUCAUSE Analytics Services data. For egregious misuse of data or access other legal remedies will be pursued.

Appendix C

ECAR Survey

ECAR

Student Study, 2016

Note: The online version of this survey may be shorter due to question branching or question skipping.

Welcome to the 2016 ECAR Student Technology Survey!

Study Description

Technology is a critical part of undergraduate students' experiences in higher education. This study explores technology ownership, use patterns, and expectations as they relate to the student experience. Colleges and universities can use the results of this study to better engage students in the learning process. Furthermore, institutions can use the data to improve IT services, increase technology-enabled productivity, prioritize strategic contributions of IT to higher education, plan for technology shifts that impact students, and become more technologically competitive among peer institutions.

We ask questions about your experiences with and attitudes toward technology and your academic experiences. Your responses will help people on your campus and beyond understand how to use technology more effectively to benefit students. There are no right or wrong answers; we would just like you to answer as honestly as you can. Participation in the survey is completely voluntary, and you can choose to exit the survey at any point. Your responses are anonymous. Required questions are indicated with an asterisk (*). This survey is expected to take about 20 minutes to complete.

Please use the survey's navigation buttons below to go back or forward within the survey. Using your device or browser's navigation buttons may result in lost answers.

Conditions and Stipulations

1. I agree to complete this online survey for research purposes and that the data derived from this anonymous survey may be made available to my academic institution in unitary and aggregate formats and/or to the general public in the form of public presentations, reports, journals or newspaper articles, and/or in books.

2. I understand the online survey involves questions about my IT experiences and expectations in higher education. Beyond demographics, all questions will address IT-related issues.

3. I understand that this survey is expected to take about 20 minutes to complete. I understand that my participation in this research survey is totally voluntary and that declining to participate will involve no penalty or loss of benefits. Choosing not to participate will not affect my college/university status in any way. If I choose, I may discontinue my participation at any time. I also understand that if I choose to participate, I may decline to answer any question that I am not comfortable answering.

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4. I understand that I can contact the research team through survey@educause.edu if I have any questions about the research survey and my rights as a participant. I understand that the survey does not contain any questions that are a foreseeable risk, nor any questions likely to create discomfort to participants. I am aware that my consent will not directly benefit me but will provide data to inform higher education institutions on how to best improve IT experiences for students and faculty.

5. I understand that my survey responses are anonymous; once responses are submitted, the researchers will not be able to identify me or remove anonymous data from the database should I wish to withdraw it. EDUCAUSE owns and maintains the data collected for the project. Unitary-level data are stored on an EDUCAUSE server and in a cloud-based storage system indefinitely for use in longitudinal analysis. These data are contained in systems that are in password-protected commercial or cloud-based data centers that are SSAE 16 SOC certified. Only the account holder can access the data contained within the account.

6. By selecting "I agree" below I freely provide consent and acknowledge my rights as a voluntary research participant as outlined above and provide consent to EDUCAUSE to use my survey responses in the technology research in the academic community projects.

You must be an adult (at least 18 years old, in most jurisdictions) and a full-time or part-time undergraduate student to participate in this survey. Indicate your agreement with the informed consent statement below. *Required.

( ) I agree.
( ) I do not agree. <<exit survey>>
If you choose this option, you will exit the survey.

Section 1: About You

1.1 What is your age? *Required. <<exit survey if not at least 18 years of age>>

1.2 Which of the following best describes your class standing during the current academic year? *Required.
( ) Freshman or first-year student
( ) Sophomore or second-year student
( ) Junior or third-year student
( ) Senior or fourth-year student
( ) Fifth-year student or beyond
( ) Other type of undergraduate student
( ) Not an undergraduate student. Note, only undergraduate students are eligible to take this survey.
<<exit survey>>

1.3 If you would like to be entered into a drawing for a $50 or $100 Amazon.com gift certificate, please provide your e-mail address here.
The drawing will be held by June 30, 2016. E-mail addresses will be disassociated from the rest of the survey data after the survey window closes, keeping your responses anonymous. Your e-mail address will only be used for the purpose of this drawing and will be permanently deleted from our database no later than July 31, 2016.

____

<<only visible if institution opts into the ECAR-hosted incentive program>>

Section 2: Device Use and Ownership

2.1 How many Internet-capable devices do you own?

Only include devices you actively use.

( ) None
( ) One
( ) Two
( ) Three
( ) Four
( ) Five
( ) Six or more

2.2a Do you own any of these devices?

	No, and I don't plan to purchase one within the next 12 months.	No, but I plan to purchase one within the next 12 months.	Yes, I currently own one (or more).
Laptop			<<show 2.2b and 2.2b.1>>
Tablet			<<show 2.2c and 2.2c.1>>
Smartphone			<<show 2.2d>>
Wearable technology (e.g., fitness device, smart watch, headset)			<<show 2.2e>>
Gaming devices (e.g., Xbox, PlayStation, etc.)			
Streaming media devices (e.g., Roku, iTV, Amazon Fire Stick)			

2.2b What type of operating system (OS) does your *laptop* have?

If you have more than one *laptop*, please select the one you use most often for school-related work.

( ) Windows
( ) Mac or OS X
( ) Chrome OS
( ) Linux
( ) Other OS
( ) Don't know

2.2b.1 Does your laptop have a touch screen?

( ) No
( ) Yes

2.2c What type of operating system (OS) does your *tablet* have?

If you have more than one *tablet*, please select the one you use most often for school-related work.

( ) iOS (iPad)

( ) Windows OS

( ) Android OS

( ) Fire OS

( ) BlackBerry OS

( ) Other OS

( ) Don't know

2.2c.1 Do you use either a keyboard or docking station with your tablet?

( ) No

( ) Yes

2.2d What type of *smartphone* do you have?

If you have more than one *smartphone*, please select the one you use most often for school-related work.

( ) iPhone

( ) Android phone

( ) Windows phone

( ) BlackBerry phone

( ) Other smartphone

( ) Don't know

2.2e What type(s) of *wearable technology* devices do you have?

Select all that apply.

[ ] Fitness device

[ ] Smart watch

[ ] Headset

[ ] Other, please specify: ____

2.3 In the past year, to what extent have you used each device for your academic work?

	Did not use at all	Used for at least one course	Used for about half of my courses	Used for most of my courses	Used for all my courses
Laptop					
Tablet					
Smartphone					
Wearable technology (e.g., fitness device, smart watch, headset)					

2.4 How important is each device to your academic success? <<show if respective item in Q2.3 = anything but "Did not use at all" options>>

	Not at all important	Not very important	Moderately important	Very important	Extremely important
Laptop					
Tablet					
Smartphone					
Wearable technology (e.g., fitness device, smart watch, headset)					

2.5 How important is it that you are able to do the following activities *from a handheld mobile device* (e.g., smartphone or tablet)? <<show if options in Q2.2a indicate tablet or smartphone ownership>>

	Not at all important	Not very important	Moderately important	Very important	Extremely important
Administrative activities (e.g., access library resources; register for courses; make tuition/fee payments; track financial aid)					
Academic activities (e.g. read e-texts; communicate with other students or instructors about class-related matters; look up course-related information while in class; take pictures of in-class activities)					

Section 3: Technology and the College/University Experience

3.1 How would you describe your overall technology experience at your institution?

( ) Poor
( ) Fair
( ) Neutral
( ) Good
( ) Excellent
( ) Don't know

3.2 Thinking about the past year, please rate your experiences with wireless networks on campus:

	Poor	Fair	Neutral	Good	Excellent	N/A
Reliability of access to Wi-Fi in student housing/dormitories						
Reliability of access to Wi-Fi in campus libraries						
Reliability of access to Wi-Fi in classroom/instructional spaces						
Ease of login to Wi-Fi network(s) provided by the institution						
Network performance (e.g., high speed, no interruptions)						

3.3 How many devices do you typically connect (or try to connect) to the network *at the same time* when you are on campus?

( ) I don't visit campus.
( ) None
( ) One
( ) Two
( ) Three
( ) Four
( ) Five
( ) Six or more
( ) Don't know

3.4 In a typical day, approximately how much time do you spend actively engaged in each of the following online activities?

	None	Less than 1 hour	1–2 hours	3–4 hours	5–8 hours	More than 8 hours
Online research/homework						
Social media						
Streaming video						
Online gaming						
Other online activity						

3.5 How useful do you find the following online early-alert or intervention notification services provided by your institution?

	Service not provided	Don't know	Not at all useful	Not very useful	Moderately useful	Very useful	Extremely useful
Guidance about courses you might consider taking in the future (e.g., "other courses you might like" or "we recommend" suggestions)							
Alerts if it appears your progress in a course is declining							
Suggestions for how to improve performance in a course if your progress is substandard							
Suggestions about new or different academic resources (e.g., tutoring, skills-building opportunities)							

3.6 Thinking about your college/university experiences within the past year, how many of your instructors…

	None	Very few	Some	Most	Almost all	All
…have adequate technology skills for course instruction						
…use technology during class to maintain your attention (i.e., to break up lectures)						
…use technology during class to make connections to the learning material or to enhance learning with additional materials (e.g., by providing audio or video examples/demonstrations/simulations of learning concepts)						
…encourage you to use your own technology devices during class to deepen learning (e.g., by searching online for related concepts, examples, or demonstrations)						
…encourage you to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class						
...encourage you to use technology for creative or critical thinking tasks						

3.7 Which resources/tools do you wish your instructors used less…or more?

	Don't know	(Less) 1	2	3	4	(More) 5
Learning management system (e.g., Blackboard, Moodle, Sakai, D2L, Canvas)						
Online collaboration tools to communicate/collaborate						
E-portfolios						
E-books or e-textbooks						
Free, web-based content to supplement course-related materials (e.g., OpenCourseWare, Khan Academy, iTunes U, YouTube, etc.)						
Simulations or educational games						
Lecture capture (i.e., record lectures for later use/review)						
Social media as a teaching and learning tool						
Nonkeyboard or nonmouse computer interfaces, such as voice, touchscreen, and gesture-based devices						
Software to create videos or multimedia resources						
Early-alert systems designed to catch potential academic trouble as soon as possible						
Search tools to find references or other information online for class work						
Publisher electronic resources (e.g., quizzes, assignments, tutorials, homework, practice problems)						
In-class polling tools (e.g, clickers, Poll Everywhere, SMS-based tools)						

Section 4: Learning Environments

4.1 In what type of learning environment do you tend to learn most?

( ) One with no online components
( ) One with some online components
( ) One that is mostly but not completely online
( ) One that is completely online
( ) No preference

4.2 In the past year, how many *courses* have you taken in each of the following categories?

<<enter number of courses>>

____ Completely online, no face-to-face components
____ Mostly online, some face-to-face components
____ About half online and half face-to-face
____ Some online components, mostly face-to-face components
____ No online components, completely face-to-face components

4.3 When you think about documenting the skills you gain during your higher education experiences, which of these would you include on your résumé?

Select all that apply.

[ ] Undergraduate degree/diploma (associate's or bachelor's) from an accredited college or university
[ ] Certificate from an accredited college or university program
[ ] Certificate from an industry-based training program
[ ] Certificate of completion from an institution/organization offering freely available course content
[ ] Digital badge that represents a skills-based competency or completed activity
[ ] E-portfolio
[ ] Jobs worked during college
[ ] Major projects completed during coursework
[ ] Volunteering/community service
[ ] Other, please specify: ____*

4.4 To what extent do you agree with the following statements?

	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I get more actively involved in courses that use technology.						
I am more likely to skip classes when streamed or recorded lectures are available online.						
I am more likely to skip classes when materials presented in class are available online.						
When I entered college, I was adequately prepared to use technology needed in my courses.						
I am concerned that technology advances may increasingly invade my privacy.						
I wish I had been better prepared to use institution-specific technology when I started college (e.g., the course registration system, the learning management system, the library search system).						
I wish I had been better prepared to use basic software programs and applications when I started college (e.g., MS Office, Google Apps, etc.).						

4.5a Tell us ONE thing that *your instructors* can do with technology to enhance your academic success.

____
____
____

4.5b Tell us ONE thing that *your institution* can do with technology to enhance your academic success.

____
____
____

Section 5: Your Personal Computing Environment

5.1 Do you have a physical or learning disability that requires accessible or adaptive technologies for your coursework?

( ) No.
( ) Yes, I have one or more physical disabilities.
( ) Yes, I have one or more learning disabilities.
( ) Yes, I have both physical and learning disabilities.
( ) Prefer not to answer

5.2a How would you rate your institution's *awareness of student needs* for accessible or adaptive technologies needed for your coursework? <<display if answer to 5.1 was any of the "yes" options>>

( ) My institution is not aware of my needs for accessible or adaptive technologies.
( ) Poor
( ) Fair
( ) Neutral
( ) Good
( ) Excellent
( ) Don't know

5.2b How would you rate your institution's *support* for the accessible or adaptive technologies needed for your coursework? <<display if answer to 5.1 was any of the "yes" options>>

( ) I am not provided with the accessible or adaptive technologies I need.
( ) Poor
( ) Fair
( ) Neutral
( ) Good
( ) Excellent
( ) Don't know

Section 6: Engagement, Efficacy, and Enhancement

6.1 Thinking about your college/university courses within the past year, to what extent do you agree with the following statements, specifically considering the role technology has played? Technology helped me…

	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
…engage in the learning process						
…develop a personal relationship with my instructors						
…ask my instructors questions						
…discuss course topics with my instructors						
…understand my instructors' expectations						
…view my instructors as approachable						
…get feedback from instructors in a timely manner						

…develop a personal relationship with other students						
…ask other students questions						
…discuss course topics with other students						
…view other students as approachable						
…get feedback from other students in a timely manner						
…participate in group activities						
…explain course ideas or concepts to other students						
…work with other students on class projects						
…learn something from other students						
…keep track of course news or announcements						
…investigate topics outside class time						
…reflect on course materials (e.g., readings, videos, etc.)						
…conduct research for class assignments						
…document class work or projects						
…complete case studies						
…analyze data						
…learn through games or interactive activities						
…learn through simulations						

6.2 Thinking about your college/university courses within the past year, to what extent do you agree with the following statements, specifically considering how technology has contributed to your learning? Technology used in my courses…

	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
…enriched my learning experiences						
…was relevant to my achievement of course learning objectives						
…contributed to the successful completion of my courses						
…connected course materials and real-world experiences						
…helped me understand fundamental concepts						
…built relevant skills that were useful outside courses						
…helped make connections to knowledge obtained in other courses						

…helped me understand hard-to-grasp concepts or processes						
…was appropriate to the content being delivered						
…helped me think critically						
…helped me focus on learning activities or course materials						

6.3 Thinking about your college/university courses within the past year, to what extent do you agree with the following statements, specifically considering how using technology has been enabling for you? Technology used in my courses has enabled me to…

	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
…receive feedback from others right away						
…communicate basic messages						
…understand what other people were trying to communicate to me						
…explain my ideas in specific terms						
…help others learn something from me						
…clearly explain new concepts I've learned to others						
…persuade my classmates why my ideas are relevant to class-related problems or topics						
…use technical or academic terminology correctly						
…explain my thought process from start to finish to others						

6.4 Thinking about your college/university courses within the past year, to what extent do you agree with the following statements about distractions in the classroom? I get distracted during classes because I…

	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
…use social media						
…text						
…read e-mail						
…play games on a laptop or mobile device						
…read websites not related to class						
…surf the Web						
…read books, magazines, or other printed materials not related to class						
…read a newspaper						
…pass notes						
…talk to neighbors						

Section 7: Demographic and Informational Questions

Please note: If you do not click on a slider at all, no response will be recorded. If you wish to submit a neutral response, you must click on the slider button in its original position.

7.1a Rate yourself in terms of your DISPOSITION toward information technology on the following scales:

Reluctant	0 ________________ [ ] ________________ 100	Enthusiast
Late adopter	0 ________________ [ ] ________________ 100	Early adopter
Technophobe	0 ________________ [ ] ________________ 100	Technophile
Skeptic	0 ________________ [ ] ________________ 100	Cheerleader
By the book	0 ________________ [ ] ________________ 100	Experimenter
Critic	0 ________________ [ ] ________________ 100	Supporter

7.1b Rate your ATTITUDE toward information technology on the following scales:

Dissatisfied	0 ________________ [ ] ________________ 100	Satisfied
Discontented	0 ________________ [ ] ________________ 100	Content
Perturbed	0 ________________ [ ] ________________ 100	Pleased
Burdensome	0 ________________ [ ] ________________ 100	Beneficial
Useless	0 ________________ [ ] ________________ 100	Useful
Distraction	0 ________________ [ ] ________________ 100	Enhancement

7.1c Rate yourself in terms of your USAGE of information technology on the following scales:

Never connected	0 ________________ [ ] ________________ 100	Always connected
Peripheral	0 ________________ [ ] ________________ 100	Central
Old media	0 ________________ [ ] ________________ 100	New media
Infrequent	0 ________________ [ ] ________________ 100	Frequent

7.2 Thinking about your future, to what extent do you agree with the following statements?

	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Technology will play an important role in my chosen career after college.						
Technology that I use in my courses now will prepare me adequately for my chosen career after college.						

7.3 Are you…?

( ) Male
( ) Female
( ) Other
( ) Prefer not to answer

7.4 I intend to earn…

Select all that apply.

[] One or more digital badges that certify my skills
[] A vocational/occupational certificate
[] A college diploma <<if outside U.S.>>
[] An associate's degree or equivalent
[] A bachelor's degree or equivalent
[] An honor's degree <<if outside U.S.>>
[] A master's degree or equivalent
[] A doctoral degree or equivalent
[] An advanced professional degree (MD, DDS, JD, EdD, etc.)
[] Other, please describe: ____
[] N/A

7.5 In what area is your major?

Select the one that is the closest match to your primary major.

( ) Agriculture and natural resources
( ) Biological/life sciences
( ) Business, management, marketing
( ) Communications/journalism
( ) Computer and information sciences
( ) Education, including physical education
( ) Engineering and architecture
( ) Fine and performing arts
( ) Health sciences, including professional programs
( ) Humanities
( ) Liberal arts/general studies
( ) Manufacturing, construction, repair, or transportation
( ) Physical sciences, including mathematical sciences
( ) Public administration, legal, social, and protective services
( ) Social sciences
( ) Other major not described above
( ) Undecided

7.6 Are you currently considered a full-time or part-time student at the institution that asked you to complete this survey?

Part time is typically fewer than 12 credit hours per quarter/semester or their equivalent.

( ) Part time
( ) Full time

7.7 What is your ethnic background? <<U.S. institutions only>>

Select all that apply.

[] American Indian/Native American/Alaskan native
[] Asian/Pacific Islander
[] Black/African American
[] Hispanic/Latino
[] White
[] Other
[] Prefer not to answer

7.8 Do you live…?

( ) On campus
( ) Off campus

7.9 Are you the first person in your immediate family to attend college?

Immediate family refers to the family in which you grew up.

( ) No
( ) Yes
( ) Prefer not to answer

7.10 May we share your open-ended, written responses with your institution?

If you have included information in your written responses that could identify you, we suggest choosing "No."

( ) No <<preselected>>
( ) Yes

Please click the "Submit" button below to submit your survey. <<if desktop or laptop>>

Please tap the right arrow below to submit your survey. <<if phone or tablet>>

Thank you for responding to the 2016 ECAR Student Technology Survey!

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Biography

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