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THE EVOLVING DIGITAL DIVIDE WITHIN HIGHER EDUCATION INSTITUTIONS: A QUANTITATIVE STUDY

by

Brent Adrian Owens

A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Education

Major: Higher Education

The University of Memphis

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Dedication

To my wonderful daughter Adrienne. Knowing that you were on the way provided me with the extra motivation to finish a project I had been working on for years. Once I met you, I wanted to do everything I could to provide the best life I could for you. While I hope you get your mom's intelligence, I imagine that this will demonstrate that your dad is not too far behind. Thank you for inspiring me every day to strive for the best. I hope you, as I have tried to do, reach for your goals and beyond.

To my beautiful, amazing, and fantastic wife, Kristin. There is no doubt that my success here is shared with you. I would not have persisted to complete this work or my degree without your support. While we always acknowledge that I supported you through your education, know that you repaid the favor. I honestly believe meeting you was the best thing that has happened to me. I appreciate all the sacrifices you have made for me and our growing family and I will work tirelessly to ensure that our future a bright one. Why you stopped looking when you found me, I will never understand, but know that I am the lucky one.

To my mom and dad. You made me the person I am today. You provided me with every need and want. You instilled the skills I needed to survive and thrive in this world. You are the best parents I could have ever asked for. Growing up in the loving and caring household you worked so hard to provide taught me countless qualities I continue to rely on to this day. All of your sacrifices were appreciated and I thank you for everything.

To my brother. The other half of my coin. Your ability to motivate me through creativity and self-direction continue to inspire. You are the one who made me curious and appreciate self-discovery. I appreciate you letting me be the annoying little brother, as it has led our lasting friendship. Thanks for taking all the weird genes.

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To the Daniel Mark Charitable Trust, when times were rough, I was able to rely on this wonderful organization for substance of the mind and body. To Dr. Mark and Dr. Michael Haynes, thank you for the assistance in completing this work.

To all the great bosses and coworkers I have had throughout my career, thank you for allowing me to grow and learn about this field. Thanks to you I never feel like my career is just work. I enjoy even the bad days. To Marianne Luther and Carol Casey, you gave me a chance in this field when you did not have to. Without you giving me an opportunity, I literally have no idea what I would be doing for a career.

To Memphis, the city, the school, and the essence. While Memphis may be anything from “the city where they love to hate” to the embodiment of southern hospitality, I will always love and fight for my city. I am proud to be a University of Memphis Graduate.

To the Memphis Grizzlies, Star Wars, and Video Games. While these often took up too much of my time when I should have been working on this project, these stress reliefs kept me sane and I am very much look forward to enjoying them more with my new found free time.

And finally, to Dr. Eric Platt and my committee members. I showed up out of the blue on a random departmental open house was holding and explained my long journey towards having him as my advisor. Dr. Platt assuaged any fears and assured that I would be graduating before my 10-year clock expired. I appreciate your work in pointing me in the right direction. My committee members helped me make this a well-formed and presentable dissertation and I will continually be grateful as I do my best to represent well all titles associated with this earned degree.

Abstract

Technology has become an integral and important aspect of our world. As such, the author of this study aims to research how technology is used by college students, the people who hope to be tomorrow's leaders and innovators. Ideally, all college students will complete their degrees with a comprehensive and well-versed understanding in the most basic and widespread technologies. However, strong technology literacy can be hampered by a student's background. This notion is often referred to as the digital divide and can cause some people to have a weak technological background. This study will investigate the digital divide at different types of institutions and see what, if any, impact it has on present-day students.

The primary research question asked in this dissertation is "what influence does the digital divide have on the technology proficiency of college students." An instrument to analyze college student's perceived technology proficiency was developed from the Computer Attitude Scale and Computer Self-Efficacy instruments. The survey was distributed to students at 7 institutions – four 4-year public, two 4-year private, and one community college and had 4,860 responses. Data from the responding college students indicated that the digital divide is having an impact upon college students perceived technology proficiency.

The data suggests that students that are attending community colleges will have a moderate correlation between their GPA and their perceived technology proficiency. This correlation does not exist at four year institutions. There are various technology constructs that have a statistically significantly difference between college students depending on the age, gender, and the institution type of the student. While caution is

given to the results due to violation of assumptions within certain statistical methods used, the multiple findings of significance and magnitude on the variables suggests the need for additional research.

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Chapter 1

Introduction

Over the past three decades, there have been major advances in technology. Computers have become mainstream and the Internet has changed the world forever (Cohron, 2015; Green, Felstead, Gallie, & Zhou, 2007; Huffman, 2018; Huffman & Huffman, 2011; Morse, 2004). Over the span of electronic computing, machines that originally took up entire rooms can now fit in a pocket. Ordinary tasks have become more efficient, advances have been made in many fields, and everyday life has changed with the abundant use of technology in present day. Information is able to be spread across the globe at a speed that was not imaginable in previous years. However, even with the current widespread nature of technology, it has not always been available to everyone. As with most great and new products, there was a cost to obtain the product. With the case of technology, this was no exception, as the cost to purchase technology, or even the infrastructure to operate it, could be in the hundreds, if not thousands, of dollars. Furthermore, it was not always practical or feasible to provide the infrastructure needed for technology to everyone in certain areas. Remote, rural, and difficult to reach locations have often been late to reap the benefits of societal advances that provide advantages to mainstream communities (Cohron, 2015; Hamby, Taylor, Smith, Mitchell, & Jones, 2018; Huffman, 2018). There are also those who inherently have negative attitudes regarding using technology and have no desire to engage in the digital environment that is spreading across the globe (Hamby et al., 2018). Whether using technology is counter to a particular culture or it is not seen as a valuable or required resource, there are those who do not see a need to use technology (Hamby et al., 2018).

Therefore, regardless of how helpful or life-changing technology is, it is not a viable option available to everyone. This concept is commonly referred to as the digital divide: a knowledge gap that exists between those who have a strong understanding and base in technology use, and those who have a weak background or understanding of technology (Goode 2010; Hawkins & Oblinger, 2006; Morse 2004; Young 2002). Initially, the digital divide was predicated upon certain groups having access to technology while others did not. The increase in mobile devices that can connect to the internet as well as the reduction of price in this technology has reduced the access problems compared to the beginning of the digital divide (Brown & Haupt, 2018; Chen, 2015; Cohron, 2015; Graham & Choi, 2015; Gray, Gainous, & Wagner, 2016; Hamby et al., 2018; Huffman, 2018; Ngambi, Brown, Bozalek, Gachago, & Wood, 2016; Tichavakunda & Tierney, 2018). The digital divide issue now deals with the manner in which users are able to utilize technology. Since technology is more prevalent, those who are stronger users of technology are able to reap more benefits through their interaction with technology. With some users having significantly higher skills and comfort with technology, the notion of the digital divide perhaps places some people at a disadvantage that will be hindering and perhaps unsurmountable in a society that is generally driven through the use of technology (Bozzetto-Hollywood, Wang, Elobeid, & Elobaid, 2018; Cohron, 2015; Murray & Pérez, 2014). As it is used for other disciplines, education is well suited as a method to alleviate the gap in the digital divide. Understanding the varied set of abilities students have when being educated is a crucial starting point to addressing the digital divide.

This dissertation is a report on technology proficiency among students in higher education. Analyzing the perceived technology proficiency of current students attending college will illustrate the basic abilities of these students to thrive in a technology driven world. This study analyzed the perceived technology proficiency between students who attend various types of institutions across the country. The first chapter of this dissertation displays a brief background of the study, the statement of the problem, a purpose statement, research questions, significance of the study, definition of terms, and a study overview.

Background of study

In the mid- to late 1990s, the digital divide began (Brown, Barram, & Irving 1995; Rapaport, 2009). Between 1991 and 1996 the United States went from 300,000 personal computers to over 10 million, during which time President Bill Clinton first used the term digital divide (Huffman, 2018). This aggressive expansion of technology led the federal government to be interested in the impacts it was having in the United States. In 1994 the National Telecommunications and Information Administration (NTIA), housed within the Department of Commerce, conducted the first major survey to analyze effects of the increase in computers. The findings of the survey, entitled “Falling Through the Net,” identified that income, age, education, and where one lived were all significant indicators of computer ownership (Cohron, 2015). These groups which were identified in the survey were the first haves and have-nots of the digital divide. With the continued rise of personal computers, a gap widened between these users. Haves had their own computers and knew how to use them. Have-nots were those who could not afford computers, had no idea how they worked, or had no desire to engage with technology

(Cohron, 2015; Goode, 2010; Hamby et al., 2018; Hawkins & Oblinger, 2006; Morse, 2004).

People who had access to computers became familiar with the hardware—including a monitor, a keyboard, and a mouse, to name a few pieces—as well as software like Microsoft Windows, programs for the computer, and computer games. People who did not have access continued to live their lives as they always had. There was no missing out on technology because they either did not have the resources or actively chose to not participate in using technology. Several have-nots actively chose to resist influences of mainstream American society, including its embracing of technology, because they saw no need to be materialistic. Regardless of access, technology, or information, more was not always better to this group of people who preferred to refuse the digital age (Hamby et al., 2018).

As time passed and there continued to be technological advances, such as the rise of the Internet, the digital divide grew wider. By the start of the new millennium, searching the World Wide Web or checking e-mail were common activities for those who both had access to and could afford to use the Internet (Goode, 2010; Hawkins & Oblinger 2006). Those who could not afford or chose not to partake in these technologies were missing valuable experience with tools that have greatly improved many aspects of the world (Cohron, 2015; Huffman, 2018). Many currently consider technology a necessity for success in the workforce as well as in higher education (Garrido, Sullivan, & Gordon, 2012; Huffman & Huffman, 2011).

There were several factors that determined the haves and have-nots of the digital divide and there were attempts to address them through education. Data show affluent and/or White families were more likely to have a personal computer and access to the Internet while less affluent and/or families of color had less access to computers and the Internet (Goode, 2010; Morse, 2004; Young, 2002). After the initial expansion of personal computers in the early 90's and the acknowledged importance of technology rose, K-12 schools began placing an emphasis on improving technology skills by providing opportunities to learn and use computers in schools (Chen, 2015, Reynolds & Chiu, 2015; Cunningham, 2015; Huffman, 2018). This would seemingly alleviate the access issue for a younger generation as most students would receive education and interaction with technology at school even if they were not receiving it at home. However, data suggests schools that served primarily less affluent students and/or students of color provided a worse experience with technology than schools that mainly served affluent students and/or White students (Goode, 2010; Morse, 2004). The "have-not" students who did not have access at home were generally receiving poor education and interaction with technology at school and thus still firmly lagging behind their "have" peers. Students had access but the experience was poor or weak, thus being a crucial development in understanding the concept of the digital divide.

Even with plentiful access for many more people, the digital divide still exists as one of the largest social challenges in the current age (Bozzetto-Hollywood et al., 2018). As technology became more affordable and the times shifted from having one computer per classroom, to everyone having their own computer in the computer lab, to everyone having a personal computer or laptop at home, access became a less important factor to the digital divide. This shift is reflected in higher education also as computer ownership in college students increased between 2004 and 2009 from 67% to 98.8% (Hawkins &

Oblinger, 2006; Smith et al., 2009). Whether in college or not however, it is important to weigh what simply having access to technology ultimately provided the general population. A rich experience with technology or how someone was taught to use the computer and its accompanying tools was equally important and eventually a more significant factor in determining the digital divide (Goode, 2010; Morse, 2004).

Initially using technology was similar to using a calculator. Having access to a calculator allowed most users to accomplish simple tasks such as entering numbers, addition, and subtraction. However, as technology advanced beyond the basic tasks that were originally performed on a computer, tasks became more complicated and complex. In comparison to the calculator, the advances in technology would be similar in the differences between adding a few numbers to computing complex trigonometry concepts of Sine and Cosine. Furthermore, as with technology, the more complicated mathematical procedures typically utilize advanced and more powerful graphing calculators instead of the cheaper basic calculators.

As the digital divide evolved to become less of an access issue, the way someone learned how to utilize technology became the main determinate of the digital divide. Essentially, people who had a richer learning experience with technology learned how to do more analytical tasks instead of basic or rudimentary tasks (Goode, 2010; Morse, 2004). As it continued to evolve, using technology to engage with social media or entertainment has a stark difference than utilizing high-level programs and functions to accomplish tasks (Cohron, 2015; Graham & Choi, 2015; Tichavakunda & Tierney, 2018). Therefore, it is important to analyze if there is a new digital divide and what impact it has on current college students. If there is a statistically significant difference between college students, those affected by this new digital divide could have serious problems being successful in a world that is becoming more reliant on technology.

Statement of the Problem

As the world becomes more technology dependent, proficiency in using it will become increasingly important (Garrido et al., 2012; Huffman & Huffman, 2011). However, people from different backgrounds and experiences will have varying levels of technology proficiency or technology literacy but still be expected to have some knowledge with technology (Cohron, 2015; Murray & Pérez, 2014). The individual must be considered when looking at large scale issues so that it is possible to analyze a problem and solution from as many dimensions as possible. Attempting to solve a systemic problem while only focusing on one or two major groups or factors of the issue will not lead to solving the problem for everyone. Only by realizing that there are multiple ways that different people are impacted or prejudiced by the digital divide can progress towards reducing the gap for all be accomplished.

Gender, socioeconomic status, age, education level, and geographic location are only a few of the many factors that can impact a relationship with technology. Additionally, these factors often commingle to further effect one’s placement in the digital divide. Ideally, addressing these major factors, which can widen the digital divide for an individual, could be accomplished with established programs that developed and improved alongside the growth in technology. However, as the complicated nature of technology changes rapidly, the impact upon these major factors has also rapidly developed over the course of the digital divide.

Currently technology has not been recognized as an essential life skill as it is in no way taught and tested in the same manner in K-12 education as are other essential life skills such as reading, writing, or math (Murray & Pérez, 2014). This is problematic for the general population as those with lower education levels are less efficient at receiving information (Yang & Grabe, 2014). Therefore, those who do not opt for higher education or do not earn their high school degree will struggle to learn and adopt information or skills with technology. As technology continues to expand, this group will continue to lag further behind the more educated population.

As for those who enroll in an institution of higher education, it is difficult for anyone to realize there is any issue in regard to student technology proficiency since students arrive at college extremely confident in their technological aptitude. This confidence exists because college students have mastered the technology that they utilize on a regular basis, but overall these technologies constitute a small portion of what is available (Bozzetto-Hollywood et al., 2018). Being a master at social media or email does not make one a master of technology. Even though there are significant technology skill deficiencies that exist among college students, the students' overconfidence has led to the misconception that all students attending college have the necessary technology skills for success and therefore there is no need to implement mandatory technology proficiency education (Bozzetto-Hollywood et al., 2018). The lack of required testing of technology aptitude means it is possible that some college graduates will be ill-prepared to fully handle life after college in a technology fueled environment.

While using some technologies will keep identifying information such as gender unknown, gender can still have a large impact on the digital divide. Throughout the rise of technology, the once significantly large gap of technology use between males and females has greatly reduced and there are now more female users in several parts of the world (Gray et al., 2016). However, the higher-level digital skills used for professional development and upgrading existing qualifications are used less by women (Gurung, 2018). Therefore, while the access for women has increased, failure to fully grasp technology advances has resulted in a persisting digital divide.

As it can influence many aspects in one's life, where a person was born, raised, and currently lives can directly affect their relationship with technology. In some situations, providing the infrastructure to the physical location where some people live is difficult and therefore access to the technology is still a major hurdle (Hamby et al., 2018; Malhotra, 2014; Sagrista & Matbob, 2016). Furthermore, around the world there can be a multitude of governmental, cultural, language, and social issues that can determine the technology usage and access by people (Malhotra, 2014; Ngambi et al., 2016). While generally the digital divide has evolved beyond access issues, some rural and global situations demonstrate that physical access to the technology is still a relevant issue.

Another group that is unable or unlikely to reap the benefits of technology is the aged and elderly. The older a person becomes, the less likely they are to utilize technology and the internet (Huffman, 2018). The learning curve on using new pieces of technology can already be an intimidating situation, so an elderly person who may not completely grasp all of the uses of technology may choose to avoid it altogether (Gray et al., 2016). This can be problematic for adult and nontraditional learners since increasing technology applications for this group to use is seen as a main method to provide their education. Whereas the use of technology can often be viewed as a way to make education more accessible, adult and nontraditional learners who may have weaker technology proficiency than younger traditional students could struggle in transitioning away from a traditional classroom setting (Eynon & Helsper 2011). Since this group is not able to become younger nor will they gain the positive technology experiences that traditional students potentially have established at a younger age, they will remain in danger of missing many life improving opportunities that technology use could help improve (Mubarak, 2015; Wildemeersch & Jütte, 2017).

Generally, people who have weaker technology proficiency are racial minorities and/or come from a lower socioeconomic status (Goode, 2010). A combination of several different factors and often linked to race and ethnicity as a major indicator, a lower socioeconomic status resulted in not having much financial ability to purchase technology (Centeio, 2017; Cohron, 2015; Hamby et al., 2018; Huffman, 2018; Ngambi et al., 2016; Rowsell, Morrell, & Alvermann, 2017; Strover, 2014; Tichavakunda & Tierney, 2018). However, some minorities and those from lower socioeconomic status have begun to utilize technology more frequently than White people (Tichavakunda & Tierney, 2018). As with the current state of the digital divide, how this group utilizes technology once they have access to it is the problem. Lower level interactions, even if it occurs at a more frequent pace, still generally results in lower levels of technology proficiency.

Higher education is a place where there is often a combination of people from a variety of backgrounds. All of the aforementioned factors, in addition to many additional individual constructs, will appear within the diversity of a student body at a college campus. Thus, the effects of the digital divide are potentially widespread in higher education. Due to lack of acknowledgement of it being a major issue on campus (Murray & Pérez, 2014) or the assumption that all students have strong technology skills (Bozzetto-Hollywood et al., 2018; Mishra, Cellante, & Kavanaugh, 2015) lends itself ripe for analysis.

Purpose Statement

One purpose of this study is to determine if the current digital divide—not defined as access to technology, but how one uses technology—influences student technology proficiency and if there is an effect on student success. Another aim of this study is to determine whether there is a significant difference between 2-year community college, 4-year public, and 4-year private students' technology proficiency.

Research Questions

What influence does the digital divide have on the technology proficiency of college students?

Eight sub-questions will help determine the answer to the overarching question.

1. What is the relationship between technology proficiency and cumulative college grade point average for students attending 2-year colleges?
2. What is the relationship between technology proficiency and cumulative college grade point average for students attending 4-year colleges?
3. What is the comparison of technology proficiency levels between students attending 2-year and 4-year institutions?
4. What is the comparison of cumulative college grade point between students attending 2-year and 4-year institutions?

5. What influence does gender have on any identified components of technology proficiency?
6. What is the relationship between technology proficiency and gender?
7. What influence does age have on any identified components of technology proficiency?
8. What is the relationship between technology proficiency and age?

Significance

This study could contribute to the field of higher education by exploring a subject that is constantly changing. With any major development in technology, its relationship to how it impacts students can be explored to see if there are any ways for higher education to improve how it uses technology. Understanding if there is a major difference between different classifications of institutions and the students' technology proficiency would potentially lead to systemic programmatic changes at the various institutions. Exploring scenarios that currently exist at some institutions of higher education demonstrate the importance of examining the digital divide.

Community colleges, for example, have higher racial minority enrollments than 4-year institutions (Knapp, Kelly-Reid, & Ginder, 2010) and a large number of students from a lower socioeconomic background (Baum & Ma, 2012; Goldrick-Rab, 2010). These are two identifying factors that have been linked to weaker technology proficiency. Four-year private schools tend to have a higher enrollment from rich and White students (Ma & Baum, 2016; The College Board, 2018) and while current research indicates that this group may not use technology as often as other groups, their actual proficiency is superior (Graham & Smith, 2011; Tichavakunda & Tierney, 2018). The perceived difference in the make-up of the student body population could lead to vastly different technological utilization for the students attending these institutions which ultimately has the potential to impact several aspects of the students' lives. Their performance in class, their efficiency in studying, the type of jobs they obtain, and many other aspects of their time in and after college could all be impacted by the digital divide. With this example, the community colleges students potentially have more students who are at risk of having low technology proficiency than 4-year institutions.

Another example that demonstrates the need for studying higher education's current digital divide is the future employability of the students. With the trends of having more technology-based jobs in the foreseeable future ("Fastest growing occupations," n.d.), having students with the required skills will be paramount. Students with a weaker background may not be interested or skilled enough to consider these types of jobs. Not implementing technology training to ensure a level field could quickly result in not providing a college graduates with the skills needed to function in many work environments, something that is contrary towards the spirit of attending higher education (Bozzetto-Hollywood et al., 2018; Cohen & Kisker, 2010). Studying college students' perception of technology proficiency will show if there is a statistically significant gap between students in higher education.

Theoretical Framework

The theoretical framework for this study assumes that the digital divide is affecting college students and their technology proficiency. Technology proficiency is viewed within the overarching term referred to as the digital divide, the concept that people from certain backgrounds will have a worse or poorer experience with technology than people from other backgrounds (Goode, 2010; Gorski, 2002; Morse, 2004). This study will focus on the effects within the United States and will not be applicable globally. The United States, where many of the first computer technologies were created (Myers, 1998), is primly situated to focus this study of the digital divide. America is one of the more developed and resource rich countries in the world, leading to a long history with technology integration among its population. Furthermore, the United States is a democracy and has not encountered governmental agencies broadly restricting technology in an attempt to control information to the general population. Studying the digital divide within a country with ample time, resources, and desire to address issues of the digital divide can provide a comprehensive view of many of the issues surrounding this framework.

The concept of the digital divide has evolved as technology has developed over time. Originally, the digital divide was defined by haves and have-nots. Haves were people who were able to have access to technology frequently. The have-nots were people who did not utilize technology because they could not afford the cost for access to technology or did not want to utilize technology (Centeio, 2017; Cohron, 2015; Hamby et al., 2018; Huffman, 2018; Ngambi et al., 2016; Rowsell et al., 2017; Strover, 2014; Tichavakunda & Tierney, 2018). Initially these have-nots of the digital divide were non-White people, specifically Black and Hispanic people as well those with a lower family income. These identifiers are part of the calculations to determine an individual's socioeconomic status. In addition to generally having less education and a smaller income, those who come from a lower socioeconomic status classification often have weaker technology skills due to not being able to afford or value consistently strong interactions with technology (Centeio, 2017; Cohron, 2015; Hamby et al., 2018; Huffman, 2018; Ngambi et al., 2016; Rowsell et al., 2017; Strover, 2014; Tichavakunda & Tierney, 2018). This division between these haves and have-nots led to some people having deep understanding of technology while others have little to no technological knowledge (Goode 2010; Hawkins & Oblinger, 2006; Morse 2004; Young 2002). As technology has become more widespread, how people use technology has been a more significant contributor to a digital divide that is evolving over time (Goode, 2010). The cost of technology decreased and efforts to provide more access to the majority of the population were working and therefore the financial aspect of the digital divide, in regards to having regular access to technology, generally faded away (Cohron, 2015). Thus the digital divide is evolving into how one utilizes technology.

Currently how one utilizes technology is impacted by a myriad of aspects that are based on one's individual background. Whereas originally the major factor as to where one was in the digital divide gap was directly related to if they had access to technology, several additional aspects have a role in one's standing in the digital divide. Socioeconomic status, which initially was a major factor in if one had access, now impacts technology in a different manner. While there are people from a lower socioeconomic status who ultimately use technology more frequently than those who would be considered in a higher socioeconomic status group, their interaction with technology is not as rich (Graham & Choi, 2015; Tichavakunda & Tierney, 2018). With the increase of smartphones and other efforts to provide access to ICT (internet and computer technology), technology and the use of the internet has become widespread (Bozzetto-Hollywood et al., 2018; Cohron, 2015; Graham & Choi, 2015; Huffman, 2018) but using a phone to check social media as a person's main interaction with technology will not lead to a deep and developed relationship with ICT. Similar technology proficiency factors such as gender, age, education level, and geographic location have seen their impact on technology shift as the digital divide is evolving. Those who develop a positive and rich experience with technology will have stronger ICT skills than those who begrudgingly or lightly use technology.

What remains constant are the positive impacts that technology has had on education and a variety of other fields (Goode, 2010; Huffman & Huffman, 2011; Martin, Diaz, Sancristobal, Gil, Castro, & Peire, 2011; McManus, Dunn, & Denig, 2003; Paul, Messina, & Hollis, 2006). Finding a way to infuse these stronger interactions with the programs and software that are now commonplace in and after higher education generally provides a much deeper understanding of the technology, resulting in more positive outcomes. Ensuring the long term success of students through teaching and improving knowledge or skillsets is an aim of higher education (Cohen & Kisker, 2010). If the digital divide still has a significant impact, then many are not utilizing technology to its fullest and are missing out on the positive attributes that technology

brings. Furthermore, have-nots continually not reaping the benefits of technology pose a major problem. As information and new technologies become available, the haves will be well placed to quickly receive the benefits whereas the have-nots, who remain on the wrong side of the digital divide gap, will be excluded. This uneven reception will keep the have-nots on the outside (Mubarak, 2015). This notion will potentially prevent the have-nots from catching up to those with a richer technology experience and impact their ability to function in a world that is relying heavily upon technology.

This study's theoretical framework is influenced by the works by Goode (2010), Morse (2004), Cohorn (2015), and Bozzetto-Hollywood, Wang, Elobeid, and Elobaid (2018), who aimed to assess and analyze the digital divide. This theoretical framework seeks to explore if college students are still experiencing any effects of a digital divide. Identifying variables that are aspects of technology proficiency and assessing how college students relate within these areas will demonstrate the impacts the digital divide may have upon college students. The identified variables encompass various aspects of technology that have proved useful and needed to have a strong proficiency foundation in a world that relies upon technology. Specifically, regarding college students, knowing that an individual's past and personal aspects can greatly affect their relationship with technology, this study aims to explore how the impact of several factors are currently altering the relationship with technology. Ensuring, and not assuming, that all students of higher education have a well-established understanding and relationship with technology is another way that these institutions can prepare students for the world after college. Analyzing student's attitudes towards and relationship with technology can give a sense of their overall technology proficiency. Seeing the impact of factors that have been identified as influencing the digital divide can lead to higher education institutions developing programs to ensure college student success in another crucial area.

Assumptions

One assumption for this study is that the sample of students studied reflects typical students at their respective institution type. It is also assumed that all students who participated answered the survey questions, which were distributed by the researcher to collect data, honestly and to the best of their ability. The students that took the survey were only given the survey via email. This is somewhat problematic as the students must engage with technology to have been surveyed about technology.

Limitations

Studying institutions primarily in the south and central regions of the United States does not give a national view of higher education institutions. Also, only one community college participated in the survey although seven were solicited to provide student email addresses. Therefore, it is obvious the findings associated with the community college students is of limited generalizability to similar institutions. Furthermore, there may be some students who are seeking degrees that will allow them to use as little technology as possible. Even though this study will show the importance of having technology skills regardless of which field of employment one finds, these students could significantly skew the results.

Delimitations

The delimitation for the study includes the time of the study, location of the study, the sample of the study, and selected criteria of the study. The data was collected from November 2016 to April 2017. The locations of where this study was completed were higher education institutions in Tennessee, Arkansas, Texas, North Carolina, Kansas, and Florida. The sample of the study is students who attend these regional institutions and decide to take the questionnaire.

Definition of Terms

- Community colleges or 2-year institutions: higher education colleges or universities that have open admission policies. The cost to attend these types of institutions is usually less than any other type of institution (Ma & Baum, 2016).

- Four-year public institution: higher education colleges or universities that have more stringent acceptance policies than community colleges. Students from community colleges typically attempt to transfer to a 4-year public institution if they want to continue their education (Ma & Baum, 2016; The College Board, 2018).
- Four-year private institution: higher education colleges or universities that typically have the most stringent acceptance policies. On average, more expensive to attend than 4-year public or 2-year institutions (Ma & Baum, 2016; The College Board, 2018).
- Digital divide: the technology literacy difference that exists between people. The digital divide is generally affected by a several factors, most notably race and income (Gorski, 2002).
- Technology proficiency: This term is often interchangeable with several other. Technology, information, computer, or digital combined with proficiency, literacy, fluency, or competency (Murray & Pérez, 2014). For the sake of this study, the researcher prefers technology proficiency but will use a variation of most of aforementioned terminology. Fully, this concept includes one's attitudes, abilities, values, knowledge, and skills that are needed to use the internet and computer technology. How one can perform, communicate, problem solve, retrieve information, create content, and a litany of other tasks are all connected to this concept (McCoy, 2010; Murray & Pérez, 2014). Concisely, it is how much one understands about technology or how to use technology.

- Information literacy: is the ability to collect, evaluate, assemble, reflect upon, and use information in order to learn and inform problem-solving and decision making (Bruce, 2003). Technological literacy, which is increasingly being tied into information literacy, is the understanding of the uses, functions, and purposes of technology for the achievement of goals (Buzzetto-More, 2009; Pearson & Young, 2002). Both are skills that are increasingly playing an important role in lifelong learning and that are dependent on the ability to engage in critical and reflective thinking (Bruce, 2003; Buzzetto-More, 2009). Both of these concepts, depending on the author, can be related to the concept of Technology proficiency.
- ICT: Internet and Computer Technology. Another term that is commonly interchangeable with Technology proficiency. Often refers specifically to the ability to use a computer or piece of technology to connect to the internet (Tichavakunda & Tierney, 2018).
- Family income level, richer or poorer: this is related to the amount of financial support a student will receive from within their household. The household can include family members or just themselves. The amount of money a student has available for income, through employment, financial aid, or family aid, is their family income level. Students that have high levels of income available are classified as rich or as having a high family income level, and those who have little income are classified as poor or as having a lower family income level.
- Racial minority or students of color: for the purposes of this study, minority or students of color will refer to ethnic diversity. Students who identify as non-White are considered a minority and a student of color.

- Non-White: These are students who classify themselves as Black or African American, Hispanic or Latino, Asian, or any other ethnic groups that is not Caucasian or White.
- Socioeconomic status: a combination of educational level, income, financial security, and perceptions of both social status as well as social class ("Education and Socioeconomic Status," n.d.). Race and ethnicity are generally major determinates of SES ("Ethnic and Racial Minorities & Socioeconomic Status," n.d.)
- Employability: the combination of factors and processes that help people progress toward having a job, finding a job, remaining in a job, or being promoted in the workplace (Garrido et al., 2012).
- Haves and Have-nots: haves were the group of people who had access to technology while the have-nots were unable to have access. Often influenced by income, geographical location, age, education, and race. These primarily socioeconomic factors determined the people who were on the positive, beneficial side of the digital divide and those who were on the opposite, negative side (Cohron, 2015; Tichavakunda & Tierney, 2018).

Study Overview

As discussed in this chapter, this study shows how the digital divide is currently affecting students. Chapter Two presents a review of literature on the digital divide, how it has changed over the years, and where it is now. Also, Chapter Two displays literature that examines the effect that technology literacy can have on students. Chapter Three includes the research design, methodology, data collection, data cleansing methodology, and data analysis. Chapter Four displays the findings of the research conducted. Chapter Five is a discussion of the findings as well as recommendations for current practice.

Chapter 2

Review of the Literature

Introduction

This study is an exploration of the theoretical framework, the notion of the digital divide, and how it currently exists on college campuses in the United States. The digital divide, the gap of technology literacy between individuals, is a phenomenon that can greatly affect people. This chapter contains a review of literature indicating the importance of technology proficiency for college students. By exploring previous research, this chapter will demonstrate why it is important to consider within higher education, the connections between technology literacy and how it can impact several aspects of a college student's life. This chapter also delves into the digital divide: the gap that has formed between those who are strong users of technology and those who are weak users of technology. By analyzing literature and data, the digital divide is discussed through several different perspectives. The history of the digital divide is explored by looking at computer and technology usage since the mainstream introduction of personal computing. Those generally affected by the digital divide is discussed by looking at the technology ownership in the first years of personal technology. Finally, how the digital divide is evolving due to wider access of technology will be discussed by looking at how different people currently use technology. To begin however, exploring some of the major benefits college students can gain from technology usage will frame the rest of this chapter.

Success in College

Technology has had a powerful impact on many aspects of our present society, including commerce, business, communication, health, entertainment, and education (Huffman & Huffman, 2011; Martin et al., 2011). In the education field, the use of technology has tangible results; students who do not use technology struggle when competing with students who do use technology (Goode, 2010; McManus et al., 2003; Paul et al., 2006). Technology provides another method for more active participation from the student in the learning process (Huffman & Huffman, 2011; Martin et al., 2011). The utilization of technology is an additional method that can be used to help keep students motivated and engaged.

Students who are more active participants in their classwork generally outperform students who are less active participants (McManus et al., 2003; Paul et al., 2006). Technology use by students has raised student engagement both inside and outside the classroom (Martin et al., 2011). According to Astin's theory of student engagement, there are several positives that students gain while being engaged outside of the classroom (Astin, 1999). As for students in the actual classroom, students who have been more engaged in class have also scored higher grades and performed better in those classes (Huffman & Huffman, 2011). Technology makes assignments for class easier to complete, ultimately resulting in higher grades (Huffman & Huffman, 2011). Furthermore, students who use technology to study for a test do better than students who did not use technology (McManus et al, 2003). The more resources a student uses in class, such as technology, the better they perform since the use of additional resources means the student is engaged and participating in active learning, both of which improve grades (Huffman & Huffman, 2011).

Specifically regarding higher education, these effects of technology usage within education can have a major impact. Looking at the perceived technology proficiency of community college students demonstrates multiple areas of concern. Community colleges have a larger number of racial minority enrollments than 4-year institutions (Knapp, Kelly-Reid, & Ginder, 2010) and a greater number of students from a lower socioeconomic background (Baum & Ma, 2012; Goldrick-Rab, 2010). These two classifications have been connected to having weaker technology proficiency.

Ideally, community college students have reliable access to technology and are using it well, since 64% of community college students agreed that technology helped improve their overall learning (Caruso, 2007). With a potentially weak technology background for some of the students however, there could be a concern that all the students attending community college are not taking advantage of the positives that technology brings to their education. They could not feel comfortable utilizing technology, not feel that it will be a necessity in their future field, or not have a background where they are able to comprehend anything beyond the basic applications of technology. Regardless of the reason, if some of the community college students are not taking full advantage of technology, they could be hindering their overall learning.

Another area for concern is demonstrated in research that has shown that community college students struggled initially when they transfer into 4-year institutions specifically because the 4-year institutions use technology at a higher level than community colleges do (Caruso, 2007; Huffman & Huffman, 2011). The reason for this discrepancy lies in the way students learn technology skills. Students in a 4-year institution indicate they learn new technology when it is required for a class assignment or something school related. Students in a community college denote they learn new technology when it is related to their current job or potential job (Caruso, 2007). Students who are already familiar or learn a skill for the classroom have the potential to use those skills in other educational settings to improve overall learning. With community college students, while they may learn skills for the job, the ability to increase learning in the classroom via technology usage does not always happen.

Employability

With employment being a significant goal for many students after they complete a post-secondary degree, understanding how technology impacts one's employability adds to fully addressing the technology proficiency issue. A goal of higher education is to prepare students with the skills needed for their future endeavors. Encouraging the use of technology is an area that higher education has been able to have some success in since a vast majority, 98%, of students who graduate college use the internet while only 68% of high school graduates use the internet (Huffman, 2018). Unfortunately, both schools and employers admit that use of the internet is not enough of a skillset, since students who graduate are still not properly prepared for future roles in regards to technology proficiency (Murray & Pérez, 2014). Furthermore, students can benefit from the technology that is used in school settings since it can relate to skills that will enhance their success in a later career (Huffman & Huffman, 2011). Many organizations will be looking for students who have basic computer training, which typically includes introductory instruction on operating systems, applications that improve productivity (word processers like Microsoft Word and spreadsheets like Microsoft Excel), the Internet, e-mail applications, computer ethics and cyber security (Bozzetto-Hollywood et al., 2018; Garrido et al., 2012). By the time students graduate college they are generally proficient in utilization of the internet to seek out information through search engines. But they often lack the productivity driven skills and understanding of the software that is sought out for new employees and needed for business and industry ventures (Bozzetto-Hollywood et al., 2018; Mishra et al., 2015).

In the present-day job market, basic technology skills are essential for anyone looking to enter the workforce and for those who are trying to acquire a better line of employment (Garrido et al., 2012). In fact, a person's ability to be employed is linked to how they use, relate to, and are aware of services that technology can provide, and how to properly deliver those services (Lindsay, 2005). The importance of technology is not found in just one field of employment; agriculture, construction, education, and service industries across a wide range of labor markets have made technology a necessity (Garrido et al., 2012). These technologies will be needed on a global job market that students in higher education will ultimately be engaging in to secure future employment (Huffman, 2018). Those who do not use technology well will still be limited by the digital divide as there will be jobs that utilize technology and those that do not (Cooke & Greenwood, 2008; Mubarak, 2015).

Another possible way to gauge success in the workforce are the salary packages employees receive. Salary, by itself, is another aspect that has a massive role within the digital divide. Salary can impact socioeconomic status and is a main conduit to being able to afford the best technology. Revisiting the history of the digital divide: originally without a strong salary, one would not be able to afford the technology. Without the technology, digital skills and other aspects like education were impacted. With lower digital skills and potentially lower education levels, it would be more difficult to obtain certain types of good paying jobs (Kaiser, 2005; Malhotra, 2014). These effects have continued to ripple into present times as those with better education and better technology, such as stronger and more consistent internet access, have a better chance at getting better jobs (Kaiser, 2005; Malhotra, 2014).

Technology can directly impact the amount of money employees make at their current and future jobs. Employees who used computers earned 63% more than employees who did not use computers (Green et al., 2007). Green et al., (2007) also found there is a substantial difference in employees who can reap the benefits gained from successful technology use; a financial difference of a 5.3% increase in pay for women and a 6% increase in pay for men (Green et al., 2007). Technology in the workplace can lead to upward mobility within a current job, which would also result in increased pay (Garrido et al., 2012).

History

Overall, computer use has increased dramatically in recent years (McCabe & Meuter, 2011). Over that time span, an entire generation of people were born with technology as the norm and have had the opportunity to grow up in the age of computers. Depending on one’s background however, not everyone may have had the opportunity to be in an encouraging technological environment over the course of their life. Due to the cost of technology (Cohron, 2015), one’s educational background, one’s socioeconomic status, or the ability to have the infrastructure for technology, usage and access has varied greatly (Goode, 2010, Hamby et al., 2018).

Additionally, some people chose to not partake in technology. These people often expressed skepticism as to if the new advances in technology really had a role in their life, let alone improved aspects of their lives. Furthermore, there were concerns about cultural values that had been instilled in families, the notion being that exposure to things that were not a part of a group's culture could have negative effects. Also, there were regional fears across certain areas in the United States; the thought being that technology could make individuals less self-reliant on local knowledge that is central to the culture for certain areas (Cohron, 2015; Hamby et al., 2018).

Some people could not afford the technology. While over time the cost of technology has decreased, it was originally expensive and only available to those with larger incomes (Bozzetto-Hollywood et al., 2018; Cohron, 2015; Huffman, 2018). Therefore, those with smaller incomes in lower socioeconomic statuses, were not able to afford technology in addition to expenses that were considered more necessary. Even if one could afford technology, ICT's impact was nowhere near the level set by current standards, so many did not desire or see the need in technology (Cohron, 2015; Hamby et al., 2018).

Some people felt they were too old to start learning and embracing technology. In 2013, Pew researchers claimed that age was largest determining factor in whether or not a person used the internet (Cohron, 2015). A few years later, data from 2016 showed that 36% of seniors were not using the internet (Huffman, 2018). Those that did were more likely to not be broadband users, settling for a slower process that was not ideal (Cohron, 2015). There are several factors that can influence older adults adapting technology. The societal aspects that influenced a person when they were younger, positive or negative, tends to impact adult learners as they age. This can affect older people's comfortable level with technology, which generally was not available when they were younger. The gambit of new and innovative technology available for everyone is not extremely helpful when examining an older population that may have low confidence, low self-esteem, low desire to utilize technology, or low technology proficiency (Eynon & Helsper, 2011). While the continued advances of technology can provide opportunities for those who may never have had them previously, the increased risks of privacy issues, data protection, and the spread of questionable knowledge are example of issues that can make adult learners and older individuals weary of adapting technology (Wildemeersch & Jütte, 2017). Beyond the difficulties of embracing and utilizing new technology, aging typically leads to an increase in disabilities, which is another hindrance in using technology (Mubarak, 2015). As younger people continue to age, perhaps this will become a less likely phenomena, but currently the digital divide is extremely visible with the elder population.

Some people were disadvantaged due to their race and ethnicity. Early in the digital divide, access was a major factor and analyzing computer ownership by race shows a stark difference. Data from 2000 show that several differences existed along racial lines; 51% of homes reported owning a computer, but only 33.7% of Hispanic homes as well as only 32.6% of Black homes reported owning a computer (Morse, 2004). The percentage of homes that had Internet were similarly divided along racial lines; 41.5% nationally said they had Internet while 23.6% of Hispanic homes and 23.5% of

Black homes reported having the Internet (Morse, 2004). Race and ethnicity is yet another socioeconomic factor that impacted the digital divide.

For some individuals, they were never exposed technology. Those who lived in rural parts of the country were not able to partake in many aspects of the digital age. Lack of access or cost to establish the necessary equipment such as cell-phone towers, broadband cables, and Wi-Fi access points generally made it difficult to gain connection to several aspects of technology (Hamby et al., 2018). Not living in or close to a metropolitan area often meant the essential access blocks to partake in the digital world were not available.

Others felt the effects from a weak educational background. The education level of parents is also connected to students' technology usage (Reynolds & Chiu, 2015). Furthermore, the population that the K-12 school was aiming to serve had an effect on the quality technology education students received in school (Goode, 2010). While schools often attempted to ensure quality technology instruction, it often lagged behind students who had consistent access at home or better instruction while at school.

These examples demonstrate ways that even as technology began to spread and has now become a dominate force in the world, there are still those who have poor access or weak experiences with technology. Ultimately, the haves continually and aggressively remained haves in the digital divide and those who were have-nots fell further behind those who used technology (Cohron, 2015). Although it is currently not based as much on having access to a computer as what one can do with technology, it is important to understand the history of the digital divide.

Access

The digital divide, in its first form, encompassed the time when the gap in technology proficiency laid almost exclusively on who had access to technology and who did not (Goode, 2010). Recognizing this issue by studying the changes happening in the country, the United States' government stepped in to try and curtail the major access issue of the digital divide. A part of the Telecommunications Act of 1996 enabled the Federal Communication Commission (FCC) to fund the implementation of technology to schools and libraries across the country, a program commonly referred to as E-rate. Over $1.7 billion was invested into over 80,000 schools and libraries so as to provide computers and internet access. The hope was that this infusion of technology would greatly reduce the number of people and children who did not have access to technology. E-rate program eligibility was determined by the location and scale of financial hardship of the institutions that received funding to improve their current technology situation (Strover, 2014). Many Americans who would have never gained experience with technology or the internet were able to do so through the initial success of the E-rate program (Cohron, 2015). E-rate was the government's attempt to address the rural and financial issues that plagued the digital divide and did so by supplying technology to rural and poor areas of the country (Strover, 2014).

While the government attempted to stymie the digital divide, as technology became more available the digital divide continued to grow. Possessing or having consistent access to computer hardware, software, and, more recently, high-speed or broadband Internet access, allowed the "have" group of people the opportunity to become familiar with new and cutting-edge technologies (Cohron, 2015; Mubarak, 2015). Those who could not fully possess technology or only received limited interaction with technology at school and at a library were still have-nots, since their technology experiences were not as rich or in depth (Cancro, 2016; Tichavakunda & Tierney, 2018). This difference between those who did and did not have access to technology began to grow as time passed and eventually began to affect schools, ultimately having a major effect on the students.

Unfortunately, not every school was able to provide the same level of instruction or equipment and thus curtailing the digital divide through the school system produced an interesting dilemma. Generally, a student needs reliable access and quality instruction in order to learn how to use technology (Morse, 2004). While E-rate was the initial step in countering the lack of technology in schools, as Goode (2010) shows, the distribution of technology resources in K-12 education often depended on the type of student the school served. When comparing these different uses of technology by schools that serve less-affluent students and/or students of color, and schools that serve affluent and/or White students, those who attended the affluent and majority-White schools had a richer learning experience with technology (Goode, 2010). Many of the key elements that are considered necessary to support a well-rounded and rich experience with technology—including experienced and prepared teachers, student-focused pedagogy, and high expectations by their teachers—are not as prominent in schools that serve less-affluent students and/or students of color (Goode, 2010).

Surprisingly, however, students who attended a school with a high number of less-affluent students and/or students of color use computers more frequently than middle-class and White students in the essential subject areas of math, English, and social studies (Goode, 2010). However, how the students used the technology was vastly different. Less-affluent students and students of color focused on mastering remedial skills and working independently while the middle-class and White students focused on information gathering, written expression, computer skills, analyzing information, collaboration, presenting information, and communicating with technology (Goode, 2010). Furthermore, less-affluent students and students of color were more likely to use computers only to write required papers. Middle-class and White students took advanced placement computer classes while using the computer to complete special projects for class (Chen, 2015; Goode, 2010). How students learn to use technology is important. Students who use technology only for memorizations of facts, figures, and formulas that then will be regurgitated on a test will have a less rich technological experience than students who learn how to problem solve by generating new knowledge through critiquing and synthesizing the facts, figures, and formulas, ultimately having a direct impact on how they view how to use technology (Morse, 2004).

Once these K-12 students attended a post-secondary institution, the issue of access to technology was still important. The median for computer ownership in the 2004 EDUCAUSE Core Data survey was 80 percent; the average, however, was 67 percent. This led some researchers to believe that the data is,

> indicating that there are differences among campuses. At private colleges and universities, computer ownership averaged 81 percent; at public institutions, the figure was 59 percent . . . at public 2-year institutions (community colleges and junior colleges), the figure was 35 percent. (Hawkins & Oblinger, 2006, p12)

One factor that could be a reason for this difference is race and ethnicity as enrollment data show that a majority of Black and Hispanic students in higher education attended community colleges more than other institutions (Knapp et al., 2010) and attended private colleges at a smaller rate (Ma & Baum, 2016; The College Board, 2018). Following the line of logic presented by Goode and Morse, one could posit that race somewhat influenced computer ownership in this 2004 survey. Analyzing data from 5 years later however (Smith et al., 2009), one can see that the access issue has faded away significantly. From the EDUCAUSE Core Data Survey from 2009, the overall computer ownership by students reached 98.8 percent with no major differences by institution type. With access to computers so high among higher education students, the original cause of the digital divide seems to have been mitigated to some extent. The lingering effects of the original digital divide continue to have an impact even though access is no longer a major determinate of technology usage.

Evolution

With computer access waning as the major factor in the digital divide, some have suggested that how one uses technology becomes the focal issue in technology proficiency (Ballesta Pagán, Lozano Martínez, & Cerezo Máiquez, 2018; Bozzetto-Hollywood et al., 2018; Chen, 2015; Cohron, 2015; Gray et al., 2016; Gurung, 2018; Huffman, 2018; Murray & Pérez, 2014; Ngambi et al., 2016; Reynolds & Chiu, 2015; Rowsell et al., 2017; Tichavakunda & Tierney, 2018). As access began to spread, more people became haves in terms of simple use of computers and the internet. The problem however was that those who were gaining access to technology were hesitant to fully explore or commit to it due to the simple notion that they did not fully understand how to utilize all the tools available to them (Cohron, 2015). Furthermore, this group of late adaptors were groups that were impacted by the original digital divide. Those with a lower socioeconomic status still currently utilize technology differently than those from a higher status (Centeio, 2017; Cohron, 2015; Hamby et al., 2018; Huffman, 2018; Ngambi et al., 2016; Rowsell et al., 2017; Strover, 2014; Tichavakunda & Tierney, 2018). It is still common, for example, that lower income households embrace technology at a lower rate than higher income households according to a 2016 Pew Research Poll (Anderson, 2017). There are close to 20% of Americans households that do not have internet (Williams, 2017) and these are mostly lower income households. Analyzing specifically by approximate income, 98% of those with a household income of $75,000 or more have access to the internet at home while 79% of households with an income of $30,000 or less do not have internet (Huffman, 2018). Comparing income and computer ownership is similar to internet access, as 46% of the poorest while only 4% of the wealthiest households do not have a computer at home (Huffman, 2018**)**. Poorer Americans are less likely to feel confident in their technology skills and use the internet as a way to seek learning opportunities (Bozzetto-Hollywood et al., 2018). Therefore, the evolving digital divide is the combination of effective access to and effective utilization of technology (Mubarak, 2015).

This new notion of the digital divide was demonstrated over the course of the mid and late 2000. As correctly predicted in Morse:

> The use of portable, wireless computers in schools will be widespread before the year 2010 and stated that when this occurs, the construct of a digital divide will no longer focus on student access to computer technology but rather on which

> students know how to use this technology as well as how it is used differently by and with various groups of students. (Morse, 2004, p. 270)

This increase within education can bring many benefits to the students. Using technology can improve the student ability to write papers, complete homework, conduct research, allow for special accommodations, and improve language proficiency (Huffman, 2018). Unfortunately, many people in general do not engage with these higher level functions of technology as leisure activities remain the main use of technology (Mubarak, 2015). Social media, being utilized by a majority of the population, is one example of a use of technology that is not generally academic in nature but is a heavy draw of people's time (Huffman, 2018). Since social media does not often provide a deep and engaging experience with technology (Tichavakunda & Tierney, 2018), understanding the impact of how the general population does utilize technology is crucial in addressing the evolving digital divide.

The use of the technology is now the current standard for the digital divide. Simply possessing the technology does not prove one's mastery over technology; it simply means that perhaps one is able to use technology. Just having the knowledge of the technology may no longer be enough as the ability to adapt and possess higher-order thinking in regard to technology becomes more in demand in today's world. Technological literacy and proficiency have overtaken access as the deciding factor as to where one stands in the digital divide (Cohron, 2015). One's ability to recognize when it is necessary to seek additional information, their effectiveness at finding said information, and having the ability to use it in the right way is a facet of having technology literacy. This process is a higher-level ability that far exceeds one simply just having access to technology, and without a previously rich experience with technology or help with the technology, it is difficult for one to achieve this deeper digital literacy (Cancro, 2016). Access is an important aspect of the process but the while the access digital divide shrinks, the proficiency digital divide continues to grow (Cancro, 2016; Huffman, 2018).

Advances in Technology

The evolving digital divide is more complicated than the original haves vs. have-nots (Tichavakunda & Tierney, 2018). And due to this notion, it is important to reframe the nature of the current digital divide so as to recognize the information resources needed to thrive in this digital world as well as the educational benefits (Huffman, 2018). As technology intertwined itself into our regular and everyday processes, it has become common for things such as government documents, job applications, communication, as well as education resources to live or happen completely online (Cohron, 2015). Therefore, since it is widely accepted that most people have access to the digital resources needed to function, analyzing the quality of people's access can illuminate another issue within the evolving digital divide.

In a world where access is expected, the speed and reliability of that access can be another factor that impacts the digital divide. While all would enjoy fast and reliable internet, slow internet can inhibit using the internet and reduce desire to partake in anything online (Cohron, 2015). Broadband connectivity is now seen as the higher end method for connecting to the internet over Digital Subscriber Line (DSL) or a dial-up connection. The reason being that Broadband internet is an "always on" connection that delivers internet content as a faster rate than other options. An “always on” internet option also leads to an increase in the amount that people use the internet (Cohron, 2015).

Over the course of the digital divide, broadband access has steadily increased from only 3% having it in the year 2000 to 70% in 2013 (Cohron, 2015). The reasons given for not owning Broadband internet is often connected to similar issues of the digital divide; people are unable to afford the cost of the service, people do not have a computer to connect to the internet at home, and people do not see the need in upgrading to a faster service (Cohron, 2015). The groups who are forgoing Broadband internet are again those who were typically have-nots in the original digital divide. Those with a lower socioeconomic status due to smaller incomes, being a minority, and being less educated, the unemployed, and the elderly often forgo the best internet connection option (Cohron, 2015). These groups of individuals will remain on the wrong side of the digital divide as they may be able to connect to the internet and other technologies but at a slower and less fulfilling manner than those who utilize high-speed Broadband internet.

Another important piece of technology to analyze in regard to the spread of access, as well as the quality of access, is the smartphone. Smartphones quickly became one of the more popular and widely available methods for people to connect to the internet (Cohron, 2015). Whereas technology ownership originally meant having a desktop computer at home, smartphones provided an opportunity for people to have a computer in their pocket at all times. Smartphones allow users to communicate with anyone anywhere by using its phone features, but it is the smart functions that have changed the world. Being able to access the internet virtually anywhere has greatly accelerated the spread and speed of information (Chen, 2015; Ngambi et al., 2016;

Tichavakunda & Tierney, 2018). Furthermore, as time has passed, multiple options ranging from expensive to affordable are generally available for smartphones so those on restricted budgets are still able to have access to smartphones (Cohron, 2015). Smartphones have helped address the access and literacy issues found originally with the digital divide (Cohron, 2015).

While there exists a powerful and useful piece of technology that most people are able to obtain, this has not solved the digital divide. In fact, as with most previous pieces of technology, a new host of issues that can widen the gap for many currently exist. The crux of the evolving digital divide is how people now utilize technology that it is so wide spread, and the use of smartphones may be the best example of this notion. Cheaper and easier access to technology like smartphones on the surface is ideal but utilizing these tools to only interact with low level experiences can expand the digital divide with those users who continue to have excellent and rich experiences with technology. Proper technology proficiency and education is required to ensure beneficial inactions with technology (Cohron, 2015).

The tools that people possess to interact with technology often vary depending on many factors, but level of income is often one of the more important ones. People have to have the financial means to purchase or use technology and one's income level can correlate to their interaction with technology. In 2016, 20% of lower income adults who were earning $30,000 a year or less only connected to the internet through use of their smartphone. This is a 12% increase from 2013 and is quite different from the small number, only 4%, of earners making over $100,000 who were smartphone only internet connectors (Bozzetto-Hollywood et al., 2018). Additionally, 67% of high earners had multiple high quality methods to connect to the internet, including a computer or laptop, a tablet, and a smartphone- all connected with a broadband internet- verses only 17% of lower income earners (Bozzetto-Hollywood et al., 2018).

With the rapid growth of smartphone ownership in the United States, analyzing who has smartphones and how they are utilizing them can illuminate current issues with the digital divide. In the case of smartphones, the original socioeconomic factors that influenced the original digital divide still have impact in regards to smartphone usage. Most people who are smartphone mostly or only internet connectors are going to be young, non-white, less educated, and with a smaller income (Cohron, 2015). While many of these mentioned factors are related through the connective umbrella that is socioeconomic status, race and ethnicity tend to stand out as a factor for smartphone ownership and usage.

Minority Americans have been leaders in having mobile access. 87% of Blacks and Hispanics own a phone compared with 80% of White Americans. Furthermore, it is more common for White people to limit usage of many of the features on a phone while minorities tend to maximize all the features and data functions that exist on phones (Graham & Choi, 2015; Smith, 2010). Research has suggested that these connections to having and using phones may be connected to the family dynamics of minorities. The primary use of these smartphones is to communicate with family members, and since minorities communicate with their nuclear and extended families more frequently than White Americans, this leads to a greater number of minorities owning phones (Graham & Choi, 2015). Once the smartphone is possessed, regardless of its initial purpose, it can provide internet access to the user.

While there are definitely many positives to this group that was often a have-not in the previous digital divide, there are potentially many issues that arise with these people possibly settling. That is only using technology that has a smaller range of features and applications than more powerful pieces of technology. Although Whites are generally considered to be haves and minorities are have-nots, this is a rare instance that, at least in regard to access, the roles are reversed (Graham & Choi, 2015). This notion is clearly demonstrated in the fact that young Black students use the internet more than young White students and 19% of White students said they go online constantly while 34% of Black students reported the same frequency (Tichavakunda & Tierney, 2018). While this increased usage of technology has resulted in positive feelings in terms of using technology, Blacks still have lower technology proficiency and ICT skills (Graham & Smith, 2011; Tichavakunda & Tierney, 2018). Therefore, as with other aspects of the digital divide, it is important to analyze how this group of people is using technology since increased access and time using technology has not increased overall skills (Tichavakunda & Tierney, 2018).

The difference could be the main piece of technology that these groups are using to connect to the internet. While the ease of using smartphones as a way to primarily connect to the internet is has benefits, it is not in the same class as using a computer to connect to the internet. Black teenagers more frequently use smartphones to connect to the internet than White teenagers (Tichavakunda & Tierney, 2018). However, White teenagers are more likely to own a computer than Black teenagers, 91% to 79% (Tichavakunda & Tierney, 2018). Some researchers have illustrated the difference between mobile devices and computer usage to the differences between snorkeling and scuba diving. Smartphones will let you see the information but it will be limited due to the software and nature of mobile technology, while computers all much more interaction and clearer viewing of the information (Watkins, 2012). While smartphones are useful for allowing information consumption, computers are superior at creating complex documents and experiences which, while potentially possible on smartphones, is much more difficult (Tichavakunda & Tierney, 2018).

Another important distinction to address is the role of social media in the lives of American youth. Social media is often used on smartphones and can account for a large amount of time that students are spending connecting to the internet. Social media has grown to have a factor in the social and emotional lives of teenagers (Tichavakunda & Tierney, 2018). These sites allow people to remain in contact with other people in their self-selected network, often consisting of friends and family members. Facebook, Instagram, Snapchat, and Twitter are some of the largest and most popular social media platforms, although there are many others (Tichavakunda & Tierney, 2018).

Black teenagers are more likely than their White counterparts to not only own a smartphone but to also to have at least two social media profiles (Tichavakunda & Tierney, 2018). This example demonstrates a manner in which having more access to smartphones and spending more time on the internet does not necessarily result in the quality internet and technology experiences needed to increase one's digital literacy. The positive and negative effects of smartphones definitely impact other major determining factors within the digital divide. Such as women are also more likely to utilize smartphones than men, but also have a lower technology proficiency much like racial minorities, while older users of technology rarely utilize mobile technology at all

(Abraham, Morn, and Vollman, 2010; Gray et al., 2016). Therefore, it is crucial to understand the possibilities and limitations of smartphones and other mobile pieces of technology. The spread of access and the positives of aspects such as social media should not be overlooked but these things still do not generally provide a deep and rich engagement with technology (Tichavakunda & Tierney, 2018).

Gender

Another aspect that has grown as technology and access has spread has been the widening gap in usage between genders. As social values, gender roles, and stereotypes effect society, certain people or groups are swayed from pursuing certain ventures. Gender usage of technology is affected by these social gender roles and therefore women are less likely to obtain a strong technical education or work in a technology intensive field (Gurung, 2018; Pande & Weide, 2012). This has led to a gender digital divide that sees technology generally associated with males, an abundance of male friendly technology, and less women in information technology lines of work (Gurung, 2018). Instead of finding ways to remove gender from the technology experience, women are often asked to adapt to a masculine culture and environment if they were to pursue technology fields or experiences (Gurung, 2018).

These gender stereotypes have led to differing usage of technology which is a key tenet of the evolving digital divide. Women and men have been found to utilize the internet and technology in differing manners. Men often use the internet for playing online video games, reading news articles, watching various media, and use smartphones more than women. Women, on the other hand, frequently engage in social media, communicating with others, online shopping, and use smartphones at a smaller rate.

(Abraham, Morn, and Vollman, 2010; Drabowicz, 2014; Gray et al., 2016). These differences are often seen even in young ages as boys and girls. Young boys are large proponents of using the internet to play online games whereas girls rarely use the internet for gaming online. Young boys often spend more time on the internet at school than young girls do (Ballesta Pagán et al., 2018). These experiences when they are younger have a role in shaping and impacting technology usage as they age into adults.

A concerning issue regarding the gender digital divide is that its effect can be seen globally. There were issues for women in both the developed and developing countries, but due to the often heavily male dominated cultures in developing areas, these women often faced different challenges in addition to the standard issues of the digital divide (Gurung, 2018). As various cultures around the world received access to technology, women were often given unequal access to technology. Depending on the differing stances and tolerances regarding gender roles, certain cultures limited the amount of access women were allowed to have to technology.

Male dominated societies often dictated that women had a different experience, if any, with technology (Gurung, 2018). In some societies, women often struggled with basic skills such as reading, as seen with literacy rates much lower than men (Malhotra, 2014), so learning technology like men was not seen as any a priority. Initially it was common that the only way these women would gain access to technology, as well as other disadvantaged groups, was through public access points like community centers or libraries (Gray et al., 2016). Part of the reason that these centers were needed is because many women in developing countries were located in remote and rural areas and much of the technology that was available was only in urban centers (Gurung, 2018). The lack of other methods for women to get online means that collectively their technology experience was devoid of any rich encounters.

Globally

As previous topics have alluded, the evolving digital divide has spread worldwide. The impact technology has had at various locals depends on a several factors. In some places, the introduction of technology is still a relative new concept so the digital divide looks closer to its original form than the evolving one. Regardless of being a developing or developed nation, there is always work that can be done to improve technology usage for everyone. Developing areas, however, tend to have many issues and a large divide due to the aforementioned factors. Often issues arise in conjunction with cultural, political, or financial situations that make technology adoption difficult (Mubarak, 2015). In addition to the specific overarching issues a developing area may encounter, the persisting signifiers of the digital divide, socioeconomic status, gender, education level, age, and other factors are still issues that must be included in determining the digital divide (Gray et al., 2016).

Location within these developing countries also plays a role in the digital divide. Just like in the United States, urban and rural locations have different access to what technology resources are actually available. Urban locations tend to have better options whereas rural locals are left with few choices. Using India as an example, some states within the country have much better access to technology than others (Mubarak, 2015). Politics can also influence the spread of technology in a developing country. Many places around the world do not have the freedom of speech mandate that the United States does. Therefore, technology and internet usage can be limited and controlled by the government at a strict level (Malhotra, 2014). While the establishment of a wider internet service, more people would have access, but too much access can be problematic for some governments. Social media and other technology allow people to communicate and share ideas quickly and often anonymously. When those ideas are counter to goals and thoughts of the current government, it can cause unrest in the country (Gray et al., 2016).

The global digital divide can have impacts on the higher education system. First-generation college students exist around the world and it is common that these students also tend to be from an underserved community (Bozzetto-Hollywood et al., 2018). Just like in the United States, this combination can easily lead to having a person who does not have sufficient technology literacy to thrive in a higher education setting without assistance (Bozzetto-Hollywood et al., 2018). In an ideal situation, the institution is going to be prepared to handle students like this but, South Africa for example, does not have an official policy on what role digital literacy has in higher education and in the learning and teaching process for their students (Ngambi et al., 2016). Without official guidance, the transition could be rough and it is likely that students will not receive optimal training with ICT while in higher education.

Education

Combining the global educational issues with the ones that exist in the United States will provide a full worldwide view of the effects the digital divide has on education. While similar to the students from Europe and many parts of the world, American students generally have copious access to technology (Bozzetto-Hollywood et al., 2018; Cohron, 2015; Huffman, 2018). However, as previously noted, this does not ensure that everyone has a positive interaction with technology. To fully explore this notion, it is important to revisit how students are being taught technology skills while in the midst of the evolving digital divide.

Elementary and secondary education has attempted to handle the major issue of the original digital divide. Computers and internet access have been incorporated into the school systems across the country with additional technology being added constantly. While a vast majority of teachers, 91%, say they have access to computers, only 20% says they have the appropriate level of technology training to teach their students (Huffman, 2018). Similarly to other parts of the world, teachers do not feel that there has been training for teachers on the technology as well as clear guidelines on the best practices for delivering information to their students, what should be taught to students at which grade, and which programs the students should be taught (Reynolds & Chiu, 2015). Infrastructure has also been brought up as an issue for teachers in the classroom. The need for faster internet connections, support structures to handle students' personal devices, the equipment to provide quality instruction in rural communities, and the ability to handle the larger demand that urban communities will bring (Huffman, 2018). There also needs to be a large enough support staff to provide training to students, teachers, and administrators on the newest technologies as well as to repair and maintain said technologies (Huffman, 2018).

As technology continues to adapt and improve, making sure students are ready for upcoming technologies and methods is one way to prepare students for a technology rich world. Extending the learning students do from inside to outside of the classroom is a feasible next step for education. Using real time problems as examples and relying on mobile technologies to all learning to take place anywhere is on the horizon for education (Chen, 2015). However, ensuring that students are going to still get the rich technology experiences outside of the classroom is a concern that is impacted by the digital divide. While teachers believe over half of their students are getting decent access to technology at school, only 18% believe they are getting adequate access at home (Huffman, 2018). This lack of consistent and deep technology interaction outside of the classroom could not only have an impact on their current education but could also impact their overall educational level when compared to their peers while attending post-secondary education.

The digital divide will reap what was sowed. The students who were impacted by the original lack of quality access due to their socioeconomic status now do not have a quality experience with technology even though access has spread. As higher education institutions continue to reach out and recruit underserved and lower socioeconomic status populations of students, there will be a need to address the weaker technology proficiency skills of these students (Bozzetto-Hollywood et al., 2018). High school students are not developing sufficient technology literacy skills and thus higher education must prepare to teach these students early in their college career for them to have a chance at success in and after college (Nataraj, 2014).

Many students planning on attending higher education do not have the technology proficiency skills needed to succeed (Bozzetto-Hollywood et al., 2018). Students who come from the roughly 20% of American households that do not have access to the internet are more likely to be first generation college students and come from lower income families. (Williams, 2017). While being first generation provides a unique set of challenges for these students (Checkoway, 2018) only 28% of them have appropriate research skills needed for college, meaning the majority of them will struggle to write college level papers (Bozzetto-Hollywood et al., 2018). Since these students did not have access at home they will also be less confident in their ICT skills and less likely to use the internet as a tool to learn with (Anderson, 2017; Bozzetto-Hollywood et al., 2018). First generation and minority students, due to their background, are strong candidates to be on the wrong side of the evolving digital divide and colleges need to be prepared to handle various levels of technological proficiency to ensure success (Bozzetto-Hollywood et al., 2018).

Additionally, in the current economic environment where higher education institutions are experiencing cuts to education and university services, schools will infuse technology into college classrooms so that more students can be taught while using fewer resources (McCabe & Meuter, 2011). One option to accomplish this that may benefit both students and institutions is increasing online education. Online classes can provide more flexibility for students while allowing the school to educate more people with potentially fewer resources (Duesbery, Brandon, Liu, & Mraun-Monegan, 2015). Depending on the type of online class there may be limited or no in person meetings which would allow the students to progress the learning on their pace. This flexibility can result in more degree being obtained by students who have full time employment or other responsibilities (Duesbery et al., 2015). As more institutions utilize online classes, it is necessary that the students have some understanding of the technology needed to succeed in an online class. The more comfortable one is with technology, the more likely they would take an online class, which could result in more freedom and options for students.

Chapter Review

This chapter focused on the origins of the digital divide and the evolution to the current digital divide. These movements and developments for higher education are crucial to better understanding the digital divide in higher education. By exploring previous research, this chapter demonstrated the connections between technology literacy and how it can impact several aspects of a person's life. By analyzing literature and data, the digital divide was discussed through several different perspectives. These perspectives have demonstrated the complexity surrounding the theoretical framework in an attempt to justify the need for additional study of the digital divide's impact in the world and within higher education. Chapter Three includes the research design, methodology, data collection, data cleansing methodology, and data analysis. Chapter Four displays the findings of the research conducted. Chapter Five is a discussion of the findings as well as recommendations for current practice.

Chapter 3

Methodology

Introduction

The author of this study will assess the theoretical framework by exploring perceived technology proficiency in American college students. This chapter will present the research questions, the design of the research, the population and sample, how data was collected, the variables, how the data was analyzed, and validity and reliability for this study.

The research questions for this study is:

What influence does the digital divide have on the technology proficiency of college students?

Eight sub-questions will help determine the answer to the overarching question.

1. What is the relationship between technology proficiency and cumulative college grade point average for students attending 2-year colleges?
2. What is the relationship between technology proficiency and cumulative college grade point average for students attending 4-year colleges?
3. What is the comparison of technology proficiency levels between students attending 2-year and 4-year institutions?
4. What is the comparison of cumulative college grade point between students attending 2-year and 4-year institutions?
5. What influence does gender have on any identified components of technology proficiency?
6. What is the relationship between technology proficiency and gender?

7. What influence does age have on any identified components of technology proficiency?
8. What is the relationship between technology proficiency and age?

Research Design

This non-experimental study utilized survey data to address questions associated with a potential digital divide in college students. Specifically, a correlational design was employed to determine the strength of the relationships that were present in the dependent variables based on student type. The rationale for choosing this method is that connections between certain relationships might be identified. The author of this study would not attempt to predict future events or causes but instead see the impact of the digital divide currently. Students who participate in the research study were asked specific questions regarding their perceived technology proficiency.

Perceived technology proficiency and demographic information were collected using a questionnaire with statements that asked the respondent to answer questions on a Likert scale. Once collected, the data will be analyzed utilizing several different methods of statistical analysis. These methods were selected as a manner to resolve the research questions. Analyzing the correlation between overall academic performance in college students with their perceived technology proficiency will illustrate how technology proficiency can influence a student’s higher education experience. Furthermore, identifying the impact individual factors that comprise technology proficiency has on college students can demonstrate how each has a role in a students’ experience. Gathering data on perceived technology proficiency regarding institution type, age, gender, and grade point average, will result in outcomes of the research questions.

This survey was replicated from a combination of computer attitude questions, computer efficacy questions, and Dr. Kathleen Smith's instrument that she used in a study analyzing college students' perceptions of aptitude and attitude toward social media technology and computer technology (Smith, 2012).

The survey had three main areas: attitude toward technology, aptitude toward technology, and a collection of demographic information. For the first section, the questionnaire sought specific answers about student aptitude regarding certain technology such as desktops, laptops, smartphones and common software including word processing, spreadsheets, e-mail, browsers, websites, web authoring, and graphic design (Smith, 2012). These technologies were randomly assigned and then presented in an ordered list, with the goal having students rank perceived knowledge with each type of technology using a Likert 5-point scale (1 = *very low knowledge* and 5 = *very high knowledge*) (Smith, 2012). The second part of the survey was a measurement to gauge student attitude toward technology. A 5-point Likert scale (1 = *do not agree, 2 = slightly disagree, 3* = neither disagree or agree, 4 = slightly agree, and and 5 = *agree*) was used to rank the students' attitudes regarding computers and technology use. The third part of this survey includes demographic and background information on the student. Specific variables that have been suggested to show the impact of the digital divide as well as other potential digital divide impact information will be asked of the student participants.

Dr. Smith's survey was adapted from The Computer Attitude Scale (CAS) which was created by Loyd and Gessler in 1984. The CAS measured attitudes towards computers by asking 30 Likert questions. Three attitudes types presented by the questions were anxiety or fear of computers, liking of computers or enjoyment working with computers, and confidence in ability to use or learn about computers (Smith, 2012). The validity of the CAS and the data collected using this instrument proved to be effective, reliable, and convenient of assessing student attitudes towards computers (Francis, Katz, & Jones, 2000; Kim, McLean, & Moon, 1994; Loyd & Gessler, 1984; Massoud, 1990).

An additional study utilized by Dr. Smith's survey was the Computer Self-Efficacy Scale (CSE) made by Murphy, Coover, and Owen in 1989 and further examined by Harrison and Rainer in 1992. The CSE consists of a 32 item, self-reporting computer self-efficacy scale that measures students' computer capabilities, knowledge, and the level of skills working with computer (Smith, 2012). The CSE reliability in each area has been shown (Harrison & Rainer, 1992; Moroz & Nash, 1997; Torkzadeh & Koufteros, 1994)

Dr. Smith modified both the CAS and the CSE to create an instrument to conduct research on student's feelings towards social media and computer technology. Dr. Smith computed the internal consistency estimates for the survey using Cronbach's Alpha, α = .89, and the subscales of technical attitude and aptitude, α = .85, as well as social attitude and aptitude, α = .74. The instrument was deemed reliable using .7 or higher as the standard of measurement (Smith, 2012).

Population & Sample

The population for this study consisted of 25 institutions strategically selected by the researcher to represent 2- and 4-year colleges and universities of various Carnegie classifications and geographic locales. The researcher had either worked at the institution or had a connection to each institution through colleagues. The institutions are presented in Table 1.

Table 1

Universities and Colleges in Initial Population

Carnegie Classification	Institution
Community Colleges	
	Cerritos College, CA
	City University of New York Bronx Community College, NY
	Collin College, TX
	Hillsborough Community College, FL
	Southwest Tennessee Community College, TN
	Spokane Falls Community College, WA
	Weatherford College, TX
Baccalaureate (Arts/Sciences & Diverse Fields)	
	Castleton State College, VT
	Central State University, OH
	Georgia Gwinnett College, GA
	Montana Tech of the University of Montana, MT
	Oregon Institute of Technology, OR
Masters	
	Appalachian State University, NC
	California Polytechnic State University, CA
	Framingham State University, MA
	Midwestern State University, TX
	Pittsburg State University, KS
	Southwest Minnesota State University, MN
Doctoral	
	University of California, Berkeley, CA
	University of Florida, FL
	University of Michigan, MI
	University of Texas, TX
	University of Vermont, VT
Private	
	Hendrix College
	Rhodes College

An open records request was made of the public institutions for the preferred e-mail address of their entire student body as of the fall 2016 census date. The request was e-mailed to the 23 institutions in mid-November 2016 with reminders sent approximately 3 weeks later. Of the institutions contacted, five provided the requested email addresses. Both private institutions agreed to participate, but required the survey be administered through a web link that their administration distributed via e-mail to their students. The final population (N = 138,612) by institution is presented in Table 2.

Table 2

Universities and Colleges in Final Population and Size for Each

Institution	Carnegie Classification	Survey Population
Weatherford College, TX	Community College	5,964 *
Appalachian State University, NC	Masters	17,782 *
Pittsburgh State University, KS	Masters	7,446 *
University of Florida, FL	Doctoral	54,678 *
University of Texas, TX	Doctoral	49,341 *
Hendrix College	Private	1,338 **
Rhodes College	Private	2,063 **

* Based on number of e-mail contacts returned
** Based on most recent IPEDS enrollment as of Fall 2015

Instrument

The researcher developed this survey to measure college students' levels of various activities associated with technology proficiency. The original instrument, adapted from Dr. Smith's survey, contained over 110 items including 97 Likert scale questions related to specific technology functions. Recognizing the considerable number of questions in the original instrument, a two-prong approach was employed to increase the efficiency of the instrument while maintaining the integrity needed to address the research questions. First, an exploratory factor analysis was conducted utilizing responses from a pilot test at two institutions with which the researcher was formerly associated. One goal of factor analysis is to maximize the variance accounted for in the dataset into the fewest number of retained components and associated questions. Once the survey was edited based upon the EFA findings, a second pilot test was conducted among a group of higher education professionals familiar with assessment techniques and aspects of information technology equipment, software, and uses.

SPSS Version 24 was employed to conduct the factor analysis utilizing a principal components extraction and Varimax rotation to generate the components matrix. The component matrix produced 97 components, one for each Likert question and accounting for 100% of the variance in the dataset. As referenced above, one goal of factor analysis is to retain the minimum number of components while optimizing the variance accounted for. Stevens (2002) provides several guidelines that can be used to determine how many components to retain: Kaiser's rule of eigenvalues >1; visual analysis of scree plots to determine the "leveling" point of components; and retaining sufficient components to account for 70% of the variance. Upon inspection of the eigenvalues and scree plot, it was determined that the first six components, which accounted for 57.848% of the variance in the data set, would be retained. While 12 additional components generated eigenvalues of greater than 1, the scree plot indicated retaining more than 6 might not be of practical worth. Figure 1 presents the findings of the scree plot.

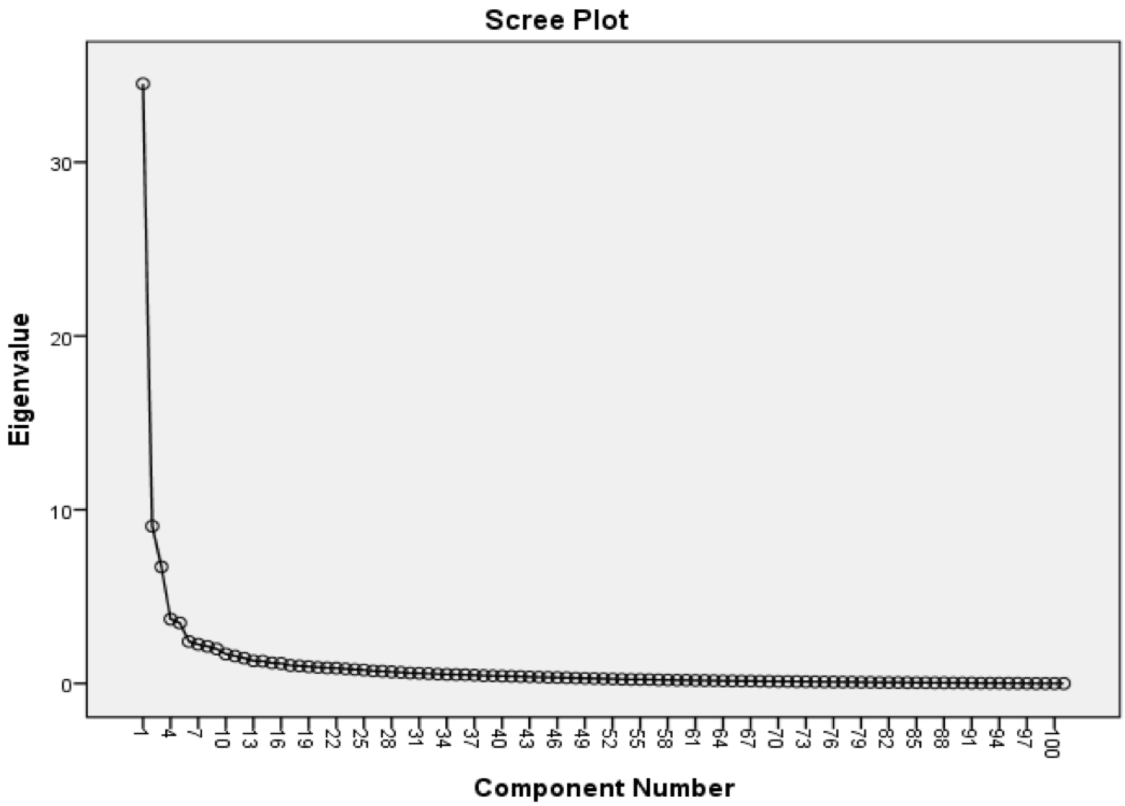

Figure 1. Scree Plot of eigenvalues and Components from Exploratory Factor Analysis

It can be seen that after the 6th point, or component, the eigenvalues as a function of the component number begin to level off.

Once the retained components were identified, the decision on which items in each component to retain was addressed. When interpreting an item's factor loading, or the correlation between each item and its corresponding component, Stevens (2002) recommends an alternative to the arbitrary standard of retaining items with a |.30| or greater value. He suggests referencing a critical value (CV) correlation coefficient based upon the sample size of the dataset. For example, with a sample size of 50, the CV is

.361 while with a sample size of 1,000, the CV is .081. It is intuitive that much like power, items from larger samples will require a lower CV to establish stronger and relevant correlations with their associated components. Stevens further suggests doubling the CV to provide for a more stringent two-tailed test thus ensuring that only questions with a robust impact are retained. With a sample of 250 on the first pilot test, the CV is .163, or .326 for a two-tailed test of item significance. Therefore, all items with a loading, or correlation coefficient, of .326 were eliminated from the survey. This resulted in reducing the Likert scale questions from 97 to 54.

The revised survey was delivered via Survey Monkey (SurveyMonkey Inc., San Mateo, CA, USA, www.surveymonkey.com) to 35 additional pilot testers employed in or associated with higher education and experienced in assessment techniques. The survey was delivered to the pilot testers along with instructions on how to provide feedback on May 14, 2016. The pilot testing closed on May 29, 2016, with 27 testers providing feedback. A review of the feedback resulted in clarifying several questions and the removal of an additional 14 Likert questions due mostly in part to redundancy with other questions. A copy of the final survey instrument and pilot test report are available in Appendices A and B respectively.

At this point, the retained components were named to represent the constructs their associated items were attempting to measure. The name components and their associated questions are presented in Table 3.

Table 3

Retained Components by Name and Associated Questions

TECHNOLOGY EFFICACY CONSTRUCT
Computers make me feel anxious I think I would do well in a computer course I feel aggressive/hostile towards computers I use computers as little as possible (recoded) I have a high level of technological efficacy
TECHNOLOGY ENGAGEMENT CONSTRUCT
I think I would enjoy working with computers I don't understand how some people enjoy spending so much time working with computers The challenge of solving problems with computers is highly applealing to me I do not enjoy discussions/chats/blogs about computers (recoded)
COMPUTER FUNCTION CONSTRUCT
Entering information onto a file Copying an individual file Attaching files to emails Using a storage device (thumbdrive, CD, etc…) Saving information onto a file Deleting files Managing electronic files/folders

Table 3 (continued)

Retained Components by Name and Associated Questions

INTERNET FUNCTION CONSTRUCT
Downloading/watching video podcasts
Utilizing social media (Facebook, Twitter, Instagram, etc.)
Downloading and/or consuming music and/or videos
Blogging
Using instant messaging
Online shopping
Playing computer games
Conducting scholarly activites (research, accessing refereed works, articles, RefWorks, Endnotes, etc..)
Locating new sources of information
TECHNOLOGY PROBLEM SOLVING CONSTRUCT
Understanding the functions of computer hardware (keyboard, monitor, etc…)
Understanding the terms/words related to computer hardware
Understanding the terms/words related to computer software
Intalling computer software
Troubleshooting computer problems
TECHNOLOGY CREATIVITY CONSTRUCT
Creating graphics (Photoshop, illustrator, etc…)
Creating Web pages (Dreamweaver, FrontPage, HTML, Java)
Using computer aided design software (AutoCAD, etc…)
Using video/audio software (Window Movie Maker, iMovie, etc..)
Creating a document (Word, Pages, etc…)
Accessing a course management system (WebCT, Blackboard, Canvas, etc…)
Creating a spreadsheet (Excel, Numbers, etc…)
Creating a presentation (PowerPoint, Keynote, etc…)

Data Collection

E-mail addresses from the participating institutions were electronically uploaded into SurveyMonkey "collectors" in blocks of 10,000 or fewer addresses. SurveyMonkey limits the number of e-mails in a single collector to 10,000 or fewer and limits the number of surveys launched per day to 20,000. Therefore, the staggered launch of 15 collectors (N = 135,211) began on February 1, 2017, and ended February 9, 2017. The initial e-mail contained an invitation to participate as well as a link to the online survey. The first page of the online survey contained additional information about the project and an informed consent where potential respondents indicated their agreement or disagreement to proceed with the survey. Second and final reminders were delivered via SurveyMonkey e-mails to non-respondents from February 10, 2017, through March 7, 2017.

An additional collector in the form of a SurveyMonkey web link was delivered to the administrators of Hendrix and Rhodes colleges on March 10, 2017. The link was distributed via e-mail to 1,338 and 2,063 students at Hendrix and Rhodes respectively. A total of 4,860 students responded to the survey for a participation rate of 3.51%. Populations, responses, and participation rates by institution are presented in Table 4.

Table 4

Survey Response Rates by Institution

Institution	Population	Responses	Participation Rate
Weatherford College	5,964 *	227	3.81%
Appalachian State	17,782 *	422	2.37%
Pittsburg State University	7,446 *	394	5.29%
University of Florida	54,678 *	1,415	2.59%
University of Texas	49,341 *	1,933	3.92%
Hendrix College	1,338 **	469 ***	13.79%
Rhodes College	2,063 **		
Total	138,612	4,860	3.51%

* Based on number of email contacts returned
** Based on most recent IPEDS enrollment as of Fall 2015
*** SurveyMonkey unable to differentiate institutions in Web link

Data Review and Cleansing

Wilkerson and the APA Task Force on Statistical Inference (1999) encourage researchers to conduct a visual inspection of their data prior to conducting statistical analysis. This is not to identify and eliminate cases that will improve the likelihood of obtaining desired outcomes, but instead to prevent spurious and/or excessive missing values from corrupting statistical analysis. A programmatic review of the raw data set identified 199 cases in which participants accepted the terms and agreement of the informed consent, then answered no further questions. These cases were removed from the data set. Next, the Likert scale responses were reviewed employing a standard cited by Downey and King (1998) in their study of replacement data methods. They discovered that mean replacement methods were effective when no more than 20% of the items were missing by case or question. A review of the remaining 4,661 cases revealed that 436 instances did not meet the 80% responses threshold. The 436 cases not meeting the 80% threshold were removed from the dataset leaving a usable sample of 4,226 cases.

Next, the self-reported grade point average was examined for values outside the acceptable converted range of 0.00 to 4.00. Participants who were first-time freshmen in college and thus did not have a college grade point average yet were asked to report their high school grade point averages on either a 100.0, 5.00, or 4.00 basis, dependent upon their high school policy. The 100.0 and 5.00 values were then converted to a 4.00 scale. SPSS was then employed to generate the range of values with those greater than 4.00 being considered erroneous self-reported values. A final review identified 118 cases greater than 4.00 that were eliminated from further analysis of grade point average.

Finally, two questions were identified as negatively worded and required recoding so that the Likert responses would agree with the remaining questions. For example, if participants were asked to respond to the question "I do not like ice cream" based on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly agree*), the responses of those who prefer ice cream would align closer with "1." If asked the question, "I eat ice cream at least twice a week," on the same scale, responses that prefer ice cream would align closer with "5." This is problematic when calculating means or indexes for constructs based on individual question responses, which was used in the present study. Therefore, the recode function of SPSS was used to invert the Likert scale responses to the following two questions: "I use computers as little as possible"; and "I do not enjoy discussions/chats/blogs about computers."

Variables of Interest

The research questions for the present study inquired about relationships and differences between various measures of perceived technology proficiency, type of institution attended, and college academic performance. The variables of interest by name, data scale, range, and abbreviation used in statistical analysis are presented in Table 5.

Table 5

Variables of Interest by Scale, Range, and Analysis Abbreviations

Variable Name	Scale	Range of Values	Abbreviation in Analysis
Technology Efficiacy Mean	ratio	1.60-5.00	TECHEFFMEAN
Technology Engagement Mean	ratio	1.00-5.00	TECHENGMEAN
Computer Functionality Mean	ratio	1.29-5.00	COMPUTERFUNCMEAN
Internet Functionality Mean	ratio	1.00-5.00	INTERNETFUNCMEAN
Technology Problem Solving Mean	ratio	1.00-5.00	TECHPROBSOLVMEAN
Technology Creativity Mean	ratio	1.00-5.00	TECHCREVATIVITYMEAN
Technology Proficiency Score	ratio	3.20-28.20	TECHPROFSCORE
2 Year Institution	nominal	2	TWOYEAR
4-Year Institution	nominal	1	FOURYEAR
Public/Private Institution	nominal	1, 2	PUBLIC.PRIVATE
Current Cum GPA	nominal	0.00-4.00	CURRGPA
Gender	nominal	0-1	Gender
Age	nominal	1-8	Age

The means for the six constructs were calculated using the Likert scale response value for each question within the construct. For example, TECHNOLOGY EFFICACY contained five questions answered on a 5-point scale (1 = *strongly disagree* and 5 = *strongly agree*). For a case answering “1” to each of the five questions, the mean score would be “1.0.” For a case answering “5” to each of the questions, the mean score would be “5.” Missing values and values of “0” associated with N/A were not included in the mean calculation.

The comprehensive score for TECHNOLOGY PROFICIENCY was a composite of the means of the six constructs. The variables 2- and 4-year and public/private institutions and gender are dichotomously coded as noted; current cumulative college grade point average is coded on an interval basis from 0.00 to 4.00. Age is divided into 8 different age groupings. The first three – 18, 19, and 20 years old, cover students on a traditional path that would be freshmen, sophomores, and juniors and college. The 21-25 age group covers students who are seniors as well as those who were on a traditional path but perhaps needed more time to complete their degree, something that has become more common in recent years. The next group, 26-30, is aimed at majority of traditional aged graduate students. While there certainty can be older or younger aged graduate students, it is assumed for this study that most graduate students would be within this range. The next group, 31-40, was aimed at collecting data from all remaining millennial generation students. The final group, over 40, was meant to capture data for student that were not a member of the millennial generation. Since there are various age ranges associated with who is in the millennial generation, selecting a group of student who was over 40 ensured by most standards that these students would be members of earlier generations.

Statistical Methods

SPSS Version 24 was employed to conduct all statistical analyses (IBM, 2016). The answers to the Likert questions from the survey were inputted into SPSS for each survey response that was suitable for the study. Descriptive statistics in the form of means, medians, and standard deviations were generated for all interval data; frequency distributions in the form of counts and percentages were generated for nominal and categorical data. Non-parametric measures of association, analysis of variance, and multivariate analysis of variance were employed to provide findings to address research questions. Specific methods to answer the research questions include using a correlation coefficient to determine the strength of the relationship between variables, examining the magnitude of the effect size between variables, performing a chi-square test, conducting ANOVAs as well as MANOVAs tests, and performing Tukey's Honestly Significant Difference (HSD) tests to analyze the data for this study.

Chapter Review

This chapter covered the research questions, the design of the research, the population and sample, how data was collected, the variables, how the data was analyzed, and validity and reliability for this study. Chapter Four displays the findings of the research conducted. Chapter Five is a discussion of the findings as well as recommendations for current practice.

Chapter 4

Findings

Introduction

This chapter will display the findings of the research conducted so as to clarify the theoretical framework, the effects of college student's perceived technology proficiency due to the digital divide. The demographic data of the sample is presented first so as to visualize the students who took the survey. This is followed by the descriptive statistics for the identified variables and the associated questions the sample. Finally, each research question will be presented with the supporting statistical analysis that was performed.

Results

The ethnicity of students by gender of the sample is presented in Table 6.

Table 6

Ethnicity by Gender of Sample

		Count	% of Gender	Count	% Within Gender
Gender (n = 4,212)					
Male		1,785	42.20%		
Ethnicity					
	American Indian/Alaska Native			9	0.50%
	Asian			274	15.40%
	Black or African American			53	3.00%
	Hispanic			226	12.70%
	Native Hawaiian/Other P.I.			1	0.01%
	Nonresident alien			19	1.10%
	White			1,053	59.00%
	Two or more races			80	4.50%
	Prefer not to answer			34	1.90%
	Unknown			5	0.30%
	Other			13	0.70%
				1,767	
Female		2,354	55.70%		
Ethnicity					
	American Indian/Alaska Native			6	0.30%
	Asian			257	10.90%
	Black or African American			101	4.30%
	Hispanic			271	11.50%
	Native Hawaiian/Other P.I.			5	0.20%
	Nonresident alien			11	0.50%
	White			1,495	63.50%
	Two or more races			111	4.70%
	Prefer not to answer			50	2.10%
	Unknown			1	0.00%
	Other			21	0.90%
				2,329	
Prefer Not to Answer		34	0.80%		
	American Indian/Alaska Native			0	0.00%
	Asian			2	5.90%
	Black or African American			1	2.90%
	Hispanic			1	2.90%
	Native Hawaiian/Other P.I.			1	2.90%
	Nonresident alien			1	2.90%
	White			9	26.50%
	Two or more races			2	5.90%
	Prefer not to answer			15	44.10%
	Unknown			0	0.00%
	Other			0	0.00%

Table 6 (continued)

Ethnicity by Gender of Sample

		Count	% of Gender	Count	% Within Gender
Other		39	0.90%		
	American Indian/Alaska Native			0	0.00%
	Asian			3	7.70%
	Black or African American			1	2.60%
	Hispanic			4	10.30%
	Native Hawaiian/Other P.I.			2	5.10%
	Nonresident alien			0	0.00%
	White			20	51.30%
	Two or more races			1	2.60%
	Prefer not to answer			0	0.00%
	Unknown			1	2.60%
	Other			7	17.90%

The remaining demographics of the sample are presented in Table 7.

Table 7

Demographic Frequency Distributions of the Sample

	Variable	Count	%
Age (n=4,220)			
	18	511	12.10%
	19	746	17.60%
	20	569	13.50%
	21-25	1,488	35.20%
	26-30	389	9.20%
	31-40	299	7.10%
	Over 40	200	4.70%
	Prefer not to answer	18	0.40%
2 or 4-Year Institution	(n = 4,159)		
	2-Year	299	7.10%
	4-Year	3,860	91.30%

Table 7 (continued)

Demographic Frequency Distributions of the Sample

	Variable	Count	%
Public or Private Institution	(n = 4,178)		
	Public	3,764	89.00%
	Private	414	9.80%
Classification	(n=4,137)		
	First Time in College/<30 SCHs	834	19.70%
	Sophomore	693	16.40%
	Junior	706	16.70%
	Senior	749	17.70%
	Graduate Student	1,049	24.80%
	Other	106	2.50%
Major (top 15)*	(n = 4,120)		
	Computer Science	228	5.40%
	Other**	207	4.90%
	Biology	187	4.40%
	Psychology	161	3.80%
	Business	148	3.50%
	Nursing	127	3.00%
	Mechanical Engineering	101	2.40%
	Biochemistry	99	2.30%
	Elect/Computer Engineering	85	2.00%
	Economics	76	1.80%
	Accounting	74	1.80%
	Chemistry	74	1.80%
	English	71	1.70%
	Civil Engineering	68	1.60%
	History	64	1.50%
Current Cummulative GPA	(n=4160)		
	0.00 - 1.00	7	0.20%
	1.01 - 2.00	28	0.70%
	2.01 - 2.50	128	3.10%
	2.51 - 3.00	492	11.80%
	3.01 - 3.50	1,194	28.60%
	3.51 - 4.00	2,319	55.60%

* Full listing of majors provided in Appendix C
** Full listing of "Other" majors provided in Appendix D

It should be noted that due to the volume of variety of responses to “Major,” only the top 15 areas of study are presented here. The complete list of “Major” as well as “Other” responses are presented in Appendices C and D respectively. High school grade point average descriptive statistics for the sample are presented in Table 8.

Table 8

Descriptive Statistics for High School Grade Point Average of the Sample

n	Range	Min	Max	M	SD	s^2
2,024	3.500	0.500	4.000	3.606	0.390	0.154

The participants were asked to provide information about the computer-related products they owned. The frequency distributions for the products owned are presented in Table 9.

Table 9

Frequency Distributions of Participants' IT Products

Participants who own:	Count	% of Sample
Computer (desktop or laptop)	4,187	99.00%
Cell phone	1,589	37.60%
Smart phone (iPhone, Android, etc…)	4,137	97.80%
Fitness tracker (Apple Watch, Fitbit, etc…)	1,154	27.30%
Gaming system (Xbox, PlayStation, etc…)	1,904	45.00%
Tablet	1,875	44.30%
eReaders	798	18.90%

Means for the survey's six constructs were obtained based on valid responses to the associated questions. The sum of these means represents the composite value of holistic technological proficiency. These values served as variables in the statistical analysis. The descriptive statistics for these variables and the associated questions are presented in Table 10.

Table 10

Frequency Distributions and Descriptive Statistics for Likert Scale Items and Associated Constructs

		1		2		3		4		5		N/A		*M**	*SD*
	n	#	%	#	%	#	%	#	%	#	%	#	%		
1=Strongly Disagree; 2=Disagree; 3=Neither; 4=Agree; 5=Strongly Agree; 0=N/A															
TECHNOLOGY EFFICACY CONSTRUCT	4,225													3.14	0.366
Computers make me feel anxious	4,225	2,223	52.60%	1,327	31.40%	423	10.00%	191	4.50%	53	1.30%	8	0.20%	1.70	0.913
I think I would do well in a computer course	4,224	114	2.70%	335	7.90%	508	12.00%	1,558	36.90%	1,698	40.20%	11	0.30%	4.04	1.041
I feel aggressive/hostile towards computers	4,224	2,736	64.80%	1,042	24.70%	294	7.00%	104	2.50%	40	0.90%	8	0.20%	1.50	0.807
I use computers as little as possible (recoded)	4,221	2,592	61.40%	1,220	28.90%	255	6.00%	116	2.70%	36	0.90%	2	0.00%	4.47	0.799
I have a high level of technological efficacy	4,220	69	1.60%	277	6.60%	666	15.80%	1,767	41.90%	1,420	33.60%	21	0.50%	3.14	0.953
TECHNOLOGY ENGAGEMENT CONSTRUCT	4,224													3.15	0.610
I think I would enjoy working with computers	4,225	158	3.70%	578	13.70%	741	17.50%	1,489	35.20%	1,247	29.50%	12	0.30%	3.73	1.135
I don't understand how some people enjoy spending so much time working with computers	4,222	1,165	27.60%	1,516	35.90%	743	17.60%	645	15.30%	140	3.30%	13	0.30%	2.31	1.128
The challenge of solving problems with computers is highly applealing to me	4,221	274	6.50%	831	19.70%	970	22.90%	1,185	28.00%	954	22.60%	7	0.20%	3.41	1.216
I do not enjoy discussions/chats/blogs about computers (recoded)	4,225	331	7.80%	983	23.30%	1,191	28.20%	1,035	24.50%	654	15.50%	31	0.70%	3.17	1.180
1=Very Low; 2=Low; 3=Average; 4=High; 5=Very High															
COMPUTER FUNCTION CONSTRUCT	4,222													4.54	0.672
Entering information onto a file	4,219	17	0.40%	54	1.30%	694	16.40%	860	20.30%	2,587	61.20%	7	0.20%	4.41	0.835
Copying an individual file	4,219	11	0.30%	54	1.30%	545	12.90%	795	18.80%	2,810	66.50%	4	0.10%	4.50	0.785
Attaching files to emails	4,211	1	0.00%	7	0.20%	289	6.90%	678	16.10%	3,235	76.80%	1	0.00%	4.70	0.602
Using a storage device (thumbdrive, CD, etc...)	4,219	23	0.50%	82	1.90%	435	10.30%	750	17.80%	2,927	69.40%	2	0.00%	4.54	0.798
Saving information onto a file	4,219	4	0.10%	26	0.60%	418	9.90%	734	17.40%	3,033	71.90%	4	0.10%	4.61	0.697
Deleting files	4,220	5	0.10%	38	0.90%	410	9.70%	734	17.40%	3,030	71.70%	3	0.10%	4.60	0.709
Managing electronic files/folders	4,215	20	0.50%	98	2.30%	574	13.60%	774	18.30%	2,745	64.90%	4	0.10%	4.45	0.847
INTERNET FUNCTION CONSTRUCT	4,224													4.05	0.745
Downloading/watching video podcasts	4,222	45	1.10%	206	4.90%	725	17.10%	916	21.70%	2,265	53.60%	65	1.50%	4.24	0.979
Utilizing social media (Facebook, Twitter, Instagram, etc.)	4,220	64	1.50%	244	5.80%	570	13.50%	830	19.60%	2,478	58.60%	34	0.80%	4.29	1.007
Downloading and/or consuming music and/or videos	4,217	28	0.70%	163	3.90%	616	14.60%	845	20.00%	2,550	60.30%	15	0.40%	4.36	0.915
Blogging	4,220	477	11.30%	884	20.90%	1,094	25.90%	620	14.70%	856	20.20%	289	6.80%	3.13	1.313
Using instant messaging	4,209	79	1.90%	176	4.20%	660	15.60%	881	20.80%	2,362	55.90%	51	1.20%	4.27	0.998
Online shopping	4,204	50	1.20%	175	4.10%	678	16.00%	928	21.90%	2,356	55.70%	17	0.40%	4.28	0.959
Playing computer games	4,201	393	9.30%	607	14.40%	883	20.90%	653	15.50%	1,513	35.80%	152	3.60%	3.56	1.370
Conducting scholarly activites (research, accessing refereed works, articles, RefWorks, Endnotes, etc.)	4,222	43	1.00%	197	4.70%	832	19.70%	1,325	31.30%	1,806	42.70%	19	0.40%	4.11	0.947
Locating new sources of information	4,216	24	0.60%	153	3.60%	831	19.70%	1,293	30.60%	1,904	45.00%	11	3.00%	4.17	0.906
TECHNOLOGY PROBLEM SOLVING CONSTRUCT	4,219													3.59	1.020
Understanding the functions of computer hardware (keyboard, monitor, etc...)	4,220	87	2.10%	257	6.10%	1,009	23.90%	1,117	26.40%	1,746	41.30%	4	0.10%	3.99	1.041
Understanding the terms/words related to computer hardware	4,221	170	4.00%	544	12.90%	1,357	32.10%	1,024	24.20%	1,119	26.50%	7	0.20%	3.56	1.130
Understanding the terms/words related to computer software	4,214	211	5.00%	695	16.40%	1,348	31.90%	947	22.40%	1,007	23.80%	6	0.10%	3.44	1.165
Intalling computer software	4,217	192	4.50%	485	11.50%	1,235	29.20%	1,034	24.50%	1,265	29.90%	6	0.10%	3.64	1.156
Troubleshooting computer problems	4,215	295	7.00%	673	15.90%	1,395	33.00%	1,039	24.60%	804	19.00%	9	0.20%	3.33	1.159
TECHNOLOGY CREATIVITY CONSTRUCT	4,223													3.51	0.701
Creating graphics (Photoshop, illustrator, etc...)	4,224	524	12.40%	1,146	27.10%	1,329	31.40%	735	17.40%	444	10.50%	46	1.10%	2.86	1.166
Creating Web pages (Dreamweaver, FrontPage, HTML, Java)	4,217	1,051	24.90%	1,458	34.50%	958	22.70%	449	10.60%	215	5.10%	86	2.00%	2.35	1.125
Using computer aided design software (AutoCAD, etc...)	4,211	1,150	27.20%	1,302	30.80%	777	18.40%	487	11.50%	329	7.80%	166	3.90%	2.39	1.239
Using video/audio software (Window Movie Maker, iMovie, etc..)	4,214	449	10.60%	863	20.40%	1,390	32.90%	891	21.10%	570	13.50%	51	1.20%	3.06	1.182
Creating a document (Word, Pages, etc...)	4,205	7	0.20%	11	0.30%	314	7.40%	876	20.70%	2,992	70.80%	5	0.10%	4.63	0.647
Accessing a course management system (WebCT, Blackboard, Canvas, etc...)	4,218	133	3.10%	189	4.50%	584	13.80%	994	23.50%	2,284	54.00%	34	0.80%	4.22	1.051
Creating a spreadsheet (Excel, Numbers, etc...)	4,222	75	1.80%	252	6.00%	864	20.40%	1,168	27.60%	1,857	43.90%	6	0.10%	4.06	1.020
Creating a presentation (PowerPoint, Keynote, etc...)	4,214	16	0.40%	49	1.20%	529	12.60%	1,182	28.00%	2,434	57.80%	4	0.10%	4.42	0.781
TECHNOLOGY PROFICIENCY COMPOSITE SCORE	4,226													21.98	3.236

* Means do not include N/A values of 0

Research Questions & Statistical Analysis

Research Question 1: What is the relationship between technology proficiency and cumulative college grade point average for students attending 2-year colleges?

A Pearson Product Moment Correlation Coefficient was generated to determine if a statistically significant relationship exists between the variables TECHPROFSCORE and CURRGPA for participants attending a 2-year college. The objective of a conducting a correlation is to observe any patterns that exist between the connections of two variables. In this instance, does perceived technology proficiency impact GPA. There can be a positive correlation suggesting that an increase in one variable will produce an increase in the other, or a negative correlation where the reverse is suggested. The correlation can range from weak to strong implicating that the stronger the connection the more each variable impacts the other one. The strength of the correlation is displayed as a correlation coefficient (r) and will have a value between -1.0 and +1.0 with the sign indicating the strength or weakness of the correlation. The correlation matrix for these two variables at a 2-year institution is presented in Table 11.

Table 11

Correlation Matrix for Technology Proficiency Composite Score and Current Cumulative GPA: 2-Year Colleges

	TECHPROFSCORE	CURRGPA
TECHPROFSCORE	1.000	0.229*
CURRGPA	0.229*	1.000

**p* < .01

The correlation between the variables was positive and moderate, ($r = .229$, $p < .01$). Therefore, the data suggests that there is a positive correlation between perceived technology proficiency and a student's GPA at 2-year institutions.

Research Question 2: What is the relationship between technology proficiency and cumulative college grade point average for students attending 4-year colleges?

A Pearson Product Moment Correlation Coefficient was generated to determine if a statistically significant relationship exists between the variables TECHPROFSCORE and CURRGPA for participants attending a 4-year college. The correlation matrix is presented in Table 12.

Table 12

Correlation Matrix for Technology Proficiency Composite Score and Current Cumulative GPA: 4-Year Colleges

	TECHPROFSCORE	CURRGPA
TECHPROFSCORE	1.000	-0.008
CURRGPA	-0.008	1.000

The correlation between the variables is negative and weak (r = -.008, p = .631). There does not appear to be a connection between perceived technology proficiency and a student's GPA at 4-year institutions.

Research Question 3: What is the comparison of technology proficiency levels between students attending 2-year and 4-year institutions?

Descriptive statistics as well as the mean differences and effect sizes in the form of Cohen's d coefficients for the six dependent variable constructs by 2- and 4-year institution are presented in Table 13.

Table 13

Descriptive Statistics for Constructs based on 2 and 4-Year Institutions

Construct	Institution Type	n	Mean	SD	Mean Diff	Cohen's *d*
TECHEFFMEAN	2-Year	299	3.119	0.406	0.026	0.070
	4-Year	3,851	3.145	0.367		
	Total	4,150	3.143	0.366		
TECHENGMEAN	2-Year	299	3.183	0.655	(0.033)	(0.054)
	4-Year	3,851	3.150	0.608		
	Total	4,150	3.153	0.608		
COMPUTERFUNCMEAN	2-Year	299	4.248	0.900	0.320	0.477
	4-Year	3,851	4.568	0.644		
	Total	4,150	4.545	0.671		
INTERNETFUNCMEAN	2-Year	299	3.867	0.893	0.205	0.277
	4-Year	3,851	4.072	0.726		
	Total	4,150	4.057	0.741		
TECHPROBSOLVMEAN	2-Year	299	3.559	1.110	0.039	0.038
	4-Year	3,851	3.597	1.010		
	Total	4,150	3.594	1.017		
TECHCREVATIVITYMEAN	2-Year	299	3.356	0.874	0.170	0.243
	4-Year	3,851	3.526	0.682		
	Total	4,150	3.514	0.699		

The Cohen's *d* effect size is calculated by dividing the mean difference on the dependent variable by the total standard deviation. As a measure of the magnitude of the difference in two means, Cohen suggested that values 0.0 to .2 be interpreted as small, .2 to .5 as medium, and .5 to .8 or greater as large (Field, 2018).

A multivariate analysis of variance (MANOVA) was conducted to determine if there was a statistically significant difference between the six dependent variable constructs representing aspects of perceived technology proficiency in 2- and 4-year institutions. A MANOVA is used for this analysis because the research question is asking to identify if the variance, or differences in answers by the respondents, is statistically different enough from each other to be significant. An ANOVA analyses the variance that exists within each dependent variable group and compares that to the variance that exist in between other group variances. If the variance is different within a group but all groups are similar with having different variance in a variable group, then the difference is probably due to the overall sample having differences and there would not be significance. If a dependent variable group's variance is different than the other groups however, that signifies that the dependent variable has an effect on the sample, resulting in an important difference. A MANOVA, in this case, is conducted over a similar ANOVA because there is more than one independent variable, in this case 2- and 4-year institutions. If the technology proficiency construct variables, or the dependent variables, were only being analyzed using the collected data from the 4-year institutions, then an ANOVA would be conducted. If there is a statistically significant difference between the variables at a 2-year and 4-year institution, that indicates that something is having an impact on these students beyond a level that would be left up to chance. For the purposes of this study, any statistically significantly difference could indicate the influence of the digital divide upon the college students.

Like the univariate equivalent ANOVA, one assumption when conducting MANOVA is equality of variances across the samples. The equality of variance assumption is how the statistical test ensures that the data being tested is similar enough to other responses so that proper analysis can occur. When the equality of variance assumption is violated, it does not mean that the results are untestable, but rather that caution must be given to any analysis made from those results. Generally the reason variances would not be equal enough for testing is that the responses collected are wildly different from each other, indicating that the sample that produced the responses differ greatly in the area they are being surveyed. In some instances, increasing the sample size could alleviate this issue since more responses can result in a larger, more uniform responses and making some responses appear more as outliers. In the case of a robust sample however, the violation of equality of variance could indicate that the sample's responses are spread out due to great differences in their levels over what they are being surveyed over.

Levene's Test of Equality of Variances is used to determine equal variances. An F statistic was generated for each construct and those with statistically significant values were deemed in violation of this assumption. In this case, Levene's Test of Equality of Variances resulted in statistically significant differences on all six dependent variables. Therefore, further interpretation of the MANOVA should be made with caution due to this violation. However, it is of interest that there was a statistically significant difference on the dependents variable constructs of Computer Functionality, Internet Functionality, and Technology Creativity between 2- and 4-year institutions. The between-subjects effects are presented in Table 14.

TABLE 14

Multivariate Analysis of Technology Proficiency Constructs by 2 and 4-Year Institutions

Construct	SS	df	Mean Square	F	sig.
TECHEFFMEAN	0.184	1	0.184	1.377	0.241
TECHENGMEAN	0.303	1	0.303	0.818	0.366
COMPUTERFUNCMEAN	28.439	1	28.439	64.138	0.000
INTERNETFUNCMEAN	11.695	1	11.695	21.400	0.000
TECHPROBSOLVMEAN	0.413	1	0.413	0.399	0.528
TECHCREVATIVITYMEAN	8.000	1	8.000	16.442	0.000

Furthermore, although the Cohen's *d* effect sizes (Table 13) were small to moderate for these three dependent variables, they could suggest the need for additional research into differences on these constructs between 2- and 4-year college students. With respect to the violation of equal variances, the perceived technology proficiency of students attending a 4-year institution is significantly higher than students at a 2-year institution in the areas regarding computer functions, internet functions, and technology creativity.

Research Question 4: What is the comparison of cumulative college grade point between students attending 2-year and 4-year institutions?

The variables associated with Research Question 4 were categorical in nature, therefore, a non-parametric analysis was conducted utilizing the chi-square statistic. The chi-square statistic compares the expected and observed frequency counts/percentages of the two variables of interest. A calculated chi-square statistic is then compared to the critical value (CV) chi-square for statistical significance. A statistically significant chi-square statistic is interpreted as the difference between the two groups on the variable of interest is due to some factor other than chance (Hinkle, Wiersma, & Jurs, 2003). The chi-square statistic comparing the CURRGPA based on 2- or 4-year institution attendance was statistically significant χ^2 (5, N = 4,155) = 20.815. The CV for 5 degrees of freedom, $p < .001$ is 20.515. The chi-square statistic for this data, 20.815, exceeded the CV, 20.515, and therefore the difference between 2- and 4-year GPA is due to something other than chance. This demonstrates that the type of institution a student attends can impact a student's GPA in college.

Research Question 5: What influence does gender have on any identified components of technology proficiency?

A multivariate analysis of variance (MANOVA) was conducted to determine if statistically significant differences exists between the six dependent technology proficiency constructs based on gender. The descriptive statistics including Cohen's *d* effect sizes for mean differences are provided in Table 15.

Table 15

Descriptive Statistics for Constructs based on Gender

Construct	Gender	n	Mean	SD	Mean Diff	Cohen's *d*
TECHEFFMEAN	Female	2,346	3.110	0.363	0.074	0.202
	Male	1,783	3.184	0.365		
	Total	4,129	3.142	0.366		
TECHENGMEAN	Female		2.987	0.593	0.385	0.632
	Male		3.372	0.559		
	Total		3.153	0.609		
COMPUTERFUNCMEAN	Female		4.457	0.707	0.197	0.294
	Male		4.654	0.605		
	Total		4.544	0.671		
INTERNETFUNCMEAN	Female		3.998	0.753	0.129	0.174
	Male		4.127	0.724		
	Total		4.055	0.743		
TECHPROBSOLVMEAN	Female		3.250	0.956	0.786	0.772
	Male		4.036	0.923		
	Total		3.593	1.019		
TECHCREVATIVITYMEAN	Female		3.433	0.700	0.180	0.257
	Male		3.613	0.689		
	Total		3.513	0.700		

As mentioned earlier, an assumption of MANOVA is equality of variances as determined by Levene's Test of Variance Equality. The analysis produced statistically significant *F* values for the constructs of COMPUTERFUNCMEAN and INTERNETFUNCMEAN indicating that the null hypothesis of non-equal variances between the groups should be rejected. Therefore, interpretation of differences in these two constructs based on the independent variable should be made with caution. However, Cohen's *d* reveals a small effect size for internet function; a small to medium effect size for technology efficacy, computer function, and technology creativity; and a medium to large effect size for technology engagement and technology problem solving.

In multivariate analysis, Wilks' λ is a measure of model statistical significance similar to the univariate *F* as seen in ANOVA and multiple regression. For the present model, gender was found to have a statistically significant effect on holistic perceived technology proficiency ($\lambda = .793$, $F(6,4122) = 179.077$, $p<.001$). The findings of the MANOVA model are presented in Table 16.

Table 16

Multivariate Analysis of Technology Proficiency Constructs by Gender

Construct	SS	df	Mean Square	F	sig.
TECHEFFMEAN	6.228	4	1.557	11.745	0.000 *
TECHENGMEAN	151.591	4	37.898	112.959	0.000 *
COMPUTERFUNCMEAN	40.394	4	10.099	22.882	0.000 **
INTERNETFUNCMEAN	18.559	4	4.640	8.464	0.000 **
TECHPROBSOLVMEAN	630.618	4	157.655	177.416	0.000 *
TECHCREVATIVITYMEAN	34.594	4	8.649	17.933	0.000 *

* *p* <.001
Note. Constructs denoted by ** violated Levene's Equality of Variance assumption; interpretations should be made with caution.

In regards to the research question, the gender of the student affected perceived technology proficiency in all six constructs. Male college students reported higher scores then females in all of the individual technology aspects in this study.

Research Question 6: What is the relationship between technology proficiency and gender?

The univariate ANOVA was utilized to determine if there was a statistically significant difference in the composite Technology Proficiency Score based on the independent variable gender. Descriptive statistics for the composite dependent variable by gender, including the Cohen's *d* effect size of the mean difference, are presented in Table 17.

Table 17

Descriptive Statistics for Technology Proficiency Score by Gender

Gender	N	Mean	SD	Mean Diff	Cohen's *d*
Female	2,354	21.209	3.185	1.773	0.549
Male	1,785	22.982	3.009		
Total	4,139	21.974	3.231		

Examining the mean values for the independent variables reveals a Cohen's value of 0.549, indicating a medium to large effect size on the mean difference. As with its' multivariate counterpart, the ANOVA also assumes variance equality across the dependent variables as tested by Levene's test statistic. For the present model, this assumption was violated as determined by a statistically significant Levene's *W statistic;* $W(1, 4137) = 4.935$, $p = .026$.

While the omnibus ANOVA generated a statistically significant model, $F(1,4137) = 329.818$, $p<.001$, $\eta^2 = .074$, further interpretation of the findings should be made cautiously due to the equality of variance violation. The omnibus ANOVA findings are displayed in Table 18.

Table 18

Analysis of Variance of Technology Proficiency Score by Gender

	Sum of Squares	df	F	sig.
Between Groups	3,190.215	1	329.818	0.000
Within Groups	40,015.738	4,137		
Total	43,205.953	4,138		

Note. Levene's test for assumption of equal variances violated.

With caution for not having equality of variances, gender impacted overall perceived technology proficiency with males demonstrating higher levels of proficiency than females.

Research Question 7: What influence does age have on any identified components of technology proficiency?

Next, a MANOVA on the six technology proficiency constructs across the dependent variable of AGE was conducted. The AGE variable was divided into the following eight intervals:

- 18 years of age
- 19 years of age
- 20 years of age
- 21-25 years of age
- 26-30 years of age
- 31-40 years of age
- Over 40 years of age
- Prefer not to answer

The data from the prefer not to answer group was not included in data analysis. The descriptive statistics for the dependent variables by AGE are presented in Table 19.

Table 19

Descriptive Statistics for Constructs based on Age

Construct	Age	n	Mean	SD
TECHEFFMEAN	18	508	3.101	0.351
	19	744	3.097	0.359
	20	567	3.117	0.350
	21-25	1,486	3.161	0.367
	26-30	389	3.208	0.365
	31-40	298	3.153	0.411
	Over 40	200	3.191	0.367
	Prefer Not to Answer	18	3.300	0.277
	TOTAL	4,210	3.142	0.366
TECHENGMEAN	18		3.102	0.603
	19		3.142	0.585
	20		3.144	0.625
	21-25		3.152	0.620
	26-30		3.222	0.613
	31-40		3.186	0.592
	Over 40		3.175	0.590
	Prefer Not to Answer		3.222	0.548
	TOTAL		3.153	0.609
COMPUTERFUNCMEAN	18		4.416	0.725
	19		4.471	0.704
	20		4.500	0.691
	21-25		4.605	0.615
	26-30		4.696	0.582
	31-40		4.602	0.675
	Over 40		4.447	0.784
	Prefer Not to Answer		4.548	0.685
	TOTAL		4.544	0.671

Table 19 (continued)

Descriptive Statistics for Constructs based on Age

Construct	Age	n	Mean	SD
INTERNETFUNCMEAN	18		4.062	0.716
	19		3.995	0.752
	20		4.069	0.732
	21-25		4.109	0.714
	26-30		4.104	0.748
	31-40		4.011	0.766
	Over 40		3.794	0.894
	Prefer Not to Answer		4.148	0.693
	TOTAL		4.055	0.743
TECHPROBSOLVMEAN	18		3.415	1.033
	19		3.446	1.005
	20		3.497	1.036
	21-25		3.653	1.015
	26-30		3.813	0.924
	31-40		3.853	0.960
	Over 40		3.624	1.066
	Prefer Not to Answer		3.700	1.050
	TOTAL		3.593	1.019
TECHCREVATIVITYMEAN	18		3.457	0.692
	19		3.500	0.686
	20		3.510	0.698
	21-25		3.558	0.677
	26-30		3.579	0.684
	31-40		3.495	0.756
	Over 40		3.276	0.830
	Prefer Not to Answer		3.595	0.653
	TOTAL		3.513	0.700

The Levene's Test of the technology proficiency constructs identified three of the six as being statistically significant: COMPUTERFUNCMEAN;

INTERNETFUNCMEAN; and TECHCREVATIVITYMEAN. As referenced earlier, a statistically significant Levene's test indicates violation of the equal variances assumption; therefore, care should be taken when interpreting the findings associated with these constructs.

The model generated a statistically significant Wilks' λ value ($\lambda = .931$, $F(48,20675) = 6.263$, $p<.001$) indicating the presence of an effect due to AGE on the six dependent constructs. The findings of the model are presented in Table 20.

Table 20

Multivariate Analysis of Technology Proficiency Constructs by Age

Construct	SS	df	Mean Square	F	sig.
TECHEFFMEAN	6.573	8	0.822	6.195	0.000 **
TECHENGMEAN	6.276	8	0.784	2.118	0.031 *
COMPUTERFUNCMEAN	32.024	8	4.003	9.021	0.000 ***
INTERNETFUNCMEAN	22.963	8	2.870	5.241	0.000 ***
TECHPROBSOLVMEAN	85.591	8	10.699	10.499	0.000 **
TECHCREVATIVITYMEAN	17.943	8	2.243	4.608	0.000 ***

* *p* <.05
***p* <.001
Note. Constructs denoted by *** violated Levene's Equality of Variance assumption; interpretations should be made with caution.

There is a statistically significant difference in all six constructs based on the independent variable of AGE; however, once again it is important to note the constructs where the equality of variance assumption was violated.

In multivariate analysis, as well as univariate, when the model produces a statistically significant difference on 3 or more means, post hoc analysis is necessary to identify on which groups the differences exists. For this analysis, Tukey's Honestly Significant Difference (HSD) was employed to identify statistically significant group differences within the constructs. The statistically significant differences between AGE intervals are presented in Table 21.

Table 21

Tukey HSD Analysis of Statistically Significant Mean Differences by Age

Construct	Mean 1	Mean 2	Mean Diff	sig.
TECHEFFMEAN	18 years	21-25 years	-0.0594	0.041
		26-30 years	-0.1067	0.000
	19 years	21-25 years	-0.0631	0.004
		26-30 years	-0.1104	0.000
		over 40 year	-0.0933	0.035
	20 years	26-30 years	-0.0912	0.005
TECHENGMEAN	NONE			
COMPUTERFUNCMEAN *	18 years	21-25 years	-0.1886	0.000
		26-30 years	-0.2797	0.000
		31-40 years	-0.1857	0.004
	19 years	21-35 years	-0.1337	0.000
		26.30 years	-0.2248	0.000
	20 years	21-25 years	-0.1048	0.039
		26-30 years	-0.1959	0.000
	21-25 years	over 40 year	0.1578	0.044
	26-30 years	over 40 year	0.2489	0.001

Note. Constructs denoted by * violated Levene's Equality of Variance assumption. Interpretations should be made with caution.

Table 21 (continued)

Tukey HSD Analysis of Statistically Significant Mean Differences by Age

Construct	Mean 1	Mean 2	Mean Diff	sig.
INTERNETFUNCMEAN *	18 years	over 40 year	0.2678	0.001
	19 years	21-25 years	-0.1137	0.018
		over 40 year	0.2013	0.019
	20 years	over 40 year	0.2748	0.000
	21-25 years	over 40 year	0.3150	0.000
	26-30 years	over 40 year	0.3130	0.000
	31-40 years	over 40 year	0.2168	0.037
TECHPROBSOLVMEAN	18 years	21-25 years	-0.2382	0.000
		26-30 years	-0.3979	0.000
		31-40 years	-0.4385	0.000
	19 years	21-25 years	-0.2069	0.000
		26-30 years	-0.3665	0.000
		31-40 years	-0.4071	0.000
	20 years	21-25 years	-0.1561	0.046
		26-30 years	-0.3157	0.000
		31-40 years	-0.3563	0.000
	21-25 years	31-40 years	-0.2002	0.047

Note. Constructs denoted by * violated Levene's Equality of Variance assumption. Interpretations should be made with caution.

Table 21 (continued)

Tukey HSD Analysis of Statistically Significant Mean Differences by Age

Construct	Mean 1	Mean 2	Mean Diff	sig.
TECHCREVATIVITYMEAN *	18 years	over 40 year	0.1811	0.049
	19 years	over 40 year	0.2244	0.002
	20 years	over 40 year	0.2343	0.001
	21-25 years	over 40 year	0.2819	0.000
	26-30 years	over 40 year	0.3030	0.000
	31-40 years	over 40 year	0.2195	0.017

Note. Constructs denoted by * violated Levene's Equality of Variance assumption. Interpretations should be made with caution.

It should be noted that while the MANOVA revealed statistically significant differences in the construct of Technology Engagement mean across AGE, Tukey's post hoc did not identify any statistically significant differences between the AGE intervals. This phenomenon is attributed to the fact that multivariate analysis determines mean differences based on the collective independent variables whereas Tukey's compares individual groups in a univariate manner. All other variables were shown to have significance and therefore suggests that one's age influences five of the six identified components that comprise perceived technology proficiency. The age group that reported higher scores fluctuates depending on the construct analyzed suggesting that different constructs are impacted by age in distinctive ways.

Research Question 8: What is the relationship between technology proficiency and age?

As with GENDER, an ANOVA was conducted on the composite Technology Proficiency Score dependent variable utilizing the independent variable of AGE. The descriptive statistics for this analysis are presented in Table 22.

Table 22

Descriptive Statistics for Technology Proficiency Score by Age

Gender	N	Mean	SD
18 years	507	21.507	3.254
19 years	733	21.611	3.206
20 years	558	21.799	3.261
21-25 years	1,452	22.217	3.162
26-30 years	385	22.613	3.022
31-40 years	293	22.317	3.296
Over 40 years	199	21.511	3.608
Prefer not to answer	11	21.856	2.323
Total	4,138	21.975	3.230

Next, examination of the Levene's Test statistic revealed the equality of variance assumption was violated across the variables. As with the previous analyses, this should be considered when reporting and/or interpreting the findings further.

The output from the statistically significant ANOVA model, is presented in Table 23.

Table 23

Analysis of Variance of Technology Proficiency Score by Age

	Sum of Squares	df	F	sig.
Between Groups	544.487	7.000	7.539	0.000
Within Groups	42,613.519	4,130.000		
Total	43,158.006	4,137.000		

Note. Levene's test for assumption of equal variances violated.

As with the multivariate analysis where AGE was the independent variable with multiple significant values, additional post hoc tests were conducted to identify on which variables the statistically significant differences occurred. The results of the Tukey HSD analysis is presented in Table 24.

Table 24

Tukey HSD Analysis of Statistically Significant Mean Differences by Age

Construct	Mean 1	Mean 2	Mean Diff	sig.
TECHNOLOGY PROFICIENCY SCORE	18 years	21-25 years	-0.710	0.001
		26-30 years	-1.106	0.000
		31-40 years	-0.810	0.014
	19 years	21-25 years	-0.606	0.001
		26-30 years	-1.003	0.000
		31-40 years	-0.707	0.032
	20 years	26-30 years	-0.814	0.003
	26-30 years	Over 40 years	1.102	0.002

There is a statistically significant difference in perceived technology proficiency and all selected age intervals but again, caution is given with analysis due to a violation of equality of variance. The data suggests that a student's overall perceived technology proficiency is affected by the age of the student.

Chapter Review

This chapter displayed the findings of the research conducted. The demographic data of the sample, the descriptive statistics for the identified variables, and the statistical analysis supporting this study were presented. Using various statistical procedures, the data collected was analyzed to assess the theoretical framework and the notion of the digital divide's current influence upon American college students. Chapter Five is a discussion of the findings as well as recommendations for current practice.

Chapter 5

Discussion & Recommendations

Introduction

The notion the theoretical framework of this study investigated was the ongoing impact of the digital divide, which is the gap that exists between people of varying technology proficiency levels. The digital divide originally existed as an access issue but as technology became more widespread it has more recently transitioned into the skills people have while using abundant forms technology. Specifically, this study explores if the digital divide has impacts on current American college students.

The research questions for this study is:

What influence does the digital divide have on the technology proficiency of college students? Eight sub-questions will help determine the answer to the overarching question.

1. What is the relationship between technology proficiency and cumulative college grade point average for students attending 2-year colleges?
2. What is the relationship between technology proficiency and cumulative college grade point average for students attending 4-year colleges?
3. What is the comparison of technology proficiency levels between students attending 2-year and 4-year institutions?
4. What is the comparison of cumulative college grade point between students attending 2-year and 4-year institutions?
5. What influence does gender have on any identified components of technology proficiency?

6. What is the relationship between technology proficiency and gender?
7. What influence does age have on any identified components of technology proficiency?
8. What is the relationship between technology proficiency and age?

As described in previous chapters, an instrument was developed to assess levels of perceived technology proficiency and distributed as a survey to college students at 2-year and 4-year institutions. The results of the survey were analyzed in the previous chapter and are now used to address the research questions.

Discussion

The first research question is addressed through the finding of a positive and moderate correlation between grade point average and perceived technology proficiency for students who attend a 2-year institution. This finding suggests a student with a higher perceived technology proficiency would also have a higher grade point average and vice versa. This notion is critical since information presented in the literature review suggests community college students are the students who would have lower technology proficiency, not only based on the fact that community colleges have a higher racial minority enrollment than 4-year institutions (Knapp, Kelly-Reid, & Ginder, 2010), but also because they have a large enrollment of students from a lower socioeconomic background (Baum & Ma, 2012; Goldrick-Rab, 2010). Since racial minorities and lower socioeconomic students have been identified as groups that typically have lower technology proficiency (Goode, 2010), this finding illustrates the need to ensure high technology proficiency for students who attend community college.

The second research question used data from students who attended 4-year institutions and looked specifically at the relationship between perceived technology proficiency and grade point average. The data indicated this is a negative and weak correlation. One reason for this may be that if students who attend 4-year institutions enter college with a higher technology proficiency than their 2-year college counterparts, then other factors have a larger impact on their success in college. Since, as discussed in the literature review, there are several benefits to students who utilize technology, students attending 4-year institutions may already be receiving these benefits and thus other factors have a greater influence on their overall performance.

The third research question explores if there is a difference in perceived technology proficiency between students who attend 2-year and 4-year institutions. These results are viewed with caution due to the violation of homogeneity of variance assumption. However, due to having statistical significance and small to moderate effect size on half of the variables, this study has at least suggested items for potential further research.

The differences on the construct variables of Computer Functionality, Internet Functionality, and Technology Creativity were found to be statistically significant between 2-year and 4-year college students. Any difference between technology proficiency between 2-year and 4-year institutions should be concerning for the reasons mentioned in previous chapters but especially in these areas. Computer Functionality involves tasks such as attaching files to e-mails, using a storage device such as a thumb drive, and managing electronic folders. Internet Functionality encompasses activities such as locating new sources of information, conducting scholarly research, and downloading video podcasts. Finally, Technology Creativity includes activities such as creating graphics, presentations or spreadsheets, and accessing a course management system such as WebCT or Blackboard.

The measured difference in these skill levels for students who attend 2-year and 4-year institutions suggests the digital divide is still present in higher education. These perceived weaker technology skills will not only impact the type of work they are able to do in college, but furthermore impact community college students' grade point averages. In addition, as mentioned in Chapter 2, weaker technology skills could impact their employability regardless of what field the student attempts to enter (Garrido et al., 2012). Ultimately, the persistence of the digital divide and the impact it can have on its students is something that will need to be addressed by institutions of higher education.

The fourth research question involves the overall grade point average of students attending 2-year and 4-year institutions and whether there is a statistically significant difference. The data analysis suggests there is a significant difference based on the type of institution a student attends. There are several factors that are outside of the scope of this study that could potentially have an impact on this result. However, recalling that there is a correlation between 2-year students' perceived technology proficiency and their grade point average, as well as significant difference on certain aspects of perceived technology proficiency among 2-year and 4-year students, technology may have an impact as well. Ultimately, a student's grade point average can have a major impact on their ability to persist throughout college and have a role in what opportunities will be available to them after college. Institutions should attempt to fill any gaps in a student's knowledge so they are able to exceed in all venues they encounter, and shrinking the digital divide would address one aspect that has the potential to have wide-ranging effects on students for their time in college and beyond.

The fifth research question looks specifically at the variables that are influenced by gender and the sixth research question analyzes the impact gender has on overall perceived technology proficiency. Problem solving, engagement, creativity, and efficacy all had medium to large effect sizes in regard to gender. While equality of variance was not met, there was still a medium to large effect with computer function and a small effect with internet function. Women in the sample were less likely to problem solve functions of a computer, less likely to use or have the skills to use the computer applications to create documents, prefer to engage less, and have more negative feelings regarding computer usage. There was also a difference with the computer and internet function variables and while analysis in regard to these two variables must be made with caution due to violation of equality of variances, there is still reason for concern. Overall perceived technology proficiency showed a significant difference but also did not meet the equal variance assumption. However, a significant difference between college males and females demonstrates that the digital divide exists between the genders within higher education. Women possessing lower technology proficiency while in college can stymie progress and advances for women once they complete higher education.

The final two research questions assessed the influences age had on certain aspects of technology proficiency as well as the overall impact of age on perceived technology proficiency. As the statistical test revealed, age was a factor with each of the dependent variables except for technology engagement. Even though Levene's test found computer function, internet function, and technology creativity in violation, these results demonstrate that age has some impact on perceived technology proficiency. This is further supported with overall perceived technology proficiency being influenced by age.

The age results could conflict with literature presented earlier in this study since in certain areas older students gave more positive responses than younger students. Referencing Table 19, students who were 26 and older consistently reported responses that were over the mean value for the constructs of Technology Efficacy, Technology Engagement, and Technology Problem Solving. This suggests that older students, on average, had more positive experiences within these constructs.

There could be several factors contributing to this seeming counter narrative of the older one becomes the less they utilize technology (Huffman, 2018). While some of these students are assuredly traditional students taking graduate level classes, some are also non-traditional and adult learners. Both can contribute towards these older learners reporting positive scores. Traditional students who have continued their education are probably benefiting from positive experiences with technology they have encountered in and outside of the classroom throughout their education journey. As for adult learners and nontraditional students, those who are willing can use technology to expand knowledge. While the increase in access to technology has not necessarily resulted in more adult learners it can improve participation levels of those who were already interested increasing their education (Eynon & Helsper, 2011). Therefore, those who have continued their education regardless of their age tend to be more willing to utilize technology to aid in their educational development.

Another perspective to analyze the age results could be through the generational lens. The age groups that were selected were primarily done to see what difference existed between freshmen, sophomores, juniors, seniors, graduate students, and adult learners/non-traditional students. Analyzing millennial student's data compared to baby boomers and generation X students could also help interpret the digital divide differently. While a previous study showed no major difference between older generations and the current one (Romero, Guitert, Sangrà, & Bullen, 2013), the current study did suggest that there are some differences. Perhaps issues of resiliency that are often mentioned with previous generations contribute to the over 40 age group reporting scores in some areas regarding perceived technology proficiency. There could be many generational defining characteristics that help adult and non-traditional learners succeed in certain areas regarding technology proficiency.

It is important to also note that in addition to technology use, internet use declined as people grew older (Huffman, 2018). The over 40 year old group did record the lowest mean score in the Internet Function construct. Therefore, even though older students may have demonstrated an affinity towards certain aspects of technology, this group could potentially still falter with general technology proficiency. Further analysis of this reveals that the three variables where older people had the lowest scores were also the three variables in violation of variance equality. This is perhaps explained with a wide range of scores that determined the lack of equality of variance originally. The multiple violations of equality of variances throughout the study indicates that the survey answers differed greatly within questions. This suggests that some taking the survey had vastly different responses from others. College student technology proficiency that varies greatly between students is another signifier that the digital divide is currently affecting higher education.

Implications for Practice

The results of the research questions illustrated that there are several different ways that the digital divide is effecting college students. While each research question did not find a significant difference, most of the data analyzed for this study indicates that the influences of digital divide is prevalent within higher education. This is concerning as higher education institutions are potentially overlooking an important skill that students will need for their lives once they complete their education. Depending on the type of institution one attends, perceived technology proficiency can influence their GPAs which can ultimately determine persistence and options after college. Furthermore, a student's personal background that they enter college with can have a major impact on their experience during and after college. Higher education should aim to ensure that regardless of school type or personal history, all students have the ability to truly succeed in the world upon completion of their education. Working towards ensuring that all students have strong technology proficiency is an additional goal colleges should aim for in producing quality students.

Both the benefits and necessity of technology indicate that proficiency should be required for anyone who is advancing their education. However, the results of this study display that students currently in college have differing levels of perceived technology proficiency and are therefore likely to leave college with differing levels as well, as there are not generally tools available to improve one's technology proficiency. Producing students with differing levels of proficiency can hinder students in their future endeavors as well as the institutions' goal of providing encompassing education and skills to their students (Bozzetto-Hollywood et al., 2018; Cohen & Kisker, 2010). Students who graduate with a degree could still struggle to pursue future opportunities because of a technology proficiency deficiency. Lack of ensuring technology proficiency could be added as another reason why higher education is seen as superfluous by some. Perhaps the largest issue with a lack of technology education in higher education is that groups that have been traditionally impacted by the effects of the digital divide will continue to be left behind technologically even though they experienced higher education. Students who experienced hardships or disadvantages upon their journey towards higher education, for example, hope that with successful completion of higher education their fortunes will improve. Without ensuring the proper technology skills for some of these students, however, the cycle of being disadvantaged could continue even with a college degree.

A student's socioeconomic status can have a long lasting impact with their relationship with technology proficiency. While originally the ability and the quality of their interaction with technology may have been the impacts of the digital divide, a college graduate's future earnings and opportunities may be impacted due to a weak technology proficiency. With technology skills being expected, desired, and required for many jobs in the future, not having strong proficiency could lead to less paying or less desired jobs for many (Kaiser, 2005; Malhotra, 2014). Ultimately this could directly impact the earning potential of weak proficiency students leading them to financially remain in a lower socioeconomic grouping. Coupling this notion with the clear effects that race and ethnicity can have upon technology proficiency illustrates the difficulties less-affluent, non-White students can encounter with trying to improve their lot in life. Even if an underserved or underrepresented student has high aptitude and achieves throughout college, having a weak technological upbringing and interaction with technology could result in an incomplete degree that does not fully serve the needs of a graduate in a technology required, post-college environment.

The perceived technology proficiency for women is also an area that higher education can work towards improving. With 57% of college students being female (Conger, 2015), ensuring that the bulk of your population has strong technology skills in a technology reliant world should be crucial. Furthermore, with the rise of emerging technology related jobs and opportunities (Garrido et al., 2012) colleges should strive to prepare their students to work in new and highly desired fields. One of the largest issues discussed in the literature regarding gender is that technology is aimed towards men (Gurung, 2018; Pande & Weide, 2012). This happens because there are not enough women involved in technology. Until there are more women who enter into a technology field, this cycle will likely continue. Higher education not only is ideally placed to address this issue, but would benefit itself and its students by providing prepared students to enter the technology field with continued proven job placement in desired fields. Eventually the cycle of technology aimed towards men would decrease, ultimately addressing a major influence of the digital divide for college students. While there have been increased efforts to have young girls and women become interested in STEM fields, having colleges address general technology proficiency for all students could also increase the overall ability and desire of females to enter into a technology field. Working towards increasing technology proficiency for women would lessen the stigma of having females be in a tech related area and over time remove a barrier that impacts women's ability to interact and grasp all aspects of technology.

Providing a useful college experience for students of any age, non-traditional and adult learners alike, will provide opportunity for those who may not have had a traditional route towards seeking education. Regardless of if the student was hindered due to poor learning environment, low socioeconomic status, or any of the several given examples that can limit traditional degree seeking, college can be the avenue for any who are dedicated to pursue higher education. However, it is imperative that regardless of one's path towards higher education, students are at least provided the tools for their potential success. As this study has clearly shown, it is unlikely that all students attending higher education will come in to their college experience with similarly levels of technology proficiency. This is not expected for areas that are deemed as educational foundational building blocks such as reading, writing, and math, but if students are deficient in those areas there are at least developmental classes available to provide the students with the skills needed to succeed. An adult learner who has decided to pursue higher education after performing the same job duties for 10 years would not currently have an equivalent class available to education them on technology at most institutions. While this person may be highly motivated and skilled, they may not have encountered any educational technology for quite some time and furthermore may only be familiar with the technology they encounter on a regular day.

This archetype of a student could have the drive to excel in college but may not be familiar with how to utilize technology that is second nature many other students. In this example, having a technological learning curve could be an additional barrier that inhibits a non-traditional learner from performing as well as they could in a class. While adult learners may be some of the more dedicated students, colleges that envision that they will be on an equal technology level as traditional students are potentially providing a pathway towards failure. It is nonsensical to assume that older students would be as familiar with technology as traditional aged college students. Depending on the age of the student, they could have received their primary and secondary education at any point in the digital divide or even before personal computing had become a reality. Furthermore, all of the initial factors of the digital divide that impact traditional students would also potentially impact non-traditional students, older students have just been affected by these aspects for longer periods of time.

Overall, there are several factors that can impact a students' technology proficiency, and the older students have been under these influences for longer periods of time than younger students. This could result in older students being better equipped to handle the difficulties they have encountered along their path towards persistence of their goals. However, it could also lead to the effects being intensified since they may be further away from a traditional learning environment, regarding technology proficiency as well as having a severe lack of basic knowledge regarding technology. As with other capacities regarding technology proficiency, there is not currently a standard for assessing where students' strengths and weaknesses lie in terms of technology proficiency. Any student could have several disadvantages suggesting they should not possess high technology proficiency, but they could thrive due to the right positive interaction that presented itself at the correct time. These positive interactions that are relevant in present day are less likely for older students considering when they were educated about and became experienced with technology, if at all. Providing opportunities for those who need or want additional technology education could not only provide students with the skills needed to succeed in and after college, but could also remove a barrier for those who would consider returning to college to further their education.

Moving forward, institutions should continue to strive toward their goal of improving students by providing enhanced education. Regarding technology, this goal should include closing the digital divide for students. Higher education is well positioned to counteract factors that expand the digital divide by implementing new policies for the future. As this study displayed previously, K-12 schools provide education opportunities for students, but the level of instruction or equipment provided often depended on the demographics of the students the school was serving (Goode, 2010). Therefore, similarly to how institutions utilize standardized testing to assess a student's education level when they are graduating from high school, a suggestion would be to administer a technology proficiency test. Incorporating this into the ACT, SAT, or exam that the community college administers to determine education level would allow the institutions to assess technology proficiency levels. Understanding a student's technological abilities as they entered college would allow the institution to see if there was a need for any additional instruction regarding technology. Community colleges have developmental classes for students who need additional instruction in math, reading, and writing, adding a developmental technology class would provide an avenue for institutions to address students with poor technology proficiency. Similarly, at most institutions it is a requirement to have certain basic subjects such as English and math passed before a student can graduate; requiring students to prove a certain level of technology proficiency would ultimately benefit the students in life after college. Furthermore, as our world becomes more reliant on technology it will become increasingly crucial that regardless of what one does in their life, having technology proficiency would be a benefit.

Another potential pathway to narrowing the digital divide gap would be to increase the resources available for K-12 education regarding technology education. As aforementioned in the literature review, this pathway needs to be taken carefully as Goode (2010) suggests it is the learning experience and not rote drills that provide better results. Simply providing the best technology to K-12 classrooms is not as important as having prepared teachers with student-focused lesson plans and high expectations for their students (Goode, 2010). Ultimately, producing and providing better-quality teachers to K-12 schools with the highest at-need students is a corridor to reducing the digital divide.

We live in a world where technology is becoming a required tool and not just a convenient skill (Garrido et al., 2012; Huffman & Huffman, 2011). Born from the lack of access, the evolving digital divide now focuses on how well one can use technology (Bozzetto-Hollywood et al., 2018; Tichavakunda & Tierney, 2018). While it may be as common to see a child playing with their parent's smartphone as it is to receive an e-mail from a senior citizen, it may be unlikely either can perform higher level tasks regarding technology.

With how rapidly technology changes, it is likely that current staples, such as e-mail and smartphones for example, become obsolete. Herein lies the true issue of the digital divide. The richer one's experience with technology, the more adaptable and comfortable one will be with new technology (Mubarak, 2015). Providing and ensuring a reliable base regarding technology by the time a student graduates from college helps prepare that student for upcoming experiences. If the digital divide persists, there will be those who will always be a step behind.

This study explored the current state of the digital divide facing selected college students. While the findings have limited generalizability due to the population and sample of the responding students, there are presently issues. With a perceived gap that currently exists, those on the wrong end of the digital divide may not fare well in the future. It is unsure if they will be able to remain competitive in future endeavors as the world continues its transition into a place where technology skills are heavily valued (Bozzetto-Hollywood et al., 2018; Mishra et al., 2015). Although not exclusively a higher education issue, colleges are in an ideal position to try and close this gap. People will continue to attend college to improve their knowledge base and gain practical skills for life after college. Incorporating technology proficiency into the curriculum will produce better-prepared students who would hopefully be able to deal with the always-changing future. The widespread usage of technology is something that will benefit everyone, but only by closing the digital divide can everyone truly take advantage.

Implications for Research

Continued exploration of the three construct variables: Computer Functionality, Internet Functionality, and Technology Creativity, is needed. A larger sample of 2-year institutions that would allow for substantiated statistical analysis would assist in concretely identifying potential differences between 2 and 4-year institutions. Additionally, expanding the survey to better distinguish between 4-year public students and 4-year private students could prove interesting. Since most of those attending 4-year private institutions tend to come from affluent and higher socioeconomic backgrounds

(Ma & Baum, 2016; The College Board, 2018), one could explore if their technology proficiency is significantly higher than 4-year public students.

Expanding the current instrument to explore additional issues impacting technology proficiency as technology continues to evolve would be beneficial. Furthermore, exploring additional socioeconomic factors such as income level, ethnicity, and additional background factors would be an interesting aspect to add to the study. Continued studies to expand the conversation regarding how students are impacted depending on their gender and age while participating in higher education can also provide a more complete viewpoint of how students are affected. While access is not considered a major issue currently (Huffman, 2018), it would be interesting to analyze one's early upbringing regarding technology to see what impact it has on present students. Also, investigating if technology proficiency had any impact on selected careers could prove useful. Surveying the career choices of students and correlating that to their technology proficiency could illuminate another aspect of the digital divide.

It is important to note that several of the groups mentioned and identified in this study have strengths identified by the literature in terms of technology proficiency. For example, students from a lower socioeconomic background may be stronger users of mobile devices. Female users spend more time online then men, although where they spend their time may not be seen as productive as the men. Older users of technology who wish to utilize it to enhance their education tend to be quite resilient throughout the learning and using of technology (Eynon & Helsper, 2011). Therefore, while this study sought to analyze the perception of technology proficiency, it is worth noting that there could be various proficiencies that prove useful in unique situations. Studying these identified aspects to not only see if this notion holds true for college students, but also if there are any positives that prove beneficial for these groups could enhance the conversation regarding technology proficiency.

Further exploring some of the suggested hindering factors that cause the digital divide could also provide some insight into technology proficiency. Analyzing if an increase in females in tech related fields is having an impact on female perceived technology proficiency could demonstrate if there are any changes to proficiency regardless of a limiting structure. Researching the positives born out of a population that is primarily relying on mobile technology, in a fast-paced world, could start new conversations about what is essential for technology proficiency. Exploring older students who may have attributes associated with tech-less generations could lead to unique ways to persist in a technology driven world for all generations. Studies on the identified structurally oppressive constructs and if they are directly leading to a continued perpetuation of weaker overall technology proficiency skills would add an important aspect to the discussion surrounding technology proficiency.

Finally, having identified three potential construct variables that demonstrate a digital divide in college students as well as the differences between genders and age groups, one could explore this issue at the K-12 level. One avenue would be to explore the difference, if any, that exists between public and private K-12 schools. Another option would be to develop an instrument to analyze the effectiveness of current technology classes for K-12 students and analyze the three construct variables that were statistically significant for college students. Expanding the survey to examine all six originally identified construct variables of Technology Efficacy, Technology

Engagement, Computer Function, Internet Function, Technology Problem Solving, and Technology Creativity, would allow the researcher to see what difference exists between K-12 students and college students regarding the current state of the digital divide.

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Appendix A

Survey

THE EVOLVED DIGITAL DIVIDE AND IMPLICATIONS FOR HIGHER EDUCATION: A QUANTITATIVE STUDY

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University of Memphis

Greetings!

You are being asked to participate in a survey related to college students' levels of technological proficiency and literacy. This assessment is part of the research associated with Mr. Brent Owens' dissertation for the doctorate of education at the University of Memphis. The population for this survey is students over the age of 18 attending various institutions of higher education in the United States.

The purpose of this research is to determine the relationship between college students' usage of technology, their level of technological proficiency, and collegiate academic success. This online survey should take approximately 30 minutes to complete. Your participation in the survey is purely voluntary and if you choose to participate, you may cease participation at any time without impunity. Furthermore, should you choose to participate, your responses will remain confidential and all data will be secured on a password protected computer housed in the office of Mr. Owens. This research has been approved by the Institutional Review Boards of the University of Memphis and the University of Texas at Arlington and the findings may be presented at a professional higher education conference or submitted for publication in a related journal.

The findings from this study could be beneficial to higher education administrators by improving access and training in technology to assist in improving student success outcomes such as academic achievement and completion. Risk associated with your participation are minimal as questions are limited to general use and expertise associated with various aspects of technology and basic demographic information such as gender, age, major, etc…

If you have questions regarding this survey, you may contact Mr. Owens at brent.owens@uta.edu or via phone at (817) 272-0552. Or, you may contact Dr. Jeffrey Wilson, Mr. Owens' faculty advisory at jlwlson4@memphis.edu or via phone at (901) 678-3428.

You will be asked to accept or reject the terms of this informed consent (below): if you accept, you will be prompted to complete the survey; if you reject the terms of the informed consent, you will be exited from the survey. Thank you in advance for your consideration of participation in this study

* I understand and accept the terms of this informed consent and wish to participate in the survey.

◯ Yes

No

Do you own a computer (desktop or laptop) ?

- Yes
- No

Which of the following electronic devices do you own? (Please mark all that apply)

- Cell phone
- Smart phone (iPhone, Android, etc...)
- Fitness tracker (Apple Watch, Fitbit, etc...)
- Gaming system (Xbox, PlayStation, etc...)
- Tablet
- eReaders

Please indicate your level of agreement with the following statements:

	Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly agree	N/A
Computers make me feel anxious						
I think I would do well in a computer course						
I feel aggressive and hostile towards computers						
I use computers as little as possible						
I have a high level of technological efficacy						

Please indicate your level of agreement with the following statements:

	Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly agree	N/A
I think I would enjoy working with computers	○	○	○	○	○	○
I don't understand how some people enjoy spending so much time working with computers	○	○	○	○	○	○
The challenge of solving problems with computers is highly appealing to me	○	○	○	○	○	○
I do not enjoy discussions/chats/blogs about computers	○	○	○	○	○	○

Please indicate your skill level in working with computer files:

	Very low	Low	Average	High	Very High	N/A
Entering information onto a file	○	○	○	○	○	○
Copying an individual file	○	○	○	○	○	○
Attaching files to emails	○	○	○	○	○	○
Using a storage device (thumbdrive, CD, etc....)	○	○	○	○	○	○
Saving information onto a file	○	○	○	○	○	○
Deleting files	○	○	○	○	○	○
Managing electronic files/folders	○	○	○	○	○	○

Please indicate your skill level in performing the following Internet tasks:

	Very low	Low	Average	High	Very high	N/A
Downloading/watching video podcasts	○	○	○	○	○	○
Utilizing social media (Facebook, Twitter, Instagram, Snapchat, etc....)	○	○	○	○	○	○
Downloading and/or consuming music and/or videos	○	○	○	○	○	○
Blogging	○	○	○	○	○	○
Using instant messaging	○	○	○	○	○	○
Online shopping	○	○	○	○	○	○
Playing computer games	○	○	○	○	○	○
Conducting scholarly activities (research, accessing refereed articles, RefWorks, Endnotes, etc...)	○	○	○	○	○	○
Locating new sources of information	○	○	○	○	○	○

Please indicate your skill level in performing the following tasks:

	Very low	Low	Average	High	Very high	N/A
Understanding the functions of computer hardware (keyboard, monitor, etc....)	◯	◯	◯	◯	◯	◯
Understanding the terms/words related to computer hardware	◯	◯	◯	◯	◯	◯
Understanding the terms/words related to computer software	◯	◯	◯	◯	◯	◯
Installing computer software	◯	◯	◯	◯	◯	◯
Troubleshooting computer problems	◯	◯	◯	◯	◯	◯

Please indicate your skill level in performing the following tasks:

	Very low	Low	Average	High	Very high	N/A
Creating graphics (Photoshop, Illustrator, etc.....)	◯	◯	◯	◯	◯	◯
Creating Web pages (Dreamweaver, FrontPage, HTML, Java, etc....)	◯	◯	◯	◯	◯	◯
Using computer aided design software (AutoCAD, etc...)	◯	◯	◯	◯	◯	◯
Using video/audio software (Window Movie Maker, iMovie, etc....)	◯	◯	◯	◯	◯	◯
Creating a document (Word, Pages, etc....)	◯	◯	◯	◯	◯	◯
Accessing a course management system (WebCT, Blackboard, CANVAS, etc....)	◯	◯	◯	◯	◯	◯
Creating a spreadsheet (Excel, Numbers, etc...)	◯	◯	◯	◯	◯	◯
Creating a presentation (PowerPoint, Keynote, etc...)	◯	◯	◯	◯	◯	◯

What is your gender?

- Female
- Male
- Prefer not to answer
- Other (please specify)

What is your age?

- 18
- 19
- 20
- 21 - 25
- 26 - 30
- 31 - 40
- Over 40
- Prefer not to answer

What is your ethnicity?

What is your current classification?

If you are a first-time in-college (FTIC) student, what was your high school grade point average (GPA)? (please enter on only 1 scale)

If your total GPA was calculated on a 4.0 scale

If your total GPA was calculated on a 5.0 scale

If your total grade was calculated on a 100 point average

What is your major?

What is your current cumulative grade point average (GPA)?

- 0.00 - 1.00
- 1.01 - 2.00
- 2.01 - 2.50
- 2.51 - 3.00
- 3.01 - 3.50
- 3.51 - 4.00

Do you currently attend a public or private college/university?

- Public
- Private

Do you currently attend a 2 year or 4 year institution?

- 2 year institution
- 4 year institution

THANK YOU FOR YOUR TIME!

Appendix B

Pilot Test

PILOT TEST SUMMARY

Prepared for Brent A. Owens by Logicas
Mentium August 5, 2016

QUESTION 1:

Do you own a computer (desktop, laptop, tablet)?

RESPONSE OPTIONS:

- Yes
- No

FEEDBACK:

Question is fine

Is ownership essential for this survey? Will there also be a question asking if they have access to a computer, even if they don't own one?

You have "tablet" as an option here and the next question; is a tablet closer to a computer or to a cell phone? (I'd argue it's a large cell phone). Consider putting tablet in one question or the other, not both.

Simple question. If one doesn't own one of the above, how could he take the survey?

Fine

Question is fine

I would split out the types of devices so you can answer yes/no to each type.

Seems straight-forward.

If you're going to list a tablet as a 'computer' then you probably also need to list smartphones

Clear, concise question.

QUESTION 2:

Which of the following electronic devices do you own? (Please mark all that apply)

RESPONSE OPTIONS:

- Cell phone
- Smart Phone (IPhone, Android, etc…)
- iWatch, Fitbit, etc…
- Electronic gaming system
- Tablet

FEEDBACK:

Do you need to add Tablet here since you already asked in the "Do you own a computer?"

Question is fine.

Once again, is there an access question regarding this later?

None?

Electronic gaming system is redundant; consider just "Gaming system (Xbox, PlayStation, etc)"

Might want to give examples of tablets

Simple Straight Forward question

Is there a need to differentiate between a cell phone and smart phone? People don't ever say where is my smart phone, they just say where is my phone. If there is a need to know then specify in parenthesis next to cell phone (not a smart phone)

Should iPad be noted as an example next to Tablet?

Would it be helpful to have an addition to this that states, "own or have regular access"? I may live in a home and have access to these items, but don't own them. Ownership might not be directly connected to use of these items.

how about none of the above as another option

In the previous question you include a tablet as a computer, but now you list it as a separate device from a computer in this question. Clarify whether a tablet is a computer or not.

Does he need to include eReaders?

IPhone is actually "iPhone"

Possibly adding an "Other" option. As we know technology continues to evolve there could be more advances when the survey is administered that you may want to capture.

Do you want to distinguish between Android and Apple? Also what about dedicated electronic readers..

iWatch? Do you mean Apple Watch? Also, should this category encompass all smart watches and fitness trackers? I would perhaps be more general in the question that way people with jawbones or other brands of smart watches would know they should check this box.

Is a tablet a computer or an electronic device?

Good question.

What about desktop or laptop computer? I see the next thing is about computer but the previous question is about all types of technology. Might want to address a match better.

QUESTION 3:

Please indicate your level of agreement with the following statements:

RESPONSE OPTIONS:

- I get a sinking feeling when I think of trying to use a computer
- Computers make me feel uncomfortable
- Computers make me feel anxious
- Working with a computer makes me very nervous
- I feel aggressive and hostile towards computers
- Using a computer would be very hard for me
- I'm not the type to do well with computers
- I'm no good with computers
- I use computers as little as possible
- I do not think I would do well in a computer course

RATING OPTIONS:

Strongly Disagree / Disagree / Neither Disagree or Agree / Agree / Strongly Agree / NA

FEEDBACK:

"I'm not the type to do well with computers I'm no good with computers Maybe just combine these 2 questions."

I'm not the type to do well with computers; I'm not the type to do well with computers Strongly disagree; I'm not the type to do well with computers Disagree; I'm not the type to do well with computers Neither disagree or agree; I'm not the type to do well with computers Agree; I'm not the type to do well with computers Strongly agree; I'm not the type to do well with computers N/A; I'm no good with computers; Maybe just ask one of these questions...."

Think about changing "sinking feeling" in the first question to apprehensive.

The statements "I'm not the type to do well with computers" and "I'm no good with computers" are redundant.

All negative...positive statements?

I perceive the first four as asking the same thing. Anxious, nervous and sinking feeling all are similar/same, unless you are extracting something about consistency in responses. Uncomfortable is also covered by those as well as the later items. "i'm not the type to do well and "i'm no good" also seem to be the same.

Might want to set this up in matrix format; Is this an existing scale? If not, I would question the use of the words "sinking feeling" as that is a colloquialism that may be regional in nature and not well understood from those outside the region

Several of the questions seem to be attempting to get the same response.
Should there be fewer questions

I would not use contractions. I am not good with computers rather than I'm no good...

There seem to be similar questions above that get at the same thing. Also, will questions be included that are of a positive nature? These seem to suggest all negative feelings towards the use of computers.

Statement 3 "anxious" and 4 "nervous" are redundant. Statement 7 needs clarification. I'm not the "type of person" or "type who does" well with computers.

too many and too similar- I would delete the "sinking feeling" as that term is seldom used, and the aggressive and hostile questions needs to be reworded - something like I dislike or hate computers is more direct.

I think the wording in some of these should be changed to "using a computer makes me feel...." or "the
propsect of using a computer makes me feel..." A computer in and of itself can not make anyone feel anything.

If the audience is college students, this question is unusual, due to the fact that almost every student now has a computer and uses it a lot. I'd be surprised if you got "Agree" and "Strongly Agree" answers.

Good questions.

In first question, it says there is a "sinking feeling". It maybe better to use a different word that clearly describes the feeling associated. "Sinking feeling" could have a different feeling with some people. 7th statement: clarification on "not the type" does that mean personality, skill level, etc.

To avoid from someone answering the same straight down..How about change some questions to the affirmative.

All seem clear.

All comments negatively worded. Might consider rewording some "I get excited when I think about trying to use a computer" and recode when creating scales. That way the reader does not just answer "strongly disagree" the whole way down and if they do, you know they did not read carefully.

Idioms are open to interpretation: sinking feeling...to what degree? Therapy has taught me that nothing can MAKE me feel. I choose my feelings. A better word choice could be: cause (Therapy can really mess with a person)

Good series, though a bit repetitive. As a reviewer I might not understand the subtle difference between each.

see above comment

QUESTION 4:

Please indicate your level of agreement with the following statements:

RESPONSE OPTIONS:

- If I have an unresolved computer problem, I continue to think about it afterwards
- Once I start to work with a computer, I find it hard to stop
- I think working with computers would be fulfilling
- I don't understand how some people enjoy spending so much time working with computers
- Figuring out computer problems does not appeal to me
- The challenge of solving problems with computers does not appeal to me
- I do not enjoy talking with others about computers
- I think I would enjoy working with computers

- When there is a problem with a computer that I can't solve, I stick with it until I have an answer

Rating Options:

Strongly Disagree / Disagree / Neither Disagree or Agree / Agree / Strongly Agree / NA

Feedback:

Do you need N/A as a choice? Everyone should have an opinion on these questions.

No recommendations

The statements "Figuring out computer problems does not appeal to me" and "The challenge of solving
problems with computers does not appeal to me" are redundant. The first statement and the last statement are redundant as well.

???? What is "working with" what does it mean?

"Figuring out computer problems" and "solving problems with computers" sound very similar at a quick read (which is what the respondents are likely doing). If the first one is getting at troubleshooting, consider using the computer interface lingo "Troubleshooting computer problems does not appeal to me". Item #1 and the last one sound very similar; if the objective is to identify consistency in answer consider phrasing them more distinctly (yet still asking the same thing).

Questions are understandable and seem meaningful

I would not use contractions

Statements 5 and 6 about resolving computer problems are redundant.

I would delete the first statement- what is an unresolved computer problem- sounds odd.

Questions/answers are fine

I would state all of the questions in the positive mode as mixing types is sometimes confusing.

Does the second statement mean that when a computer is not working, I try to find it hard to stop? Possibly need to clarify that statement a bit.

Solving problems using a computer or solving computer problems - could be stated a little clearer   Seem clear.

"I think I would enjoy working with computers" seems odd after so many questions about working with computers. Either move it to top of list, or drop it.

These questions make sense, and are well written. I believe they can capture usefull information from a wide variety of respondents.

Wouldn't it be better to go with "technological devices" than computer only because of the item about
what all the kid owns? I am seeing a mismatch.

QUESTION 5:

Please indicate your level of ability in completing the following tasks:

RESPONSE OPTIONS

- Opening a file
- Escaping/exiting from a software program
- Using the computer to write a letter/essay
- Using a printer to make a copy of your work
- Copying an individual file
- Attaching documents to emails
- Using a storage device (thumbdrive, CD, etc....)
- Entering and saving information into a file
- Using emails for communication
- Deleting files
- Organizing/managing files and folders
- Opening software programs

RATING OPTIONS:

Very Low / Low / Average / High / Very High / NA

FEEDBACK:

The question about "using a printer to make a copy of your work" seems odd. This is not clear. I would recommend rewording.

Clarify "file."

good. clear and concise.

"The scale is relative - difficult to say it's an objective quantification of the results.

-Exiting a software program -Entering and saving information onto a file

Questions are clear and understandable

On the using a storage device question, people rarely use CDs, either put DVD or external hard drive.

Not sure if these are organized in any particular fashion (i.e. easiest to hardest, etc.). Perhaps they could be presented in alpha order for clarity and to not have them random. Another idea is to put like questions together (i.e. opening software, next to escaping/exiting from software).

these are okay

Questions/answers are fine

These are all good.

Should it state level of skill vs level of ability??

What about other messaging platforms - Skype, txting, facetime, ect

I think you should make it clear you're talking about computer files in the first question.

I'm concerned about response scale here "level of ability" suggests a scale from "novice" to "expert". I think you actually want to keep the response scale intact, because it matches the items, but rephrase the question stem to ask people about their "level of confidence in completing the following tasks"

Some confusion will be genersted between "opening files" and "opening software program" possibly change the first to "opening files (word document, excel spreadsheet) and "software program (microsoft word, r studio).

An item about ability using word processing software, e.g., Google Docs, MS Word, Corel WordPerfect,
Open Office, WordPad, Abi Word, MS Works, etc.

QUESTION 6:

Please indicate your level of ability in performing the following Internet tasks:

Response Options:

- Downloading/watching video pod-casts
- Accessing online social networks (Facebook, Twitter, etc....)
- Downloading/listening to web-based music/videos
- Blogging
- Using instant messaging for communication
- Online shopping
- Playing computer games online
- Using online chat rooms
- Finding scholarly/refereed journal articles for class assignments
- Locating new sources that I find useful

Rating Options:

Very Low / Low / Average / High / Very High / NA

Feedback:

for locating sources, should this specify research sources or does it mean some other type of source?

Are the last two questions the only academic Internet tasks you are interested in measuring?

Podcasts doesn't have a hyphen.

??

on "Playing computer games online" do you mean via your computer or via your gaming system? on "Locating new sources that I find useful"...sources of what? scholarly articles was already covered, so..."

Questions are clear and understandable

Most people listen to pod-casts, I have never encountered one that you watch.

I would add video chat room and possibly a category for Skype/Facetime"

Same suggestions as last section.

these are fine

Clarify what you mean by "locating new sources" - new sources for what?

These questions are fine.

You might break down the second statement to ask about proficiency with various social media networks. For instance some student maybe more proficient using snap chap than instagram, etc.

How about using the term streaming for music and video - add using a search engine to find what I am looking for - blogging and chat rooms seem like dated terms - Podcasts doesn't have a hyphen in it.

Same comment as in previous question. Consider changing the stem to "level of confidence in performing the following tasks on the Internet" also consider changing N/A to N/A- have not done.

Blogs/Vlogs....many Deaf individuals post vlogs

The terminology now is "online forums" not chat rooms. I mention this because younger people might not understand.

Using online citation and bibliography technology like RefWorks or Endnotes

QUESTION 7:

Please indicate your level of ability in performing the following tasks:

RESPONSE OPTIONS:

- Understanding the functions of computer hardware (keyboard, monitor, etc....)
- Understanding the terms/words relating to computer hardware
- Troubleshooting computer problems
- Understanding the terms/words relating to computer software
- Installing computer software

RATING OPTIONS:

Very Low / Low / Average / High / Very High / NA

FEEDBACK:

Consider moving question three to the end of this series.

on #1, do you also want more complex components such as wifi, hard drive, etc.? #2 may need examples too...e.g. TB (Terabyte), HDMI, Router, etc.; similarly for the software terms, although there are less of these since we just download and click. Consider omitting the software terms question."

Very clear

Statements 2 and 4 change relating to related

these are ok

Questions/answers fine

These questions are fine.

See earlier comment about ability vs skill

This is vague and confusing - not sure what you are trying to identify - one who uses a keyboard should understand its function. I think the writer is trying to determine proficiency with hardware. Need to be more specific maybe. "Do you feel you can make adjustments to your monitor and keyboard?"

Clear

Again here are you after level of ability (novice to expert) or their level of understanding? If you change to level of understanding, you can remove the word "understanding" from the items, making it seem shorter.

Good section, able to show different understanding stratification.

I would put troubleshooting at the end of this list.

QUESTION 8:

Please indicate your level of ability in performing the following tasks:

RESPONSE OPTIONS:

- Creating graphics (Photoshop, Illustrator, etc.....)
- Creating Web pages (Dreamweaver, FrontPage, HTML, Java, etc....)
- Using computer aided design software (AutoCAD, etc...)
- Using video/audio software (Window Movie Maker, iMovie, etc....)
- Installing computer software
- Accessing a course management system (WebCT, Blackboard, etc....)
- Creating a spreadsheet (Excel, Numbers, etc...).
- Creating a presentation (PowerPoint, Keynote, etc...)

RATING OPTIONS:

Very Low / Low / Average / High / Very High / NA

FEEDBACK:

Ask about using Word since you asked about the other applications. How comfortable are they with creating documents?

This section of questions seems fine. However this page had three sections of questions and the previous page had one. Consider 2 sets and 2 sets?

Very clear

You might consider organizing this section and the previous sections by hardware related, software related, user related, etc.

these are ok

You have installing computer software listed again

These questions are fine.

Clarification with first two statements. For example, I maybe proficient in using Photoshop or web page software but not proficient in the actual design and creation of graphics and webpages

add CANVAS to course management - more prevalent than Blackboard

Clear

Level of comfort; I think ""installing computer software does not fit in this block. But I understand it does not really fit elsewhere, either. Maybe move to previous question?

Good section/questions.

Damn, the lack of items about word processing is starting to freak me out! Students HAVE to manage those to survive in college!

QUESTION 9:

What is your gender?

RESPONSE OPTIONS:

- Female
- Male
- Prefer not to answer
- Other (please specify)

FEEDBACK:

No recommendations

consider putting prefer not to answer at the bottom, after "other". Also, is asking them to "specify" awkward or intrusive? Unless additional information is obtained by correlating to transgender or identifying as another gender, no additional info may be needed.

No Comment

ok

Fine

Clear

Good

QUESTION 10:

What is your ethnicity?

RESPONSE OPTIONS:

- Black/African American
- Asian/Pacific Islander
- White/Caucasian
- Hispanic/Latino(a)
- Native American
- Prefer not to answer
- Other (please specify)

FEEDBACK:

No recommendations

consider putting prefer not to answer at the bottom. order of options does not seem to be "standard", i.e. in order of typicaly percentages (white, black, hispanic, asian/pacific, etc). This may not be an issue and may not need adjustment, but it reads oddly compared to what one may be used to on a demographic survey.

Might want to consider splitting this into race and ethnicity like the census does

No comment

Should the survey mimic current OMB responses to allow multiple responses and separate race from ethnicity?

If survey is going to particular students at a particular school, perhaps you could use categories that are regularly used by those students and/or school. They might already readily identify with particular ones.

ok

Fine

I would add 'Two or More' to the list.

Question confuses Race and Ethnicity - You can be White and identify with Hispanic ethnicity

Clear

I have more than one race/ethnicity. I want to check all that apply. Default: use IPEDS race categories (no separate Hispanic question) and let them check all "

Good

QUESTION 11:

What is your current classification?

Response Options:

- First time in college (FTIC) <30 semester credit hours
- Sophomore
- Junior
- Senior
- Graduate Student
- Other (please specify)

Feedback:

No recommendations

FTIC will be confusing if the student took a few classes at another institution (< 30 hours). They will then have to select "other". If you want to get at FTIC, need more specificity (maybe reference dual credit hours?) and another classification for Freshman or <30 hours of transfer credit.

I think "student classification" might make this question more specific

No comment

Should a status of "Dual Credit Student (still in high school) be added in case there is an 18 year old that
is still in high school

Similar to above, might want to give choices related to respondents institution, if possible. Harder to accomplish with students from multiple institutions.

what classification- academic status- would benefit from clarity

Fine

Graduate student - Student in a professional program (Medicine, Law)

Clear

Good

What about the 15-30 hours transfer student freshman who is not technically considered first time anymore?

QUESTION 12:

If you are a first-time in-college (FTIC) student, what was your high school grade point average (GPA)? (please enter on only 1 scale)

RESPONSE OPTIONS:

- If your total GPA was calculated on a 4.0 scale
- If your total GPA was calculated on a 5.0 scale
- If your total grade was calculated on a 100 point average

FEEDBACK:

No recommendations

Too many ifs. Start with "total."

students may be prone to error entering as phrased above. could you have two blanks for the scale questions, e.g. My GPA was on a_point scale.

The "please enter on only one scale" was a bit confusing. I might suggest a question that asks about which scale and then asks for the actual number.

Clear relevant question.

Does a response for a 40 year old attending college for the first time need to be added?

ok

Include an option that says "N/A" if you aren't a FTIC

Not that I don't have faith in my fellow man/woman, but not sure everyone will interpret "FTIC" the same way. For example, am I to interpret as this term is my FTIC, or is it the current academic year, etc.?

Drop down might be better here for data collection purposes - free form allows for too many variables - Maybe with ranges

I might restructure this a bit, ask them for their gpa (first question) then in the second question ask them if it was 4 or 5 point scale. Reduces confusion. Also making this mandatory to enter a number means lots of people will leave it blank. Can you add "I don't remember" and/or "decline to respond"

When I see the number '1', I tend to look for that number. I think it is clearer to spell 'one' or 'ONE'

Not sure if trying to draw a correlation between gpa and computer ability.

QUESTION 13:

What is your major?

FEEDBACK:

Big List :)

No recommendations

is this list taken directly from the catalog? otherwise it may be confusing.

You may have to do some manual coding after data collection on this one as the number of options is so large.

Simple question

ok

Fine

How would double majors be reported.

Clear

List undeclared at the top? Or does everyone have a major coming in?

Extensive list, might condense down to what college.

QUESTION 14

What is your current cumulative grade point average (GPA)?

RESPONSE OPTIONS:

0.00 - 1.00

1.01 - 2.00

2.01 - 2.50

2.51 - 3.00

3.01 - 3.50

3.51 - 4.00

FEEDBACK:

Students don't always know the difference in a semester GPA and a cumulative GPA.

IF letter grade matters, consider making your breakpoints at the ABCDF breaks; So 0.00-0.99, 1.00-1.99 etc, up to 3.00-3.59, 3.60 to 4.00.

You might add "on 4.00 scale".

Simple question

Might want to be more specific to include past or previous institution(s) or is it only for work completed at the present institution.

If a student takes this survey prior to the end of their first semester, this question will not apply.

ok

Fine

If the survey is sent out during the students' first semester at the institution, a cumulative gpa would not
be available. Are you wanting the gpa at the current institution only? A transfer student might report a previous gpa.

Clear

What if the student doesn't know their current GPA? (I'm just saying...what if?)

Fine.

add "at this university" or college or institution, whichever is most appropriate; gotta account for those
transfers who will do what they can to boost their egos

QUESTION 15

What is your age?

RESPONSE OPTIONS:

- 18
- 19
- 20
- 21 - 25
- 26 - 30
- 31 - 40
- Over 40
- Prefer not to answer

FEEDBACK:

Is it important to know they are 18, 19, or 20? Why not put these in an age range like the others?

ok. since age is seems to be an important demographic piece, are they allowed to "prefer not to answer"?

Is there a reason that 18,19, and 20 are set apart and not categorized?

simple question

It is possible that you could survey someone under 18 on a college campus

ok

Fine

While they probably won't get many answer over 40, I would add additional age options beyond it. The reason being is that GenXers are now over 40, and most are proficient with computers. If the highest age grouping is "over 40", you may not be able to detect differences in technological comfort with the young folks. I would give more options so you increase the likelihood of finding a difference or a notable effect size. You can always lump into the over 40 category is responses are too small for any of the older categories. Besides, 40 is the new 20. My wife doesn't buy that, but I will show her!

Some could be as young as 17 -

Clear

Good.

QUESTION 16:

Additional Comments / Suggestions about this survey?

FEEDBACK:

Overall looks pretty good. I would suggest giving the respondent an opportunity to specify any areas they may feel they need improvement that are not specifically identified on the survey.

Survey seems very thorough hitting key questions. Not too long and easy to navigate through it.

Make sure these questions are measuring how you define technological efficacy or academic success.
There could be a need on different questions based on how you operationalize of these words.

Some of the wording too simplistic (scales) some too advanced (directions) e.g., contractions used in scales, "impunity" used in consent notice.

i believe page 2 is not editable, but consider adjusting verbiage to indicate *perceived* levels of technological proficiency and literacy since it is largely "feeling" based.

No

Make it shorter

Interesting survey. Some of the questions might be addressable through some existing instruments. Not sure.

I would just suggest being mindful of the length of the survey

Good survey

I think the survey is effectively measuring the intended outcomes of technology proficiency. I think there are just a few statements that need clarification as some could interpret differently than others.

I suspect younger participants will discount this survey if some of the references are not updated - some of the language related to technology seems dated - didn't see reference to twitter or snap

None

Good survey overall.

My beef is with the missing paper writing related technology--a whole important piece of the technology to grade link is missing. Trust me, as a former community college professor who had to teach her
students how to cope with writing in other than text messages and emails (and I hear it's no better for professors in 2016), you need these items.

Appendix C

Frequency Distributions for All Reported Majors

	Frequency	Percent	Valid Percent	Cumulative Percent
ACCOUNTING	74	1.8	1.8	4.3
ADVERTISING	56	1.3	1.3	5.6
AEROSPACE ENGINEERING	47	1.1	1.1	6.7
AGRIBUSINESS	6	0.1	0.1	6.9
AGRICULTURAL COMMUNICATIONS	3	0.1	0.1	7.0
AGRONOMY	7	0.2	0.2	7.1
AMERICAN STUDIES	1	0.0	0.0	7.1
ANIMAL SCIENCE	21	0.5	0.5	7.6
ANTHROPOLOGY	26	0.6	0.6	8.3
APPLIED ARTS AND SCIENCES	2	0.0	0.0	8.3
ARABIC LANGUAGE AND LITERATURE	2	0.0	0.0	8.3
ARCHAEOLOGY	1	0.0	0.0	8.4
ARCHITECTURE	24	0.6	0.6	8.9
ART	29	0.7	0.7	9.6
ART HISTORY	10	0.2	0.2	9.9
ASIAN STUDIES	5	0.1	0.1	10.0
ASTRONOMY	8	0.2	0.2	10.2
ATHLETIC TRAINING	6	0.1	0.1	10.3
AUDIOLOGY	4	0.1	0.1	10.4
BILINGUAL EDUCATION	5	0.1	0.1	10.5
BIOCHEMISTRY	99	2.3	2.3	12.9
BIOENGINEERING	33	0.8	0.8	13.6
BIOENVIRONMENTAL SCIENCES	3	0.1	0.1	13.7
BIOLOGICAL SCIENCES	17	0.4	0.4	14.1
BIOLOGY	187	4.4	4.4	18.5
BIOSTATISTICS	2	0.0	0.0	18.6
BROADCAST JOURNALISM	2	0.0	0.0	18.6
BUSINESS	148	3.5	3.5	22.1
BUSINESS ANALYTICS	8	0.2	0.2	22.3
CHEMICAL ENGINEERING	49	1.2	1.2	23.5
CHEMISTRY	74	1.8	1.8	25.2

CIVIL ENGINEERING	68	1.6	1.6	26.8
CLASSICAL LANGUAGES	3	0.1	0.1	26.9
CLASSICAL STUDIES	3	0.1	0.1	27.0
CLINICAL MENTAL HEALTH COUNSELING	3	0.1	0.1	27.1
CLINICAL PSYCHOLOGY	1	0.0	0.0	27.1
COMMUNICATION STUDIES	57	1.3	1.3	28.4
COMMUNITY AND REGIONAL PLANNING	4	0.1	0.1	28.5
COMPUTATIONAL SCIENCE, ENGINEERING, AND MATHEMATICS	17	0.4	0.4	28.9
COMPUTER ENGINEERING	61	1.4	1.4	30.4
COMPUTER INFORMATION SYSTEMS	23	0.5	0.5	30.9
COMPUTER SCIENCE	228	5.4	5.4	36.3
CONSTRUCTION ENGINEERING	8	0.2	0.2	36.5
CONSTRUCTION SCIENCE AND MANAGEMENT	21	0.5	0.5	37.0
COUNSELING	1	0.0	0.0	37.0
COUNSELING PSYCHOLOGY	7	0.2	0.2	37.2
COUNSELOR EDUCATION	4	0.1	0.1	37.3
CREATIVE WRITING	10	0.2	0.2	37.5
CRIMINAL JUSTICE	27	0.6	0.6	38.2
CURRICULUM AND INSTRUCTION	17	0.4	0.4	38.6
DANCE	4	0.1	0.1	38.6
DATA SCIENCE	1	0.0	0.0	38.7
DENTAL HYGIENE	2	0.0	0.0	38.7
DESIGN	15	0.4	0.4	39.1
DIGITAL MEDIA STUDIES	8	0.2	0.2	39.3
DRAMA	1	0.0	0.0	39.3
EARLY CHILDHOOD	16	0.4	0.4	39.7
ECOLOGY AND EVOLUTIONARY BIOLOGY	8	0.2	0.2	39.9
ECONOMICS	76	1.8	1.8	41.7
EDUCATION FOR HEALTH CARE PROFESSIONALS	6	0.1	0.1	41.8

EDUCATION PSYCHOLOGY	6	0.1	0.1	41.9
EDUCATIONAL ADMINISTRATION	30	0.7	0.7	42.6
EDUCATIONAL HUMAN RESOURCE DEVELOPMENT	2	0.0	0.0	42.7
EDUCATIONAL LEADERSHIP	21	0.5	0.5	43.2
EDUCATIONAL PSYCHOLOGY	3	0.1	0.1	43.3
EDUCATIONAL TECHNOLOGY	26	0.6	0.6	43.9
ELECTRICAL AND COMPUTER ENGINEERING	85	2.0	2.0	45.9
ELECTRICAL AND COMPUTER ENGINEERING-ENGINEERING CIRCUIT DESIGN	4	0.1	0.1	46.0
ELECTRICAL ENGINEERING	39	0.9	0.9	46.9
ELECTRONIC MEDIA AND COMMUNICATIONS	4	0.1	0.1	47.0
ELECTRONIC SYSTEMS ENGINEERING TECHNOLOGY	5	0.1	0.1	47.1
ELEMENTARY EDUCATION	37	0.9	0.9	48.0
ENERGY	3	0.1	0.1	48.1
ENGINEERING	49	1.2	1.2	49.2
ENGINEERING MANAGEMENT	4	0.1	0.1	49.3
ENGINEERING MECHANICS	3	0.1	0.1	49.4
ENGINEERING PHYSICS	1	0.0	0.0	49.4
ENGINEERING SYSTEMS MANAGEMENT	1	0.0	0.0	49.4
ENGINEERING TECHNOLOGY 2018	2	0.0	0.0	49.5
ENGINEERING TECHNOLOGY-MANUFACTURING AND MECHANICAL ENGINEERING 2018	4	0.1	0.1	49.6
ENGLISH	71	1.7	1.7	51.3
ENTOMOLOGY	2	0.0	0.0	51.3
ENVIRONMENTAL SCIENCE	21	0.5	0.5	51.8
EPIDEMIOLOGY	1	0.0	0.0	51.8
EXERCISE AND SPORT SCIENCES	35	0.8	0.8	52.6
FAMILY AND CONSUMER SCIENCE EDUCATION	9	0.2	0.2	52.9
FINANCE	49	1.2	1.2	54.0
FINE ARTS	5	0.1	0.1	54.1
FOOD SCIENCE	2	0.0	0.0	54.2

FORENSIC AND INVESTIGATIVE SCIENCES	4	0.1	0.1	54.3
FORESTRY	1	0.0	0.0	54.3
FRENCH	6	0.1	0.1	54.4
GENERAL STUDIES	19	0.4	0.4	54.9
GENETICS	2	0.0	0.0	54.9
GEOGRAPHICAL SCIENCES	13	0.3	0.3	55.3
GEOLOGICAL SCIENCES	20	0.5	0.5	55.7
GERMAN	3	0.1	0.1	55.8
GLOBAL POLICY STUDIES	2	0.0	0.0	55.8
GOVERNMENT	28	0.7	0.7	56.5
GREEK	1	0.0	0.0	56.5
HEALTH POLICY AND MANAGEMENT	18	0.4	0.4	57.0
HIGHER EDUCATION	14	0.3	0.3	57.3
HIGHER EDUCATION-HIGHER EDUCATION RESEARCH	2	0.0	0.0	57.3
HISTORY	64	1.5	1.5	58.8
HORTICULTURE	4	0.1	0.1	58.9
HOSPITALITY AND RETAIL MANAGEMENT	3	0.1	0.1	59.0
HUMAN DEVELOPMENT AND FAMILY SCIENCES	19	0.4	0.4	59.5
HUMAN RESOURCE DEVELOPMENT	8	0.2	0.2	59.6
HUMANITIES	3	0.1	0.1	59.7
HYDROLOGY	1	0.0	0.0	59.7
INFORMATION TECHNOLOGY	16	0.4	0.4	60.1
INSTRUCTIONAL TECHNOLOGY	1	0.0	0.0	60.1
INTERDISCIPLINARY STUDIES	6	0.1	0.1	60.3
INTERIOR AND ENVIRONMENTAL DESIGN	6	0.1	0.1	60.4
INTERNATIONAL AFFAIRS	38	0.9	0.9	61.3
INTERNATIONAL BUSINESS	9	0.2	0.2	61.5
JAZZ	1	0.0	0.0	61.6
JOURNALISM	41	1.0	1.0	62.5
KINESIOLOGY	11	0.3	0.3	62.8

LANDSCAPE ARCHITECTURE	4	0.1	0.1	62.9
LANGUAGES AND CULTURES	3	0.1	0.1	63.0
LAW	40	0.9	0.9	63.9
LINGUISTICS	15	0.4	0.4	64.3
MANAGEMENT	12	0.3	0.3	64.5
MANUFACTURING ENG TECH	3	0.1	0.1	64.6
MARINE BIOLOGY	2	0.0	0.0	64.7
MARKETING	39	0.9	0.9	65.6
MASS COMMUNICATIONS	5	0.1	0.1	65.7
MATERIALS SCIENCE AND ENGINEERING	20	0.5	0.5	66.2
MATHEMATICS	59	1.4	1.4	67.6
MATHEMATICS EDUCATION	6	0.1	0.1	67.7
MECHANICAL ENGINEERING	101	2.4	2.4	70.1
MEDICINE	28	0.7	0.7	70.8
MEXICAN AMERICAN AND LATINA/O STUDIES	3	0.1	0.1	70.8
MICROBIOLOGY	24	0.6	0.6	71.4
MIDDLE EASTERN STUDIES	1	0.0	0.0	71.4
MODERN LANGUAGES	2	0.0	0.0	71.5
MOLECULAR AND CELL BIOLOGY	4	0.1	0.1	71.6
MUSEUM SCIENCE	3	0.1	0.1	71.6
MUSIC	51	1.2	1.2	72.8
NATURAL RESOURCES MANAGEMENT	1	0.0	0.0	72.9
NEUROSCIENCE	45	1.1	1.1	73.9
NUCLEAR ENGINEERING	7	0.2	0.2	74.1
NURSE PRACTITIONER	8	0.2	0.2	74.3
NURSING	127	3.0	3.0	77.3
NUTRITION	24	0.6	0.6	77.9
OCCUPATIONAL SAFETY AND HEALTH	1	0.0	0.0	77.9
ORTHODONTICS	2	0.0	0.0	77.9
Other (please specify)	207	4.9	4.9	82.8
PETROLEUM ENGINEERING	7	0.2	0.2	83.0
PHARMACEUTICAL SCIENCES	35	0.8	0.8	83.8

PHILOSOPHY	13	0.3	0.3	84.1
PHYSICS	58	1.4	1.4	85.5
PLANT AND ENVIRONMENTAL SOIL SCIENCE	1	0.0	0.0	85.5
POLITICAL SCIENCE	60	1.4	1.4	86.9
PSYCHOLOGY	161	3.8	3.8	90.8
PSYCHOLOGY-CLINICAL PSYCHOLOGY	17	0.4	0.4	91.2
PUBLIC ADMINISTRATION	5	0.1	0.1	91.3
PUBLIC HEALTH	32	0.8	0.8	92.0
PUBLIC POLICY	12	0.3	0.3	92.3
PUBLIC RELATIONS	26	0.6	0.6	92.9
RADIO/TELEVISION/FILM	26	0.6	0.6	93.5
RECREATION, PARK AND TOURISM SCIENCES	10	0.2	0.2	93.8
RELIGIOUS STUDIES	15	0.4	0.4	94.1
RHETORIC AND WRITING	5	0.1	0.1	94.3
RUSSIAN, EAST EUROPEAN, AND EURASIAN STUDIES	1	0.0	0.0	94.3
SAFETY ENGINEERING	1	0.0	0.0	94.3
SCHOOL PSYCHOLOGY	3	0.1	0.1	94.4
SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION	10	0.2	0.2	94.6
SECONDARY EDUCATION	5	0.1	0.1	94.7
SOCIAL WORK	34	0.8	0.8	95.5
SOCIOLOGY	42	1.0	1.0	96.5
SOFTWARE ENGINEERING	2	0.0	0.0	96.6
SPANISH	11	0.3	0.3	96.8
SPECIAL EDUCATION	26	0.6	0.6	97.4
SPORT MANAGEMENT	9	0.2	0.2	97.7
STATISTICS	7	0.2	0.2	97.8
STUDIO ART	4	0.1	0.1	97.9
SYSTEMS AND ENGINEERING MANAGEMENT	2	0.0	0.0	98.0
TECHNICAL COMMUNICATION	1	0.0	0.0	98.0
TEXTILES AND APPAREL	4	0.1	0.1	98.1
THEATRE	17	0.4	0.4	98.5
TRANSLATIONAL SCIENCE	1	0.0	0.0	98.5

TURFGRASS SCIENCE	2	0.0	0.0	98.6
UNIVERSITY STUDIES	9	0.2	0.2	98.8
URBAN AND REGIONAL PLANNING	18	0.4	0.4	99.2
VETERINARY MEDICINE	19	0.4	0.4	99.6
VISUAL ART STUDIES	3	0.1	0.1	99.7
WILDLIFE AND FISHERIES SCIENCES	7	0.2	0.2	99.9
WOMEN'S AND GENDER STUDIES	1	0.0	0.0	99.9
WRITING	1	0.0	0.0	99.9
ZOOLOGY	3	0.1	0.1	100.0

Appendix D

Frequency Distribution of All Majors Listed as "Other"

	Frequency	Percent	Valid Percent	Cumulative Percent
Accounting and economics	1	0.0	0.0	95.1
Agricultural extension education	1	0.0	0.0	95.2
Agriculture Education	1	0.0	0.0	95.2
Agriculture Operations Management	1	0.0	0.0	95.2
Apparel Design and Merchandising	1	0.0	0.0	95.2
Applied physiology and kinesiology	1	0.0	0.0	95.2
Applied Physiology and Kinesiology	1	0.0	0.0	95.3
Appropriate Technology	1	0.0	0.0	95.3
Art and Entertainment Technologies	1	0.0	0.0	95.3
Art and Entertainment Technology	1	0.0	0.0	95.3
Arts and Entertainment Technologies	3	0.1	0.1	95.4
Arts and Entertainment Technology (animation, video games development)	1	0.0	0.0	95.4
auto tech	1	0.0	0.0	95.5
Automotive Technology	3	0.1	0.1	95.5
Biochemistry/Molecular Biology	1	0.0	0.0	95.6
Biology and Educational Studies	1	0.0	0.0	95.6
Biomathematics	1	0.0	0.0	95.6
Biomedical engineering	2	0.0	0.0	95.6

Biomedical Engineering	2	0.0	0.0	95.7
Biomedical informatics	1	0.0	0.0	95.7
Building Science	1	0.0	0.0	95.7
Business & Anthropology	1	0.0	0.0	95.8
Career and Technical Teaching with an emphasis in Technology Education	1	0.0	0.0	95.8
Chemistry/ Biochemistry Double Major	1	0.0	0.0	95.8
Child Development	2	0.0	0.0	95.9
Christian Studies	1	0.0	0.0	95.9
Cognitive Neuroscience	1	0.0	0.0	95.9
Commercial Photography	1	0.0	0.0	95.9
Communication Science & Disorders	1	0.0	0.0	96.0
Communication Sciences & Disorders	1	0.0	0.0	96.0
Communication sciences and disorders	1	0.0	0.0	96.0
Communication Sciences and Disorders	4	0.1	0.1	96.1
Computer Science and English	1	0.0	0.0	96.1
Computer Science Biomathematics double major	1	0.0	0.0	96.1
Computer Science Engineering	1	0.0	0.0	96.2
Criminology	1	0.0	0.0	96.2
Criminology and Law	1	0.0	0.0	96.2
CTE	1	0.0	0.0	96.2
Curriculum and Instruction Education	1	0.0	0.0	96.3
Dentistry	1	0.0	0.0	96.3

Diagnostic Medical Sonography	1	0.0	0.0	96.3
Doctorate of Pharmacy Student	1	0.0	0.0	96.3
Double major with music and natural resource conservation	1	0.0	0.0	96.4
Double Major- Spanish & Physics	1	0.0	0.0	96.4
Double Major: Health Sciences and Psychology	1	0.0	0.0	96.4
Early Childhood Education	1	0.0	0.0	96.4
Education- Urban Teaching	1	0.0	0.0	96.5
Education: Curriculum, Teaching, Teacher Education	1	0.0	0.0	96.5
Emergency Management	1	0.0	0.0	96.5
Emergency medicine	1	0.0	0.0	96.5
environmental studies	1	0.0	0.0	96.5
Environmental Studies	1	0.0	0.0	96.6
Event management	1	0.0	0.0	96.6
Exercise Science	1	0.0	0.0	96.6
Extension education	1	0.0	0.0	96.6
Family, Youth, and Community Science	1	0.0	0.0	96.7
Fermentation Sciences	1	0.0	0.0	96.7
Fire and Emergency Services Management	1	0.0	0.0	96.7
Fire Science and Technology	1	0.0	0.0	96.7
Fisheries & Aquatic Sciences	1	0.0	0.0	96.8
Fisheries Science	1	0.0	0.0	96.8
French and Japanese	1	0.0	0.0	96.8

Game Development and Information Technology	1	0.0	0.0	96.8
Geomatics	1	0.0	0.0	96.9
Geomatics	1	0.0	0.0	96.9
Graphic communication	1	0.0	0.0	96.9
Graphic communications	1	0.0	0.0	96.9
Graphic Communications	3	0.1	0.1	97.0
Graphic Communications - Graphic Design	1	0.0	0.0	97.0
Graphic Design	2	0.0	0.0	97.1
Health Education	1	0.0	0.0	97.1
Health Education and Behavior	4	0.1	0.1	97.2
Health Promotion	2	0.0	0.0	97.3
Health science	2	0.0	0.0	97.3
Health Science	2	0.0	0.0	97.4
Health Sciences	1	0.0	0.0	97.4
Hospitality and tourism management	1	0.0	0.0	97.4
Industrial and Systems Engineering	1	0.0	0.0	97.4
Information studies	1	0.0	0.0	97.4
Information Studies	3	0.1	0.1	97.5
Information Studies: HCI	1	0.0	0.0	97.5
Laboratory technician	1	0.0	0.0	97.6
Library and Information Science	1	0.0	0.0	97.6
Library Science	1	0.0	0.0	97.6
Management Information Systems	1	0.0	0.0	97.6
Master in sustainable development practice	1	0.0	0.0	97.7

Media science	1	0.0	0.0	97.7
Media Studies (ie Cultural Studies)	1	0.0	0.0	97.7
Medical Laboratory Science	3	0.1	0.1	97.8
Medical Physics	1	0.0	0.0	97.8
Medical Technology	1	0.0	0.0	97.8
Ms sustainable design	1	0.0	0.0	97.8
MSIS - Information Science	1	0.0	0.0	97.9
Music education	1	0.0	0.0	97.9
Music Education	1	0.0	0.0	97.9
Natural science undeclared	1	0.0	0.0	97.9
Neuroscience & Religious Studies double major	1	0.0	0.0	98.0
Neuroscience and Psychology double major	1	0.0	0.0	98.0
Occupational Therapy	1	0.0	0.0	98.0
Pharmacy	3	0.1	0.1	98.1
PharmD	1	0.0	0.0	98.1
Photography	1	0.0	0.0	98.1
Physical education	1	0.0	0.0	98.2
physical education teacher education	1	0.0	0.0	98.2
Physical therapist assistant	1	0.0	0.0	98.2
Physical Therapist Assistant	1	0.0	0.0	98.2
physical therapy	1	0.0	0.0	98.2
Physics	1	0.0	0.0	98.3
Physics and Creative Writing	1	0.0	0.0	98.3
Plan II Honors and Sustainability Studies	1	0.0	0.0	98.3

Plant Science (Plant Genetics Specialization)	1	0.0	0.0	98.3
Plastics engineering technology	1	0.0	0.0	98.4
Political Economy, Public Policy	1	0.0	0.0	98.4
Radiology	1	0.0	0.0	98.4
Radiology Technology	1	0.0	0.0	98.4
Reading Education	1	0.0	0.0	98.5
Recreation Management and Spanish Double Major	1	0.0	0.0	98.5
Risk Managemnt & Insurance	1	0.0	0.0	98.5
Spanish Education	1	0.0	0.0	98.5
Speech-Language Pathology	2	0.0	0.0	98.6
Sustainability	1	0.0	0.0	98.6
sustainability and the built environment	1	0.0	0.0	98.6
Sustainability Studies	1	0.0	0.0	98.7
Sustainable agricultural	1	0.0	0.0	98.7
Sustainable Development	2	0.0	0.0	98.7
Sustainable Development with a concentration in Environmental Studies	1	0.0	0.0	98.7
Sustainable Technology	2	0.0	0.0	98.8
Technology - conc. Sustainable Design & Construction, Building Science	1	0.0	0.0	98.8

Technology Commercialization	1	0.0	0.0	98.8
Telecommunications	2	0.0	0.0	98.9
Tourism	1	0.0	0.0	98.9
Tourism and Hospitality	1	0.0	0.0	98.9
Translational Science	1	0.0	0.0	99.0
undecided	5	0.1	0.1	99.1
Undecided	8	0.2	0.2	99.3
undecided (most likely biochemistry or sociology)	1	0.0	0.0	99.3
Undecidied	1	0.0	0.0	99.3
undeclared	1	0.0	0.0	99.3
Undeclared	14	0.3	0.3	99.7
Undeclared (Pre-Pharmacy)	1	0.0	0.0	99.7
Undeclared (UGS)	1	0.0	0.0	99.7
Undeclared but want to go into Mechanical Engineering	1	0.0	0.0	99.7
undeclared wanting to transfer to mechanical	1	0.0	0.0	99.8
undeclared, liberal arts	1	0.0	0.0	99.8
Undeclared, Transferring to math	1	0.0	0.0	99.8
Undeclared/Pre-Pharmacy	1	0.0	0.0	99.8
Undergraduate Studies	1	0.0	0.0	99.9
Undetermined	1	0.0	0.0	99.9
Urban Studies	2	0.0	0.0	99.9
Wildlife Ecology and Conservation	1	0.0	0.0	100.0
Youth and Community Studies	1	0.0	0.0	100.0
Youth and community studies (education)	1	0.0	0.0	100.0

Institutional Review Board
Office of Sponsored Programs
University of Memphis
315 Admin Bldg
Memphis, TN 38152-3370

Oct 17, 2016

PI Name: Owens Brent
Co-Investigators:
Advisor:
Submission Type: Modification
Title: The Evolved Digital Divide and implications for college students: A Quantitative study

Approval: Oct 14, 2016
Expiration: *

*Modifications do not extend the expiration of the original approval

Approval of this project is given with the following obligations:

1. This IRB approval for modification has an expiration date, an approved renewal must be in effect to continue the project prior to that date. If approval is not obtained, the human consent form(s) and recruiting material(s) are no longer valid and any research activities involving human subjects must stop.

2. When the project is finished or terminated, a completion form must be submitted.

3. No change may be made in the approved protocol without prior board approval.

Thank you,
James P. Whelan, Ph.D.
Institutional Review Board Chair