Access Granted: A Study of the Factors Affecting the Development of Technology Literacy in Black Males

by

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Dedication

I dedicate this work to my loving wife, Bethany Joy Bell. You have been the light unto my path and my guiding light in the darkness, we did it! Keep shining, the world needs your light. To my mother and sister, I want to say thank you for always believing in me, even when I didn't believe in myself. To my kids Taylar, Gabriel, and Oliver, this is to show you that anything is possible, and you can do anything you set your mind to. To my educator colleagues, who are down in the trenches each day fighting for the children. To my former students, who have inspired me to be the best that I could be so that I could serve as an example of how education can be the vehicle to attain anything you desire. To the young Black males, struggling to find their place in this world. Finally, to my unborn son Thaddeus James. You have inspired me to be a better person, because I knew I needed to set the example for you to follow when you arrive.

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Abstract

One of the most urgent challenges of the digital divide is the need to expand technology literacy. Access to technology was believed to be one of the causes for the discrepancy that exists, but there is a deeper divide: the divide that exists between technology literacy, and career readiness. Although access to technology has improved over time, the educational outcomes for Black males in related fields have not. A critical area of concern is the lack of a Black male professional presence in technology fields, which has serious implications for the future of our society. These implications include a less diverse workforce and a negative impact on Black males' sense of identity. This study identified the factors that may impact the ability of Black males to acquire high levels of technological literacy. A model composed of environmental factors and individual influences that could affect technology literacy was proposed and tested. Data collection was accomplished through surveying undergraduate Black male students who have senior or junior level class standing and are enrolled in computer science or information technology (IT) related programs at institutions of higher learning in the United States. Findings indicated a significantly negative relationship between Black males and the acquisition of technology literacy, and a positive relationship between institutional support and technological literacy. The positive relationship between ethnicity and institutional support, lessened this impact for Black males. The implications of the research will be used to help institutions develop interventions aimed at increasing technology literacy, and ultimately leading to a larger presence of Black males in these fields.

Keywords: digital divide, technological literacy, Black males, self-efficacy, persistence, computer science

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Chapter 1: Introduction

Since the 1990s, research has shed light on Black males and the digital divide that exists between this racial group and their White and Asian counterparts (Jackson et al., 2008). Most of this research has centered on physical access to computers and Internet in the home (Kvasny & Payton, 2005). Fewer studies have explored the racial disparities in the development of technological literacy skills among minorities, and more specifically, Black males in higher education. Although access to technology has improved, the educational outcomes for Black males have not (DiSalvo, 2012). Sax, Ceja, and Teranishi (2001) conducted a nationwide survey and found that the level of technological preparedness varied significantly by race, class, gender, and economic background. Research has shown that even after adjusting for income and education, Blacks and Hispanics have lower computer usage, computer access, and computer ownership than Whites (Frehill, Benton-Speyers & Cannavale, 2004). These disparities in access are referred to as the first level of the digital divide. Computer usage is regarded as the second level of the divide (Tien & Fu, 2008). Studies in recent years (Mansell 2002) have paid more attention to the use of time and the purpose behind using computers and technology. Just as the access to technology does not guarantee its use, the use of technology does not necessarily lead the users to have adequate knowledge and skills to operate computers (Tien & Fu, 2008). Tien and Fu (2008) further state that computer knowledge and skills, therefore, become the third level of the digital divide. The divide between the knowledge and skills needed in order to enter a computer science or technology-related degree program, and how this divide impacts Black male informational technology (IT) career aspirations is the focus for this study. This category of knowledge and skills, also known as technological literacy, is highly developed in some groups such as White and Asian males. Further study is needed to ascertain the experiences and successes of Black males in education and technology fields as well as the factors that impact these areas. By closing this digital divide, it may be possible for minority youth, in particular Black males, to acquire the tools necessary to be well prepared for technology focused higher education opportunities and careers.

Margolis, Estrella, Goode, Holme, and Nao (2008) state that relatively few African Americans pursue technology as a field of study or profession (as cited in Charleston, 2012). According to the National Center for Science and Engineering (2013), only 9.2% of the technology workforce is considered Black or Latino/a. Part of this phenomenon could be contributed to the aforementioned digital divide but also the skills necessary to make the shift from consumers of technology to creators of content. If the United States is to remain globally competitive, we can no longer rely on White men as the only source of viable scientific and technical talent (Gilert & Jackson, 2007). The changing racial and ethnic demography in the United States challenges schools to educate an increasingly diverse student population (Lee, 2002).

A critical area of concern is the lack of a Black male professional presence in technology fields, which has serious implications for the future of our society. Some of these implications include a less diverse workforce, and an impact on Black males' sense of identity with regards to their place in society. Numerous statistics highlight the IT labor shortage of minorities. While Blacks make up 12% of the population, they represent only 7.3% of the computer and data processing industry (Stockard, Klassen, & Akbari, 2005). Google Inc., one of the leading technology companies in the world, recently revealed that only 2% of their workforce is comprised of African Americans. There are currently efforts underway by this technology giant to improve these numbers, including the company working with Historically Black Colleges and Universities (HBCUs) to both "elevate" the coursework and increase the presence of minorities in the field of computer science. The Bureau of Labor Statistics (2017) created a table that had projections for computer science occupations in the United States with faster than average growth for the years 2016-2026, and among the highest were those that required a bachelor degree in computer science.

Table 1

Computer Science Occupations in the U.S. with Faster than Average Growth, 2016-2026

CS Occupations with Faster than Average Growth	Degree Needed	Number of Jobs 2016	Employment Change 2016-2026	Percent Change
Software Developers, Applications	Bachelor's	831,300	1,086,600	30.7%
Information Security Analyst	Bachelor's	100,000	28,500	28%
Computer and Information Research Scientist	Master's	27,900	5,400	19%
Web Developer	Associate's	162,900	24,400	15%
Computer and Information Systems Manager	Bachelor's	367,600	44,200	12%
Database Administrator	Bachelor's	119,500	13,700	11%

Researchers have directed considerable attention to the educational challenges of Black males over the past decade (Kunjufu, 2001; Price, 2000; as cited in Yohannes-Reda, 2010). Some of the research suggests that increasing the number of Black males in the fields of computer science and technology not only improves their earning potential but also creates educational role models that can inspire the next generation. Despite the challenges, however, there are numerous examples of Black males who are high-achieving alumni of prestigious universities and have secured occupations in the fields of computer science and IT. For example, Dr. Juan Gilbert is the Banks Family Preeminence Endowed Professor and Department Chair of Research in the Computer, Information Science and Engineering Department at the University of Florida, where he leads the Human-Experience Research Lab, and Dr. Christopher Emdin is an associate professor in the department of mathematics, science, and technology at Teachers College in New York, an alumni fellow at the Hutchins Center at Harvard University, and serves as the STEAM

Ambassador for the U.S. Department of State. Studying the successful experiences of individuals such as these provide examples of how some Black males who possess higher levels of technology literacy persisted and thrived in STEM-related and computer science fields. These examples could possibly shed light on strategies to assist those who have not been able to succeed in these fields. By increasing the participation of Black males in both computer science and technology-related degree programs in institutions of higher education, more role models will be created that can inspire future generations. This study will explore factors related to technology literacy and examine how some Black male students acquire higher levels of technological literacy.

Today, technological literacy (i.e., the ability to use, manage, assess, and understand technology in order to improve learning, productivity, and performance) is a skill set those students in K-12 settings must begin mastering to ensure success at the college level and beyond (International Technology Education Association, 2007). Schools that service large minority populations are not prepared to be competitive in this technological era (Margolis et al., 2008). Although there is more access to computers and other technology (software, tablets, iPods, smartphones, etc.) in schools, the teachers who are responsible for leading this charge have little or no experience with technology themselves. In 1995, President Clinton proposed a challenge to have all the nation's children technologically literate by the 21st century (Mitchell, 1999). Part of that challenge was for schools to not only develop engaging software and on-line learning experiences, but also provide teachers with the support and training needed to help students become even more literate with technology. This idea surrounding technology and technology skills is still a pressing issue today.

Cain (2012) asserts that Blacks have historically been much less likely to have access to personal computers and thus have felt the greatest impact of the digital divide. Such a phenomenon begs the following questions: Despite this gap, how do some Black males excel in computer science and technology-related degree programs at levels similar to their White or Asian counterparts? What obstacles or barriers have they overcome? What factors that contribute to their educational resilience can educational institutions and prospective employers focus on to raise the presence of Black males in these fields?"

Statement of the Problem

Underrepresentation of Black males with high levels of technological literacy is a societal issue. High levels of technology literacy can potentially lead to employment in computer science and technology-related fields. The lack of a Black male presence in these fields is a serious problem because it limits diversity in the workplace. According to Cain (2012), the next stage for combating the digital divide is empowerment. This empowerment references a shift from access to and use of technology to educational, workforce, and societal gain. These gains are important for Black males, as they are necessary for a shift in negative thinking that has historically surrounded them. Diversity has a positive impact on the workplace by increasing productivity, creativity, and problem-solving, while also helping the United States increase its competiveness in the global market (Carnevale & Fry, 2000). Recent advancements in technology have become such an integral part of our everyday lives that the lack of diversity in areas of technology, along with the lack of cultural capital that is associated with technology, will lead to even more division between cultural groups. Since IT is an enabling technology (in this case providing means and opportunity) that affects the entire economy, failure to possess the technological skills required by IT professionals will lead to Black males being absent in the development of this country's future. Because of this, there is a clear opportunity and a need for Black males to possess a high degree of technological literacy in order to continue their contribution to society.

By examining the technology related experiences of Black males in education, IT and computer science area employers and institutions of higher learning can develop strategies and programs to promote an increase in the number of Black males in computer science and technology-related fields.

Significance of the Study

Research (Chen, Guidry, & Lambert, 2009) states that the use of technology can influence academic achievement and subsequent career choices. However, there have been few studies that focus on Black males and their levels of technology literacy or their technological aspirations. This study will focus on those factors that have allowed some Black males to overcome barriers to achievement and enter a computer science or technology-related program at a college or university. By identifying factors that enabled these students to enter and persist in these competitive fields, as well as factors related to high levels of technological literacy, this study will provide a foundation for understanding how colleges and potential employers can assist in the recruitment and retention of minority students through role modeling and mentoring (Cain, 2012). Although there is a well-documented call for increasing the number of women and other minorities in technology fields, this study is significant because it aims to address the exclusion of large numbers of Black males from economic, social, and educational advancement in an area that is critical to United States' competitiveness. The fact that there is little research on Black males and levels of technological literacy makes this study significant to the literature by addressing that research gap.

Rationale and Purpose

There is limited quantitative research on successful Black, male computing majors; such a study may be key to providing a deeper understanding of whether their persistence can be explained because of complex interactions between psychological, motivational, social, and emotional factors. The purpose of this study is to examine and understand how some Black male students are overcoming barriers to developing high levels of technological literacy and finding success in computer science and technology-related fields. This research will explore factors correlated with attaining high levels of technological literacy including computing identity, support (family, peer, and role models), computer-science-related career aspirations, barriers to technology literacy, and digital media experiences.

By looking at the path that Black male students travel beginning in college, this study hoped to uncover the factors that lead to successful navigation of an educational system that has historically not portrayed Black males in a positive light, and could potentially allow these individuals to find success in the field of technology. The findings of this study add to the body of knowledge concerning Black males and their educational experiences and development of an identity associated with computing. Understanding their persistence, even in the face of potential barriers, is necessary for improving the number of Black males in the computing workforce.

Research Questions

The purpose of this research study was to examine factors related to acquisition of technological literacy for Black males and their decisions to pursue higher education and career fields related to computer science and technology. The following are the primary research questions for this study:

Question 1: What factors influence levels of technology literacy for Black males?

Question 2: To what extent is there a relationship between having technological literacy and aspirations for a career in computer science or technology among Black males?

These questions were addressed with the conceptual framework illustrated in Figure 2.

The framework examines the technological literacy of Black males by looking at both environmental factors and individual influences that may have direct and indirect effects. Understanding and focusing on their success despite historical, economical, educational, and racial factors is important for increasing the number of Black males in computer science fields.

Conceptual Framework

Anti-deficit achievement framework. The anti-deficit achievement framework created by Dr. Shaun Harper (2010) was used for conceptual sense making for the study. The researcher incorporated the anti-deficit achievement framework as a conceptual lens to examine the interplay between key actions, influences, and experiences of Black male students enrolled primarily at HBCUs and small regional universities.

Grounded in previous research on African American student experiences in higher education settings, Harper (2010) created the anti-deficit achievement framework. As an alternative approach to deficit perspectives surrounding African American students, the framework focuses on understanding how Black male students successfully navigate higher education despite facing a myriad of challenges (e.g., stereotypes, institutionalized racism, microaggressions). The framework segments student's educational experiences into the following three phases: (a) pre-college socialization and readiness, (b) college achievements, and (c) post-college success. In addition, the eight dimensions of the anti-deficit achievement framework include familial factors, K-12 forces, out-of-school college prep resources, classroom experiences, out-of-class engagement, enriching educational experiences, graduate school enrollment, and career readiness (Harper, 2012 p. 8)

For this study, the researcher focused on the college achievement phase and the following five dimensions: familial factors, classroom experiences, out-of-class engagement, enriching educational experiences, and career readiness. In addition to Harper's (2010) anti-deficit achievement framework, the researcher also utilized the theory of self-efficacy (Bandura, 1977) as a theoretical guide to examining the underrepresentation of Black males in computer science and technology-related degree programs. These frameworks consider how experiences lead to the construction of an identity associated with technology and examines how holding, or not holding, an identity associated with technology impacts an individual's aspirations and future choices. The research gathered from the study will have theoretical implications for these existing theories and add to the growing body of research surrounding Black male students.

Even though this framework was developed to explore the African American male's experience with education and associated areas of achievement, the nature of the framework makes it easily adaptable to other student populations; in this case, the population is Black males in computer science or technology-related degree programs. Using an anti-deficit inquiry, the researcher seeks to understand how Black male students developed identities associated with technology at institutions of higher learning. How their confidence in certain areas lead to various forms of achievement in that and other areas is a question that this review also seeks to answer.

Using the framework as a guide, the researcher developed a survey instrument to examine the factors related to underrepresentation and perceived factors that have promoted or hindered Black male students' computer science or technology aspirations. These aspirations along with higher levels of technology literacy, can lead to increased numbers of Black males seeking computer science degrees. The study examined the factors that may have contributed to higher levels of technology literacy and student persistence in computer science, leading towards possible baccalaureate degree attainment.

Figure 1, Harper's anti-deficit achievement framework represents the initial conceptual framework on which the study was conducted.

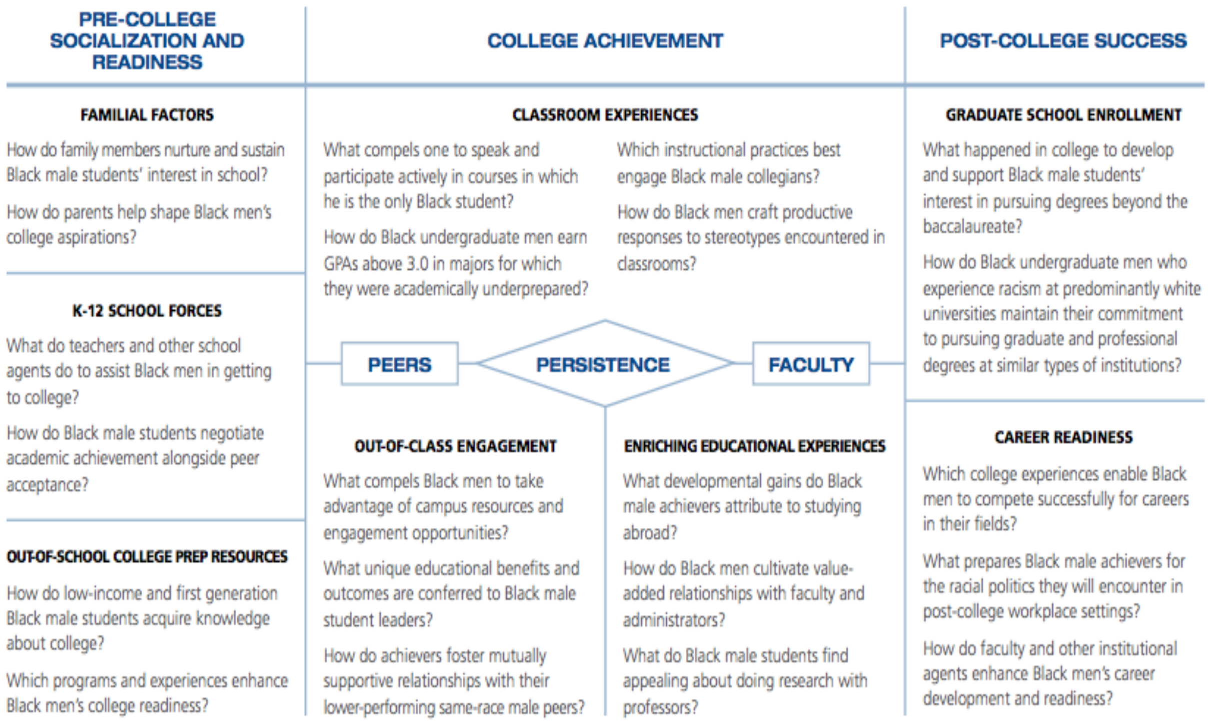


Figure 1. Anti-Deficit Achievement Model (source: Harper, 2010)

Figure 2 represents the conceptual framework created for the study. In this study, an integrative conceptual framework using two theories (anti-deficit achievement framework and self-efficacy) served as the guide for exploring and understanding the phenomenon of underrepresented Black males in the fields of computer science and technology. Central to this study are the experiences and challenges Black male college students face in obtaining or retaining computer science or technology-related degrees and positions. It was adapted from Harper's framework. A discussion of each element of the literature review is represented in the conceptual framework that follows.

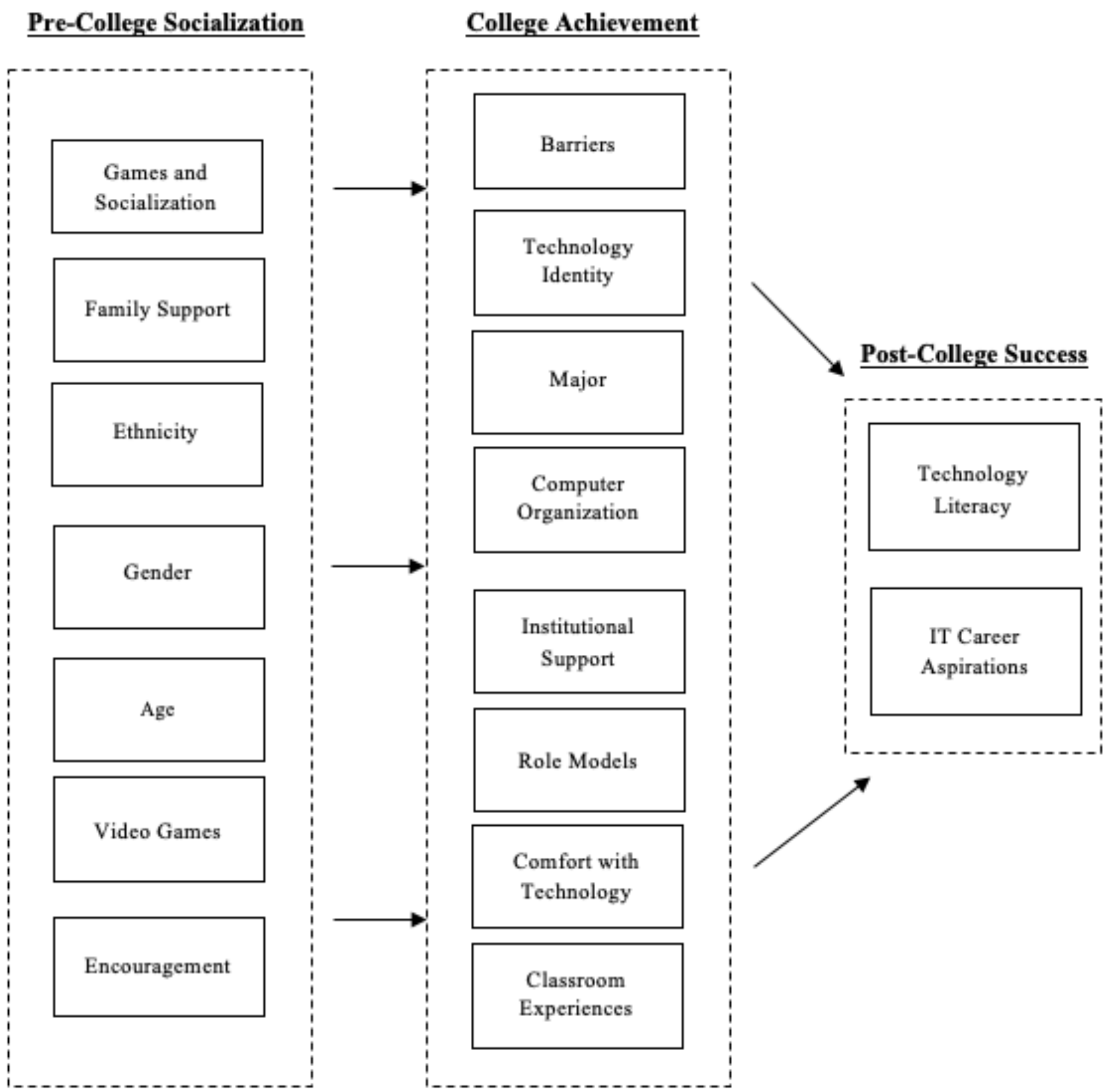


Figure 2. Technology Literacy Conceptual Map

Self-efficacy theory. Self-efficacy is associated with the belief that one has about their capabilities (Bandura, 1977). Bandura further maintained that a person's belief about their capabilities influences their future-oriented behavior within that domain, and in turn produces outcomes that are self-fulfilling (Bandura, 1977). Incentives are one variable within the self-efficacy theory that serves to justify whether a behavior will be initiated (Bandura, 1986). Bandura's theory of self-efficacy beliefs (Bandura, Barbarabelli, Caprara, & Pastorelli, 2001) explains that a student will be motivated to persevere when he believes his actions will produce positive outcomes (as cited in Yohannes-Reda, 2010). Pajares (2002) states that self-efficacy beliefs are strongly linked to choosing a science or technology major. Thus, Black males may be more likely to enroll in computer science or technology-degree programs if they perceive themselves to maintain a higher level of ability and/or success in said areas. Developing positive self-efficacy is a key factor for Black males with regards to enrolling in advanced level courses experiencing academic success (Spade, Columba, & Vanfossen, 1997). This development of positive self-efficacy may increase the inclusion in rigorous science and mathematics coursework, and possibly increase their presence in technology fields.

There has been extensive research around the concept of self-efficacy, and most relevant to Black males and computer science or IT, is the prolific research on self-efficacy beliefs in relation to academic achievement (Lent, Brown, & Larkin, 1986) and to occupational choice (Betz & Hackett, 1981). The research surrounding self-efficacy makes a compelling argument that self-efficacy is integral to Black males' entry and persistence in the fields of computer science and information technology.

Definition of Terms

Aspiration is the term used to define the desire or ambition for which someone is motivated to work very hard. Quaglia and Cobb (1996) state that aspirations are defined "as a student's ability to identify and set goals for the future, while being inspired in the present to work toward these goals" (p. 130).

Black is an everyday English-language phrase, often used in socially based systems of racial classification of ethnicity to describe persons who are defined as belonging to a black ethnicity in their particular country. They are perceived to be dark-skinned relative to other racial groups.

Computer science is defined by the Association of Computing Machinery (2003) as the study of computers and their algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society (as cited in Margolis et al., 2008).

Demographics are defined as the statistical characteristics of human populations (such as age or income):

- *Age*: “an individual's development measured in terms of the years requisite for like development of an average individual” (Retrieved from http://merriam-webster.com/help/citing-the-dictionary).
- *Gender*: “the behavioral, cultural, or psychological traits typically associated with one sex” (Retrieved from http://merriam-webster.com/help/citing-the-dictionary).
- *Ethnicity*: “of or relating to large groups of people classed according to common racial, national, tribal, religious, linguistic, or cultural origin or background.” (Retrieved from http://merriam-webster.com/help/citing-the-dictionary).
- *Class level*: “a body of students or alumni whose year of graduation is the same.” (Retrieved from http://merriam-webster.com/help/citing-the-dictionary).

Identity is used to describe the way individuals and groups define themselves and are defined by others based on race, ethnicity, religion, language, and culture (Deng, 1995). In psychology and sociology, identity is a person’s conception and expression of their individuality or group affiliations.

Information technology (IT) is the term referring to anything related to computing technology such as networking, hardware, software, the Internet, or the people that work with these technologies. These technologies are used for the processing and distribution of data.

Microaggressions are a term defined by Sue et al. (2007) as the common verbal, behavioral, and environmental indignities, whether intentional or unintentional, that communicate hostile or negative slights to marginalized groups. Perpetuators of microaggressions are often unaware that they engage in such interactions when they interact with minorities.

Self-efficacy is one's belief in his/her ability to succeed in certain situations. One's sense of self-efficacy has a major influence on how they approach challenges and goals.

Technological literacy According to the International Test and Evaluation Association (2002), technological literacy can be defined as "the ability to use, manage, assess, and understand technology" (as cited in Cunningham, 2009, p. 13).

Limitations

The researcher made several assumptions during the design of this study. The small sample size and the lack of a control group decrease the generalizability of the findings related to the quantitative research questions. The scope of the study depends on the self-reporting of the participants and their willingness to participate in the actual study. Additionally, the self-reporting of the responses by the participants may result in under-or over reporting on some of the measures. Although online surveys may attain response rates equal to or more than that of traditional modes, many Internet users are bombarded by messages and therefore less inclined to respond. Survey question options could lead to unclear data because respondents may interpret certain answer options differently. Lastly, without face-to-face contact to clarify questions, some of the data obtained could be less reliable.

The scope of this study was limited by the decision to gather data from only Black males who were enrolled at the postsecondary level from four-year institutions (specifically small regional universities and HBCUs). Additional limiting factors included the decision to limit the sample to Black males who are pursuing degrees in computer science related fields.

Summary

Chapter 1 summarizes the importance of closing the digital divide and acquiring technological literacy skills for Black males. It introduces the literature related surrounding the current state of the digital divide and the need for Black males to develop higher levels of technology literacy. The purpose statement, research questions, conceptual framework, and definition of terms familiarize the reader with the nature of this study.

Organization of the Remainder of the Study

This study will be presented in three main chapters. Chapter 2 includes a review of the literature focusing on the significant factors influencing the development of technology literacy in Black males: stereotypes and perceptions, computing self-efficacy, classroom experiences, support, digital gaming habits, barriers to developing technological literacy, computing identity and aspirations and limited technology opportunities. The chapter also includes an examination of the history of the Black males' educational experiences. Chapter 3 explains the methodological choices and overall design for this quantitative study, as well as the description of the sample that was involved in this study. The findings of this study are presented in Chapter 4. In Chapter 5, the findings relative to the research questions are supported in detail. Accordingly, suggestions for development of both practice and programming along with recommendations for future research are also provided.

Chapter 2: Review of the Literature

Introduction

In Chapter 1 several factors were introduced that have a theoretical effect on Black males and development of technology literacy. Chapter 2 explores the significant historical experiences and expectations that have led to the underperformance of Black males in the areas of computer science and technology. The purpose of this study is to examine the factors that have a theoretical effect on Black males and the development of technology literacy. To address the educational complexities, racial variability, and persistence in computer science degree attainment, this chapter will highlight the issues and factors that may have impacted and supported Black male student performance in education, and more specifically, in the fields of computer science and technology.

The chapter begins with a brief introduction, and then continues with an exploration of the significant historical experiences and expectations that have led to the underperformance of Black males in education and how these experiences and expectations affect their numbers in the areas of computer science and technology. Then, using the anti-deficit achievement framework by Harper (2010) as a lens to look at Black male achievement, the chapter will examine the factors that could possibly lead to increased persistence by Black males in these traditionally underrepresented areas. This will be done through a discussion of available research and literature relevant to the following eight areas: stereotypes and perceptions, IT career aspirations, computing self-efficacy, classroom experiences, technology literacy, digital gaming habits, potential barriers to acquisition of technology literacy, and support. The examination of these areas provides an outline for this study's exploration of the possible factors related to persistence in computer science and technology related degree programs in higher education.

Current definition of Technological Literacy

Technology literacy is the ability to effectively use technology to access, evaluate, integrate, create and communicate information to enhance the learning process through problem-solving and critical thinking

Background

Since Oake's (1990) seminal review of the literature on women and minorities in science, technology, engineering, and mathematics (STEM), there have not been any significant changes. The underrepresentation and underachievement of these groups in STEM fields persists to this day (Gasman, Nguyen, Conrad, Lundberg & Commodore, 2017). One factor that attributes to these poor outcomes is access to quality K-12 educations, specifically with regards to Black male students (Gasman et al., 2017). Scholars posit that not only are many minority students likely to be enrolled in inappropriately funded school districts (Condron & Roseigno, 2003), during their enrollment, they often become susceptible to negative stereotypes that impact their performance (as cited in Gasman et al., 2017). These factors can act as potential barriers to Black males in the acquisition of technological literacy and discourage them from persisting in the field of computing. Research (Jackson et al., 2008) indicates that demographic variables (race/ethnicity, socioeconomic status [SES], and age) may have an impact on technology access and usage. Black males typically are raised in urban areas, attend schools that are lacking in resources, and have low numbers with regard to college enrollment and persistence. Porter and Donthu (2006) state that these variables are relevant in the context of explaining technology usage.

Given the importance of gender, educational aspirations, social isolation, Black male success in higher education, and technology literacy, two theoretical frameworks were used to provide the background for this study: the anti-deficit achievement framework and self-efficacy theory. To begin this study, it was necessary to review the literature in multiple areas. To understand the phenomenon of underrepresentation of Black males in the fields of computer science and informational technology, it was necessary to explore the historical literature surrounding Black males and their successes and plights in higher education. Secondly, studies that focused on Black males and their absence from the technology or computing workforce were reviewed. Next, the literature focusing on potential barriers that may prevent Black males from developing an identity associated with STEM and technology was reviewed. Finally, further examination of the research led to the literature review focusing on the following five areas: IT career aspirations, computing self-efficacy, the digital divide, barriers to technology literacy, and support.

History of Black Males in Education

According to the study conducted by Palmer and Maramba (2011), Black males only represented 4.3% of the total enrollment in postgraduate institutions in the United States (p. 432). Coleman et al. (1966) state that it is not surprising that there is a connection between the educational performance of Black males and the hardships they endure within the larger society (as cited in Noguera, 2003). There are harmful environmental and cultural factors that affect the education of Black males in this country. One out of every three Black children is raised in a poor household, and on a consistent basis, schools that serve Black males fail to nurture, support, or protect them. Society and the existing educational system play a major role regarding the inequities that exist. Black students who do enroll on college campuses struggle to overcome the deficits that exist due to systems of oppression and marginalization that have been in place for centuries.

Due to the societal forces that Black males must face, this group often develops a rebellious disposition regarding social institutions in general (Taylor & Graham, 2007). Researchers referring to cultural-ecological theory developed by Ogbu (2004) suggest that ethnic minority male adolescents from economically marginalized groups sometimes adopt an oppositional identity in which they display indifference to or even disdain for their own race. Certain cultural influences can lower the aspirations of Black males and contribute to their adaptation of self-destructive behavior.

Researchers further suggest that the perception of Black males as tough and cool is reinforced by rap videos, thug culture, the media, and the American social culture at large (Juvonen, Graham, & Schuster, 2003; Rodkin, Farmer, Pearl, & Van Acker, 2000). These images increase the likelihood that this population will be labeled by teachers, suspended or expelled from school, or become a part of the juvenile justice system (Skiba, 2000). Some of the existing perceptions include descriptions of Black males as violent, hostile, aggressive, and unintelligent, which decreases their interest in school (Graham & Hudley, 2005; Noguera, 2003).

For young Black males to be able to succeed in school or life, they must have self-pride. Years of inhumane treatment against African Americans and misperceptions and stereotypes about the African American culture leave young Black males knowing only a history that devalues them as human beings. It is important that Black males know their true history and the vast contributions that members of their race have made to the field of economics, science, technology, and politics.

Gaps in the research. Most empirical studies amplify minority student failure and deficits instead of achievement (Harper, 2010). By identifying factors that can enable these students, specifically Black males, to not only enter and persist in the competitive fields of computer science and technology, but also the factors related to high levels of technological literacy, this study will add to the foundation of literature for understanding how institutions of higher learning and potential employers can assist in the recruitment and retention of Black male students. While there is plenty of research focusing on the barriers that Black males face in college, less research is available focusing on interventions and programming aimed at increasing academic success for this population.

Stereotypes and Perceptions

Researchers, including Ogbu and Fordham, have attributed the marginality of Black students to oppositional behavior (Fordham, 1996, p. 46; Ogbu, 1987, p. 314). They argue Black students hold themselves back out of fear that they will be ostracized by their peers. However, this research does not acknowledge the dynamic that occurs between Black male students and the culture that is operative within schools. While these students may contribute to their marginality, they are more likely to be directed into these roles by the adults who are supposed to help them navigate the educational system.

It is likely that the depictions of Black males can negatively impact the perceived ability and subsequent behavior of this group and impede their pursuit of the "American Dream" (Jackson & Moore, 2006, p. 201). Jackson and Moore (2006) also state that African Americans are more likely than any other group to be suspended or expelled from school, underrepresented in gifted education programs or advanced placement courses, and underachieve or disengage academically (p. 201). They experience the most challenges in higher education settings as both students and professionals. Education, to a large extent, will determine the ability of Black males to advance socially, and their quality of life will be impacted because of their educational attainment (Jackson & Moore, 2006).

If Black males are inundated with stereotypical images fostered by racism and prejudice, they will perceive themselves as inferior and unworthy of a quality education. Such views will ultimately create an underachieving disposition that will negatively impact their overall quality of life.

According to Frey (2013), because of deficits and struggles, Black students are likely to enter college, but not persist to degree attainment. Certain cultural influences can lower the aspirations of Black males and contribute to their adaptation of self-destructive behavior. The ineffectiveness of public schools to educate Black males plays an integral part in the racial inequality present in the United States. This inequality persists in institutions of higher education, leading to low degree attainment among this group of students.

According to the National Center for Education Statistics (NCES, 2010), although more students have enrolled at greater rates in higher-education institutions than at any time in history, there are still significant achievement gaps between African American and White students.

IT career aspirations. Although there is evidence that there is an association between socioeconomic status (SES) and aspirations, it is unclear in what ways this affects technology aspirations. It is believed that students gain some of their aspirations from their parents, known as cultural capital (Bourdieu, 1985). Researchers believe that Black males from high SES families tend to have higher educational aspirations than their lower and low SES counterparts (Strayhorn, 2009). High levels of SES are positively associated with technology experiences and opportunities, which could lead to higher technological aspirations.

Yonezawa, Wells, and Serna (2002) believe that messages about students' capabilities become so ingrained that it appears nearly impossible for students to make choices outside of those "leveled expectations." Over time, these expectations become a part of who they are. For Black males, there are few expectations that they will excel in mathematics or science courses or have high levels of technological literacy, so they aspire to do other things and pursue other careers. A study conducted by Cain and Trauth (2013) points to an acknowledgment by Black males that they will be stereotyped in an environment that is White male dominated such as computer science. Black males will not develop technology aspirations when they do not see other successful Black males in those technology positions.

In a study conducted by Zarrett, Malanchuk, Davis-Kean, and Eccles (2006), Black males were found to have positive attitudes and high regards towards the computer field but also concerns about race and gender discrimination. Zarrett and Malanchuk (2005) also state that though Black males may express similar levels of interest in pursuing an IT career as White males, concerns about, or experiences of, race and gender discrimination may be one reason why some Black males choose to pursue majors in fields other than computer science. Several factors were identified as early determinants of IT-related aspirations of Black male students, including academic achievement, concerns about race and gender discrimination, math ability, coming from families with lower levels of expectations (as compared to their White counterparts), lower academic expectations held for themselves, and advice and encouragement received with regards to IT. In choosing certain career paths, Black males may potentially see themselves as the only minority in the workplace, and that can lead to fear of stereotypes and discrimination, which could ultimately lead them to choose different career paths (Zarett et al., 2006).

Computing self-efficacy. One possible mediating variable with regards to Black males and technology literacy could be self-efficacy, which could lead to the development of an identity associated with technology and computing. Bandura (1977, 1986) asserts that the role of self-efficacy in academic settings, including one's self-image as a learner in the context of academic achievement, can't be ignored or trivialized (as cited in Whiting, 2009). Self-efficacy is one aspect of our identity. The belief that "I can do it" is critical to how a student performs in academic settings. According to research, racial identity affects Black males' achievement and motivation (Cross & Vandiver, 2001). Development and fostering of not only a positive racial identity, but also an identity associated with computing can lead to an increase in the technological aspirations of Black male students. The concept of identity and seeing oneself in a role opens the door to the possibility of one assuming that role (Cain, 2012). One of the challenges in motivating young Black males to engage with computing is that they do not traditionally identify with computing culture (Katz, Aronis, Allbritton, Wilson, & Soffa, 2003).

According to Gilligan (1993), many foundational studies on masculinity suggest that identity development among boys is primarily characterized by autonomy, achievement concerns, competence, mastery, supremacy, and competitiveness (as cited in Harper, 2004). For many, the desire to be "cool" and admired by one's peer's contrasts with the image of one who wants to read a book or do well in school. In a study conducted by Harper (2006), Black males consistently used a limited number of variables to describe masculinity—dating and romantic relationships, athletic activity, competition through sports and video games, and the accumulation and showing off material possessions. The "geek" identity, one that is contradictory to the masculine identity, is often associated with technology and computers and may act as a barrier for Black males to identify themselves as computer scientists, thus impacting their self-efficacy (DiSalvo, 2012). Social influences such as the endorsement of negative schemas (geek, socially isolated) and positive schemas about computer science and technology (good for the world, solves problems), as well as the encouragement the young adults receive from others to pursue IT, play a major role in whether an individual decides to pursue a career in IT or computer science (Zarrett et al., 2006). Steele (1997) suggests that people are more likely to identify with something if they will perceive it will be the norm in their social group (as cited in DiSalvo et al., 2011). Disidentification with computing and technology contributes to underrepresentation among Black males (Katz et al., 2003). Since advanced experiences with technology is not seen as the “norm” within their peer group, this disidentification with computing that Black males possess, can limit their technology aspirations and opportunities.

Digital Divide

Classroom experiences. There are many negative media images of Black males in our society. These images influence how Black males are perceived in everyday life. According to Davis (2003), these images portray the Black male as violent, disrespectful, unintelligent, and threatening. Without a doubt, these images carry over into schools and can negatively influence the ways young Black males are perceived in school settings.

Some researchers suggest that the academic demise of Black males in the classroom can be attributed to a deficit of basic educational skills, which could be alleviated by differentiating instruction for this population of students (Wright, 1987; Noguera, 2003). Developing a positive rapport with the instructor can promote positive classroom experiences and academic achievement for Black males. In computer science and mathematics classrooms, White and Asian male students typically do not experience having their intellectual abilities doubted because of their race or gender (Margolis et al., 2008). It is in these classes that the small amount of Black male students present, often encounter experiences that have a profound effect on how they view the world, and education in general. Often in teaching basic computing techniques, individual interaction with computers is encouraged (and required). Studies have shown that for Black students, learning is strengthened by social interaction (Burge & Suarez, 2005). Burge and Suarez (2005) further state the method of computer instruction for the computer student is quite different from the teaching strategies that have proven to be successful for the Black student. The Computer Science Teachers' Association recommends that all students participate in a sequence of three computer science courses at the high school level. Yet in many schools attended by students of color, if any computer courses are offered at all, they tend to focus on basic applications or typing (Goode, 2010). In these schools, rigorous science courses are less likely to be offered than in more affluent neighborhoods and schools. Without these advanced courses, Black males (and other underrepresented groups) are less likely to pursue technology-or computer-science-related majors in higher education.

Margolis et al. (2008) found that schools often exacerbate inequalities in students' computing knowledge by systematically offering the most advanced and rigorous course work to those students who already come from the most tech-savvy homes (these are not typically Black male students), while giving only the most basic course work to students with the least computing knowledge. In these cases, the inequality surrounding technology literacy is reinforced and promoted. Margolis et al. (2008) also state that the importance of social networks in the classroom was crucial for educational achievement. With regard to computer science and IT-related aspirations, one area to look at is how one interacts with technology.

Technology literacy. Technology literacy involves more than the ability to use software or operate a digital device; it includes a large variety of complex cognitive, motor, sociological, and emotional skills, which users need to function effectively in digital environments (Eshet, 2004). In a study conducted by Charleston (2012), many of the participants reported that their initial interest in technology stemmed from experiences with the Internet, graphics, and gaming. They further stated that as their understanding of computers and technology deepened, so did their desire to become more immersed in computing. The digital media identities, and practices of young Black males (how they navigate the popular culture landscape to gain recognition and prestige) are based largely on the desire to gain respect from their male peers (Watkins, 2012). Watkins (2012) further asserts that this bid for respectability is visible across the many platforms that converge in the use of sites like MySpace, and Facebook, including music, video, photos, wall posts, and status updates. Black males lag other groups in their use of digital technology, with one notable exception: video game playing. According to some research, video game playing is linked to poorer academic performance and aggressive behavior (Anderson, Gentile, & Buckley, 2007). Conversely, there is evidence that playing video games is related to higher visual spatial skills, skills viewed by many as fundamental to learning science, technology, engineering, and mathematics (Subrahmanyam, Greenfield, Kraut, & Gross, 2001).

Digital gaming habits. Researchers (Dyson, 1997; Lee, 1991) have explored the benefits of bridging the worlds of formal learning and the communities in which children live (as cited in DiSalvo et al., 2008). Children have an informal knowledge base and skill sets that could be integrated into more formal educational settings. DiSalvo (2011) notes that many Black males have a passion for video games, but unlike their peers, they do not transfer that engagement into a curiosity or agency with the underlying technology. Why is this group not transferring this passion for games into a passion for technology? Digital games are increasingly being viewed as a potential opportunity for learning in many different content areas because of their ability to capture children's interest (DiSalvo, et al., 2008). According to a report by the Federation of American Scientists (2005), many of the skills that these players develop while using video games are some of the same skills that employers will be seeking in technology driven fields (as cited in DiSalvo et al., 2008). In a study on Black male youth and gaming conducted by DiSalvo et al. (2008), many of the Black male participants indicated that family members had introduced them to digital gaming, purchased games for them, and served as playmates for console games. There is a clear need for institutions to develop programming that addresses this need and create interventions that encourage Black males to take their passion for gaming and transfer that passion into other areas of technology because while playing these games, Black males' self-efficacy and engagement levels are high. There are those who follow what has been coined the *constructionist* view for using games for learning. These proponents have focused their efforts on providing students with greater opportunities to construct their own games—and to construct new relationships with knowledge in the process (Kafai, 2006). Game making does not require expensive technologies to provide learners with the opportunities to develop their programming skills (Kafai, 2006). This may be an opportunity for Black males to expand on their skills and develop higher levels of technological literacy. While this may be an area for Black males to increase their levels of technological literacy, they may be hindered or experience reluctance due to the expectations they encounter in school or their communities, which may prevent them from aspiring to acquire more knowledge surrounding technology. Looking at variables that may act as barriers to Black male students acquiring higher levels of technology literacy is crucial to understanding and addressing the digital divide.

Potential Barriers to Developing Technological Literacy

Katz et al. (2003) point out that many factors have been identified as barriers to Black males succeeding in computer science including lack of pre-college advanced placement courses, access to computers, low computational math skills, lack of mentors and role models, economic pressures to support family, low self-efficacy, and isolation (as cited in DiSalvo, 2012). Additionally, factors such as stereotype threat, racialized social hierarchies, and limited technology opportunities could be preventing Black males from developing higher levels of technological literacy.

Stereotype threat and microaggressions. According to Banks (1995), an examination of U.S. history reveals that the “color line” of race is a socially constructed category, created to differentiate racial groups and to show the superiority or dominance of one race over others. Steele and Aronson’s (1995) work reveals that racial stereotypes are deeply woven into the fabric of U.S. society, yet their daily effects are often misunderstood. These researchers examined how such stereotypes may interfere with Black students’ ability to achieve high scores on standardized tests measuring aptitude or intelligence. This research suggests that negative stereotypes of Black students’ intellectual abilities play a role in underperformance. Awareness of these stereotypes can create a phenomenon known as stereotype threat (Cain & Trauth, 2013). These threats emerge from both stereotypical representation and lack of representation in a particular domain or field (Cain & Trauth, 2013). In computer science, there is a perception that White and Asian male students have the most knowledge. This could be an intimidating factor for Black males in classes with these individuals.

Many computer classes and computer fields are dominated by White males, which could lead to reinforcement of stereotypes and increased levels of intimidation. The term microaggressions is defined as subtle insults (verbal, nonverbal, and/or visual) directed toward people of color, often automatically or unconsciously (Solórzano & Yosso, 2000). Even subtle comments in rigorous courses or the workplace can have detrimental effects on Black males’ sense of belonging in those areas. The nature of racial stereotypes is woven into the fabric of society, but the cumulative effects are often misunderstood and can reinforce stereotype threat. Racial stereotypes in both academic and social spaces have real consequences, the most obvious of which are the resulting negative racial climate and African American students' struggles with feelings of self-doubt and frustration as well as isolation (Solorzano & Yosso, 2000).

In her essay "Competing Theories of Group Achievement," author Theresa Perry (2003) writes: "You scarcely can find a Black student who cannot recall or give you a litany of instances when he or she was automatically assumed to be intellectually incompetent" (p. 97)

Researchers (Solórzano & Yosso 2000; Ceja & Yosso 2000; Pierce 1974) believe that in educational settings, these biased beliefs (forms of microaggressions) about capacity, motivation, and abilities of different racial groups are widespread, and when combined with structural experiences, they chip away at underrepresented students' trust, interest, and persistence (as cited in Margolis, 2008).

Limited technology opportunities. There are many factors that contribute to the lack of representation of Black males in IT and computer science fields. According to Cooper (2000), race, age, language, and disabilities are significant predictors of IT access and familiarity, even controlling for socioeconomic status. Structural inequality is reproduced as social factors intersect with infrastructural barriers to IT access. The lack of access and the desire to use IT among economically disadvantaged racial and ethnic minorities exacerbates their ability to function as citizens in a democratic society (Shelley et al., 2004). Students with high levels of technological literacy tend to come from homes with a wealth of resources where they have the opportunity to experiment with technology in depth (Margolis, 2008). Since many Black males do not come from these types of homes, they tend to gravitate towards other areas in education.

While providing access to hardware and software resources remain important, the real digital divide remains at the level of understanding (Amiel, 2006). Amiel further states, "what has kept large sections of the population on the unfortunate side of every technological divide is an inability to comprehend the significance and role these tools have in their life and community." These barriers that many Black males encounter may have significant impact on the development of an identity that is associated with technology. One area that may allow them to overcome these barriers is the support (or lack of) they receive as they attempt to navigate the pathway to a career in a computer science or technology-related field.

Support

According to researchers (Lee & Ekstrom, 1987; Plank & Jordan, 2001), because many Black males are more likely to be the first in their families to attend college, they are also more likely than their White counterparts to be influenced by their high school counselors when it comes to their academic futures (as cited in Margolis, 2008). Unfortunately, many counselors may prescribe to deficit-model thinking with regard to Black males and may not encourage them to enroll in rigorous math and science classes necessary for them to be successful in technology fields.

Family support. During a research study, Palmer, Davis and Maramba (2011) found that family support emerged as a salient factor for academic success. Some participants highlighted their families' use of role modeling to impress upon them the significance of an education, and active engagement and support fueled their success. Many students talked about how their parents were integral to both their retention and persistence. Hendricks (2014) states that the family's position in the academic accomplishment of Black students is critical, while Edwards (2011) states that critical to the educational achievement of the Black male is the cultural capital or the amount of time parents invest instilling and developing the habits, styles, and behaviors that prepare their children to learn and do well in school, to pursue a college education, and to ultimately attain a college degree (as cited in Hendricks, 2014). Researchers (Tinto, 2007; Parade, Leerkes, &

Blankson, 2009) believe that when it comes to unknown and potentially uncomfortable situations such as going to college, Black students look to extended family for emotional and social support (as cited in Sledge, 2012). Families that are supportive and reliable before students go off to college typically maintain a close connection throughout the students' college careers because the earlier they gain a sense of comfort from family, the more confident they will be when building relationships with others (Sledge, 2012). Findings from a qualitative study conducted by Hrabowski, Maton, and Greif (1998) reveal that parents of high-achieving Black male students frequently spoke with teachers, were active members of parent organizations, and were involved with events on campus. These parents also worked to ensure that their students were placed in the highest level courses (as cited in Mahoney, 2017).

Peer support. According to researchers (Chang et al., 2011; Harper et al., 2004), being surrounded by same race peers and faculty is significant for Black students, many of whom struggle to persist in the face of unwelcoming climates or racial microaggressions at predominantly White institutions (PWIs). One place where Black males may find peer support when they arrive on campus is university student organizations. Student organizations for Black males may be used as agents of social integration on many college campuses. This example of peer support is one place where students of color often find social acceptance. Recent evidence from research on small groups suggests that group dynamics influence the development of individuals' self-efficacy (Choi, Price, & Vinokur, 2003). Tinto (1993) maintained that college students who perceive their norms, values, and ideas as congruent with those at the center of an institution are more likely to become academically and socially integrated into that institution. Unlike White students, whose social integration occurs primarily through informal associations with peers, Tinto (1993) believed that social integration among students of color at the university level was influenced more by formal forms of associations, such as involvement in student organizations. Students of color can use these organizations as vehicles that enable them to integrate into the larger campus setting.

It is believed that peer groups play a powerful role in shaping identity because the desire to be accepted by one's peers and "fit in" with those peers often becomes a paramount concern for most students (Noguera, 2003). These peer groups assume a great influence over the feelings that students have towards achievement. Even when students are willing to break away from what they perceive to be the norm, they are aware of the fact that they are doing it with limited role models and social support, making a challenging endeavor even more difficult (Margolis et al., 2008). As a result, students often move away from AP/honors classes, instead enrolling in "regular" classes where their friends are in order to feel support. By doing this, they lessen the constant feeling that their abilities are being called into question, but they also miss out on the rigor, knowledge, and capital that these AP/honors classes provide. With regards to the effect peer interaction has on computing, Charleston (2012) suggests that peer modeling or positive peer influence was extremely salient regarding persistence in computing.

Role models. Although it is important for Black males to be fluent with technology and the skills needed to be successful in IT and computer science, it is very uncommon for them to see faces that look like theirs in positions that require those skills. A lack of role models may have a huge influence on their desire to pursue careers involving technology. Many students in today's society are media-savvy, critical consumers of a wide range of marketing messages, which by and large lack a diversity of role models (Margolis et al., 2008). For many students of color, computer science role models are "computer nerds" who do more to create barriers to interest than foster its development (Margolis et al., 2008). According to Pajares (2002), the success of a role model who possesses similar attributes is particularly helpful in raising self-efficacy beliefs. Research has shown that mentoring leads to increased IT student retention at the undergraduate level (Agosto, Gasson, & Atwood, 2008). The presence of minority faculty mentors in computer science and technology departments help some Black males overcome barriers like fear and social isolation. Charleston (2012) examined factors related to computing science aspirations among Black students and found that mentorship played a significant role in socializing participants to the world of computing.

While conducting his 219-participant study, Harper (2010) found that participants did not deem themselves superior to or smarter than their less accomplished, disengaged same-race male peers, in fact, most believed lower-performing Black male students had the same potential, but had not encountered people or culturally relevant experiences that motivated them.

Summary of the Literature Review

Much research has been conducted on Black male college students, but limited research on Black males who have persisted and entered the computing and technological workforce has been conducted. Further examination of the research suggests that there are many factors that influence the acquisition of technological literacy among Black males. These factors are grounded in the context of societal and cultural expectations, race and identity, and experiences with technology. The review of existing literature shed light on a gap in the research regarding Black males and technological literacy and how this relationship impacts computing aspirations. This study sought to address this gap in the literature by examining the experiences of Black males with regards to technology and development of an identity associated with technology.

Since technological literacy represents the future of our global society and our country, one cannot ignore the overwhelming need to have Black males developing high levels of technological literacy, because this will influence the structure of the workforce and society directly or indirectly. By conducting a comprehensive analysis of social, academic, and other factors related to their persistence in computing, this study explores the within group variations among Black male students to help explain their persistence in this underrepresented STEM field. From this literature review, it is clear that this is an area where the research is limited, and more research needs to be done. Fully understanding the experiences of Black male students in the field of computing and technology will provide information that may allow institutions of higher learning, researchers, and policy-makers to develop supports and programs aimed at improving the recruitment, persistence and graduation rates of Black males in computer science.

This chapter presented a review of the significant literature based on the educational experiences of Black males in computer science and technology-related fields of study. Institutional factors, microaggressions, experiences with technology, and support were primary factors identified that led to successful entrance into a computer science or technology-related degree program by the Black males. Chapter 3 will outline the methodology that was used for this study.

Chapter 3: Methodology

"The best way to predict the future is to create it."
--Peter Drucker

The following chapter presents the research methodology that was used as a guide for this study. It identified the participants, the setting, expands on the instrument that was used, describes the methods of data collection and analysis, and tests hypotheses.

Introduction

The purpose of this research was to examine the factors that could have an influence on technology literacy. This was done by seeking feedback from a sample group of students (primarily Black males) about the familial, post-secondary experiences, and self-efficacy factors that have contributed to their persistence in and through the science, technology, engineering and mathematics pipeline (Harper, 2012).

Previously reviewed literature in the earlier chapters suggested that there may have been barriers that prevented Black male participation in fields of computer science and technology. The argument for support, observable role models, early experiences with technology, familial encouragement, and developing an identity associated with computing were well documented. This study provided an opportunity for randomly selected Black male students in computer science degree programs to respond to questions related to their experiences, influences, perceived barriers, and perceptions as they persist in the field of computer science. This research was driven by the belief that Black males can attain academic success in the field of computer science, a field in which they have been traditionally been underrepresented.

Using the five dimensions---familial factors, classroom experiences, out-of-class engagement, enriching educational experiences, and career readiness---the researcher sought to identify the factors that have led some Black male students to major in computer science or technology-related degree programs at the postsecondary level.

Participants

The participants in the study were students enrolled in computer science or technology related degree programs at 4-year institutions of higher learning. Of the 114 technology literacy surveys completed electronically through Qualtrics, or manually from the paper/pencil version, 67% (n = 76) were male students. Of the 76 male respondents, 71% (n = 54) identified themselves as Black/non-Hispanic and were selected for the sample group. As depicted in Table 2, the percentage rated of the sample group enrollment by major was 87% computer science and 13% other. Furthermore, descriptive data about the respondents reflected that 28 students, or 25%, classified themselves as freshman; 21, or 19%, as sophomores; 24, or 22%, as juniors; 31, or 28%, as seniors; and 10, or 9% of respondents, did not specify their class level.

Setting

This study looked at the experiences of Black male students enrolled in computer science or technology-related degree programs. While not all of the institutions hold the Historically Black College and University (HBCU) designation, the fact that 9 of the 11institutions represented in the study hold this designation make it central to the study. HBCUs are the only institutions in the United States that were created for the express purpose of educating Black citizens (Gasman, 2013). Here are a few characteristics of HBCUs:

1. High numbers of graduates from these institutions move into professional fields. For example, 50% of African American lawyers, and 80% of African American judges are HBCU alumni.

2. HBCU's have, on average about one-eighth of the endowments of private universities in the country; however, they accept more low-income and first-generation college students than any other kind of institution in the country. The schools also host HBCU-specific scholarships to ensure that all students get a fair chance at an education.

Even though all of the institutions in this study reside within the Midwest and Southeastern regions of the United States, and the majority of the institutions hold the HBCU designation, they may still possess slightly different environmental characteristics (e.g., campus size, degree/program offerings, and institutional selectivity). Since each of the institutions have their own individual campus culture and environment, and vary in enrollment size, looking at a single institution would not provide enough information to make observations about the effects of HBCUs on the Black male student experience/persistence in the field of computer science or technology. Institutional characteristics that might come into play are campus size, diversity of the surrounding community, access to the computing industry, and the selectivity of the institutions. Since these characteristics vary in nature, it makes more sense to get a broad impact of these experiences and feelings regarding computing across multiple campuses.

Instrumentation and Procedure

The survey instrument was developed based on the conceptual model shown in Figure 2 and had eight sections: demographics, IT career aspirations, technology identity, classroom experiences, technology literacy, digital gaming/socialization, barriers to literacy, and support. Each section was coded with a corresponding letter for that variable; questions related to technology literacy and technology aspirations (dependent variables) were alpha-numerically coded to correspond to specific subcategories in those areas (D_1-7, DG_1-2, SOC_1-3, CWT_1-2, BTL_1-4, IN_SUPP1-3, TI_1-4, ICA_1-4, TL_1-4). Survey items were primarily constructed based on concepts presented in the literature review. Participants were asked to respond to a series of statements about their classroom experiences, digital gaming habits, technology literacy, various types of support they may or may not have received, computing identity, and barriers to technological literacy which they may have encountered. The survey instrument includes questions on a Likert scale which requested input regarding technology experiences and the perceived impact these experiences have had on the individual's aspirations toward a career related computer science or IT. Most responses to these items were on a Likert scale of 1 through 4, with 1 representing *strongly disagree*, 2 representing *disagree*, 3 representing *agree*, and 4 representing *strongly agree*. There were also items that required the participants to respond to open-ended and multiple-choice questions. The survey represented the basis for the descriptive and inferential data analysis for the study. The final Qualtrics survey is found in Appendix A.

A quantitative research paradigm emphasizes the importance of generalizability and reliability (Henn et al., 2006). The aim is to apply the relationship obtained among variables to the general population. Thus, a sample which is representative of the population chosen is essential. There may be some limitations with regard to the proposed study. The population being investigated (Black males in computer science or technology-related programs) is limited in number. There is potential for error in the findings based on the limited population.

Demographics. The survey included six questions that focused on age, gender, ethnicity, current class standing, major, and college/university of registration. Participants were allowed to select "prefer not to answer" in place of demographic information.

Human Subjects Approval

Prior to distributing the survey, the researcher completed all of the documents necessary to proceed with the study and submitted to the University Human Subjects Review Committee

(UHSRC) at Eastern Michigan and then repeated the process at three other institutions of higher learning. This included the Request for Human Subjects Approval to describe the research, CITI completion report, informed consent, and IRBNet study protocol. Approval was received prior to survey distribution (Appendix B).

Participants received notification as to the purpose of the study and that participation was voluntary and without risk or harm. Participants were also notified that they could discontinue the survey at any time and results were confidential. An informed consent page for the survey included procedures to safeguard the data and information regarding data use (degree requirement). The survey could not be started without acknowledging the terms of the study electronically.

After receiving IRB approval from Eastern Michigan University, Morehouse College, North Carolina A & T State University, and Dillard University, the researcher contacted the computer science chairpersons at the select institutions to explain the research and request permission to distribute the survey to students enrolled in computer science degree programs. The researcher used Qualtrics, a data collection software to electronically distribute the instrument to faculty members so they could pass along the survey link to students in their courses. Faculty members were provided with a brief overview of the research and purpose of the survey, which included a link to the technology literacy survey. A follow-up email reminder was sent out one week later to each faculty member who had received the survey link. Four weeks following the date of the initial contact, a replacement email (containing a follow-up link) was sent to all non-respondents.

Survey: Design, Pilot and Distribution

The quantitative questionnaire (Appendix A) surveyed university and college students in terms of demographics: age, gender, ethnicity, class level, degree major, and institution currently enrolled in ($n = 6$). Questions were asked about technology aspirations ($n = 5$); technology identity ($n = 8$); classroom experiences ($n = 6$); technology literacy ($n = 7$); digital gaming habits ($n = 5$); barriers to technology literacy ($n = 8$); and support ($n = 11$), for a total of 56 questions. A pilot survey was distributed to a select group of educational leaders prior to distribution to determine the usability of the instrument, time to complete (approximately 5–10 minutes), and overall comprehensiveness. The survey was revised based on the feedback from the pilot study, and changes were made accordingly.

The sample included higher education students from nine HBCUs and two small regional universities with valid email addresses. Department faculty were encouraged to distribute the survey through incentives that included sharing the results of the study and a $5 gift card for any student who completed the survey. One hundred forth-three responses were received, but only 114 were complete and used in the data analysis. Survey items were constructed primarily based on concepts presented in the literature review. The survey initially asked the potential participants if they are or have ever been interested in a career in the field of computing or technology. If the answer was no, the individual was thanked for their participation and instructed not to continue with the survey. The survey was constructed to confirm the relationships identified in the conceptual framework and specific to the research questions. Survey items were constructed primarily based on concepts presented in the literature review.

A web-based survey format was chosen for several reasons. The survey sample was taken from public institutions of higher education. Students at these institutions were very likely to have some form of high-speed Internet access; therefore, accessibility to the survey should not have been a problem. Web-based surveys have the benefits of reduced time to completion, directed branching, and reduced overall survey costs if no significant programming is required (Schonlau, Fricker, & Elliott, 2012).

Independent and Dependent Variables

The independent variables in the study were age, gender, ethnicity, family support, gaming, and socialization around digital games. Comfort with technology, institutional support, and barriers to technology literacy were analyzed as mediating variables. Two constructs, technology aspirations and technology literacy were measured as dependent variables. Table 2 identifies the variables and their coding as they were prepared for data analysis.

Table 2

Overview of Variables

Independent Variables:	Demographics (D) (D_1) 1. Program of Study (D_2) 2. Age (D_3) 3. Gender (D_4) 4. Ethnicity (D_5) 5. Class Level (D_6) 6. College of Registration (D_7) 7. Major Family Support (F_SUP) (F_SUP1) 1. Growing up I was encouraged (F_SUP2) 2. I received support from my family Digital Gaming (DG) (DG_1) 1. Playing for “fun” (DG_2) 2. Exchanging Strategies Games/Socialization (SOC) (SOC_1) 1. Social nature of Games (SOC_2) 2. Playing in Online Group (SOC_3) 3. Tech Skill Development Comfort with Technology (CWT) (CWT_1) 1. Skills on par with Peers

Table 2 *continued*

	(CWT_2) 2. Access Growing Up
Mediating Variables:	Institutional Factors (IN) (BTL_1) 1. Ignored at Institution (BTL_2) 2. Negative Perceptions (BTL_3) 3. Keep interests Hidden (BTL_4) 4. Family Support (Low) (IN_SUP_1) 1. Institutional Support (IN_SUP_2) 2. Role Models (IN_SUP_3) 3. Encouragement Technology Identity (TI) (TI_1) 1. Confident working with Technology (TI_2) 2. Future resides in Technology (TI_3) 3. See myself as a Computer Scientist (TI_4) 4. I can be successful in my Program
Dependent Variables:	IT Career Aspirations (ICA) (ICA_1) 1. Desire a Career in CS (ICA_2) 2. Desire a Career in Tech Area (ICA_3) 3. Advanced Degree in CS (ICA_4) 4. Computer Programmer (desire) Technology Literacy (TL) (TL_1) 1. Working with Files/Software (TL_2) 2. Creation of Electronic Portfolio (TL_3) 3. Comfort with different Digital Media (TL_4) 4. Maintenance of Personal Website/Blog

Data Collection and Analysis

The survey was initially distributed through SuveyGizmo, a web-based survey service at the beginning of October 2016. It was not well received and responses that came in were limited. At the beginning of May 2017, the survey instrument was refined and distributed through Qualtrics, Inc., also a web-based survey service. In order to recruit participants from outside universities and colleges, the researcher had to obtain IRB approval from multiple institutions, causing a delay in survey response. Reminders were sent in the fall of 2017, and the survey closed at the end of March 2018. Results were downloaded into Microsoft Excel and uploaded into the Statistical Package for the Social Sciences (SPSS) for analysis. The data set was filtered, eliminating any surveys that were not 100% complete. Data analysis included descriptive analysis, principal component analysis, multiple linear regression, and path analysis. Descriptive statistics, including frequency distributions, regression analysis, and correlation coefficients, were used to analyze the groups of responses. In other terms, "How much did the independent variables contribute to Black males' selection of a computer science or technology related major?" "What were the relationships between the independent variables and the dependent variable?" and "Was there an impact?" Using various descriptive techniques, the researcher developed frequency tables for each question posed to participants in the study. This allowed the responses to be summarized in the form of percentages. Factor analysis is the means by which the researcher used to determine construct validity. According to research (Byrne, 2013), exploratory factor analysis (EFA) is used in situations where the connection between the observed and latent (hidden) variable is unknown. Since the dimensions or components that underlie the survey instrument are hypothesized rather than confirmed, an exploratory approach was undertaken in this study. The constructs that emerged were: (a) technology identity, (b) technology aspirations, (c) classroom experiences, (d) institutional support, (e) digital gaming, (f) socialization around gaming, (g) barriers to technology literacy, (h) tech literacy, and (i) family support. The literature supports a principal component analysis (PCA) for such a situation since it is based on the total amount of variance the nine components have in common (Stevens, 2002).

Path Analysis

Path analysis provides a way to estimate the assumed causal effect that one variable has on another through its assumed causal effect on other variables. This will allow the researcher to measure experimental data and prove whether the variable causes an outcome. The utility of path analysis here is to decompose the sources of correlation between an independent variable (such as classroom experiences) and a dependent variable (in this study it would be technology literacy and technology aspirations). The chief advantage of using path analysis is seen when there are two or more dependent variables. In path analysis, multiple linear regressions will extend the function of linear regression by allowing multiple independent variables to be used as predictors of a single dependent (outcome) variable (Hill & Lewicki, 2006). To facilitate this, categorical (predictor) variables will be dummy coded to allow for inclusion into the regression equations (Hill & Lewicki, 2006).

When running regression or path analysis models, given multiple predictors, it could be problematic if some independent variables are categorical and some continuous. Dummy coding overcomes this issue by recoding categorical variables that have more than two categories into a series of binary variables. Values that are assigned categorical variables are typically arbitrary and lack meaning. Dummy coding will allow for the creation of meaning by replacing arbitrary categorical values with a binary attribute of zero (0) or one (1). Thus, by assigning gender the values of '0' for male and '1' for female, the value could be interpreted as the absence or presence of a particular characteristic, which in this case would be being female. Dummy variables are used in regression analysis to avoid the assumption that the original numerical codes for the categories correspond to an interval scale.

Results obtained through path analysis and multiple regression analysis includes moderating (interaction) and mediating effects. A moderating variable influences the strength of the relationship between two other variables, producing the interaction effect. Mediator variables help to clarify the nature of the relationship between the independent and dependent variables, which are outlined in Table 2.

Data Reduction Methods

The process of data analysis for completed surveys included data reduction to determine the relationships among variables. A principal component analysis and factor analysis were conducted to consider the relationships between the variables and will be presented in the following chapter (Table 5). Relationships were uncovered that helped determine the effect or influence between the indicators that helped to define, explain, and support variables in the study. Some variables were then re-coded for analysis in keeping with the conceptual framework for the study. Interaction variables were computed to test for interaction effects. In order to determine significant relationships, a multiple linear regression model was used.

Summary

Chapter 3 began with descriptions of the sample of this study. The survey instrument and procedures were presented, followed by the data collection and analysis of that data. Independent and dependent variables were defined, and the survey distribution was reviewed, including Human Subjects Review and other appropriate documentation. The sampling techniques, instrumentation and data collection methods in this research study were designed to understand why some Black males enroll and persist in computer science or technology-related degree programs. Principal component analysis was used to establish the construct validity of the survey and linear regression modeling for its predictive capabilities to answer the following questions:

- How reliable and valid is the overall model?
- Can we say with confidence that there is a relationship between the independent variables and the dependent variable beyond what may be described as coincidence?
- Is there a relationship between the variables? If so, how strong is that relationship?
- How important are each of the independent variables?
- Do any of the variables drop out after the analysis have been run?

A review of the findings from the study and analysis of the data are presented in Chapter 4.

Chapter 4: Results

This chapter describes the analysis of data followed by a discussion of the research findings. The findings relate to the research questions that guided the study. The purpose of this quantitative study was to identify the factors that may influence, or act as barriers and prevent, Black male students from acquiring higher levels of technological literacy. These higher levels of technological literacy could lead to persistence in the fields of computer science and technology. The study sought to determine how demographic differences or institutional experiences contributed to the technology literacy variables. A total of 143 surveys were received; however, only 114 were usable for this study and met criteria established for inclusion. Of the remaining 29 surveys deemed unusable, 15 did not complete the survey in that five or more items were omitted and the remaining 14 were completed by faculty members. The survey was distributed to university and college students primarily at HBCUs to better understand the experiences of Black males and the impact of these experiences on technology literacy and technology career aspirations. The research sought to answer the following questions:

Question 1: What factors influence levels of technology literacy in Black males?

Question 2: To what extent is there a relationship between having technological literacy and aspirations for a career in informational technology (IT) for Black males?

Methods of Data Analysis and Presentation of Data

The descriptive statistical analysis was used to identify frequencies and percentages to answer all of the questions presented in the survey instrument. The statistical significance of relationships among selected variables was determined using linear regression with a significance level that was set at 0.05.

Independent Variables

Demographics. A preliminary review of the demographics of the students enrolled at nine HBCUs and two small regional universities was conducted to gain insight into the analysis. This provided context for the study and allowed comparisons with the survey data. A description of the research sample of college and university students is shown in Table 3. The research sample of students was slightly more experienced (in terms of class level), Black, and enrolled primarily at HBCUs.

A little more than half of the survey respondents had attained a junior class level standing or higher (55.9%, $n = 62$). Two-thirds (66.7%, $n = 76$) of the survey respondents were male and three-quarters (74.6%, $n = 85$) of the survey respondents were part of a computer organization at the college or university they were currently enrolled at. Nearly half (47.4%, $n = 54$) of the survey respondents were Black males. The results may indicate a shift in the numbers of minorities that are seeking careers in the fields of computing and technology or may be the result of sampling error in which the self-reporting (or volunteer) effect may be present. The study found no significant relationships between the demographic variables of age, class level, or gaming. Ethnicity was significant with regard to technological literacy and, additionally, institutional support. It is somewhat surprising that no other demographic variables emerged as significant, such as age or digital gaming. The study confirmed that Black males and levels of technological aspirations or technological literacy have not changed or kept pace with the increase of careers in the technology arena.

Table 3

Descriptive Analysis of Demographic Variables

Characteristic	Frequency	Percent
SEX		
Male	76	67%
Female	38	33%
RACE/ETHNICITY		
Black/Non-Hispanic	90	79%
Non-Black	24	21%
FIELD OF STUDY		
Computer Science	99	87%
Other	15	13%
AGE		
18-24	100	88%
25-34	12	11%
35-44	1	1%
CLASS LEVEL		
Freshman	28	25%
Sophomore	21	19%
Junior	24	22%
Senior	31	28%
N/A	10	9%
COLLEGE OF REGISTRATION		
College A	54	47%
College B	16	14%
College C	16	14%
College D	13	11%
College E	6	5%
Other	9	6%

Institutional data. Nearly all of the respondents were from HBCUs (85.1%, n = 97) whose enrollments ranged in size of the population from 600 to 12,000 students. The average institutional size was 4,300 total student enrollments for all of the HBCUs in the study. These universities are primarily located in the Southeastern region of the United States. The two regional universities located in the Midwestern region of the United States accounted for a small portion of the survey respondents (14.9%, n = 17).

Table 4a

Comparison of Institutional Data

	A	B	C	D	E
Geographic Region	Southeast	Southeast	Midwest	Southeast	Southeast
Enrolled Students	10,700	500	22,000	2,100	10,200
Institutional Type	Public	Private	Public	Private	Private
Institutional Environment	Community Engagement	Community Engagement	Community Engagement	Community Engagement	Community Engagement

Table 4b

Black Male Technology Literacy Study Participating Institutions

Institution Type	*College or University*
Public Research Universities	Georgia State University
Private Historically Black Colleges and Universities	Clark Atlanta University Howard University Morehouse College Tuskegee University Voorhees College Dillard University Lane College
Public Historically Black Universities	North Carolina A & T State University
Comprehensive Public Universities	Eastern Michigan University

Dependent Variables

Factor analysis. Factor analysis was conducted as a data reduction method to explain the relationship between variables and to determine the effect (if present) of latent variables. The analysis found that 29 of the 56 items (a little less than one-half) loaded in the rotated component matrix shown in Table 5.

Principal component analysis and multiple regression

Data were then analyzed to determine the relationships between items. Principal component analysis is the process the researcher used to understand the relationships between the data. Relationships between dependent variables were observed and mediating variables were identified by combining survey items that loaded together. This analysis allowed the data to be extracted from the table and converted into new variables. The analysis identified several constructs from the data collected from the survey instrument which was then re-coded.

Multiple regression is an appropriate method for data analysis in this research because it provides regression coefficients indicating the direction and the magnitude of the relationships between variables. These coefficients represent the change in the dependent variable, given a one- unit increase in the predictor variable. This method also allows the researcher to determine the variance explained by the model.

Table 5

Principal Component Analysis

		Pattern Matrix									
		Component									
		1	2	3	4	5	6	7	8	9	10
Technology Identity	TCHID1	.692									
	TCHID2	.830									
	TCHID3	.783									
	TCHID4	.751									
	TCHID5	.656									
	TCHID6	.609									
	TCHID7	.705									
Technology Aspirations	TASP1		.817								
	TASP2		.784								
	TASP3		.796								
	TASP4		.813								
Barriers	BTL1			.765							
	BTL2			.590							
	BTL3			.729							
	BTL4			.678							
Socialization around digital games	SOCGM1				.742						
	SOCGM2				.883						
	SOCGM2				.827						
Classroom Experiences	CLSSEX1					.712					
	CLSSEX2					.725					
	CLSSEX3					.798					
	CLSSEX4					.602					
Technology Literacy	TL1						.726				
	TL2						.701				
	TL3						.652				
Institutional Support	INSUP1							.636			
	INSUP2							.767			
	INSUP3							.802			
Family Support	FSUP1								.845		
	FSUP2								.813		
Comfort with Technology	CWT1									.602	
	CWT2									.799	
Digital Gaming	DG1										.885
	DG2										.781
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization											
a. Rotation converged in 8 iterations.											

Reliability and Validity

Cronbach's alpha was calculated for the constructs generated by the research instrument to determine internal consistency for each construct. A guideline recommended by George and Mallery (2003) for interpreting alpha values is: greater than .9 (*excellent*), greater than .8 (*good*), greater than .7 (*acceptable*), greater than .6 (*questionable*), greater than .5 (*poor*) and less than .5 (*unacceptable*). All of the reliability coefficients had alphas in the acceptable to excellent categories except for Column 9, which represented “comfort with technology.” The values were as follows:

- Column 1 (*n* =7, .893) 112,
- Column 2 (*n* = 4, .886) 112,
- Column 3 (*n* = 4, .757) 113,
- Column 4 (*n* = 3, .871) 112,
- Column 5 (*n* = 4, .754) 110,
- Column 6 (*n* = 3, .681) 113,
- Column 7 (*n* =3, .715) 112,
- Column 8 (*n* = 2, .802) 114,
- Column 9 (*n* = 2, .510) 114, and
- Column 10 (*n* = 2, .847) 112.

The eigenvalues of the 10 factors were 4.617, 3.337, 2.615, 2.531, 2.526, 2.463, 2.445, 2.000, 1.947, 1.880, and 1.616, respectively. The “total variance explained,” shown in Table 6, lists the eigenvalues and reveals the 10-factor solution explains 67.590% of the total variance calculated across the 29 technology literacy variables.

Table 6

Variance of Constructs

Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	4.617	11.840	11.840
2	3.337	8.556	20.396
3	2.615	6.704	27.100
4	2.531	6.489	33.588
5	2.526	6.476	40.064
6	2.463	6.315	46.380
7	2.445	6.269	52.649
8	2.000	5.128	57.777
9	1.947	4.992	62.769
10	1.880	4.821	67.590

Note. Extraction method: principal component analysis.

Table 6 shows the items arranged within the 10 factors and the loading values. One question, “There are other members of my racial or cultural group in my classes related to computer science or technology,” did not load to any factor and was dropped from the analysis.

Descriptive Statistics

For the study, data were also analyzed for mean, standard error of the mean, and standard deviation to understand values and weights for individual and latent variables captured in Table 2.

After running analysis to look at the descriptive data for the study, there were a few items that were worth noting. Questions 8, 9, and 11 generated more positive responses (agree or strongly agree) indicating a positive attitude towards a career in computing, which represents technology aspirations. More than 80% of respondents (> 80 responses) scored Questions 8, 9, and 11 between 4 and 5 (agree/strongly agree) on the Likert scale.

The following results were obtained indicating a positive attitude towards technology aspirations:

- Question 8---87% of the participants (n = 99) agreed or strongly agreed to *I plan to obtain an advanced degree in the areas of computer science or technology*.

- Question 9---87% of the participants (*n* = 98) agreed or strongly agreed to *I am planning to devote my career to an area related to computer science or technology*.
- Question 11---85% of the participants (*n* = 96) agreed or strongly agreed to *I can see myself working as a computer scientist or computer programmer in the future*.

Descriptive Statistics for Variables

Data for the variables in the study were analyzed for mean and standard deviation to understand the values that were presented in the principal component analysis table (Table 5). These findings will be reported statistically later in the study.

Digital gaming (DG1-2). Descriptive analysis showed that students from the study displayed a high level of engagement in the playing of video games ($M = 3.06$). Exchanging strategy surrounding the playing of these video games was also deemed important by these survey respondents ($M = 3.02$).

Socialization around gaming (SOC1-3). "Socialization" around digital games was deemed important based on the survey responses ($M = 3.11$) which were higher in number. Socialization was categorized as talking about and learning about games, and also thinking about the development of the games, as opposed to just playing video games for fun. It was moderately high in terms of respondents believing that it was important to play digital games with their peers in order to develop their technology skills ($M = 2.69$). Respondents did not believe that it was important to play video games alone in order to develop their technology skills ($M = 2.65$). This supports the study findings that suggest that just playing video games (gaming) was not correlated with technology aspirations or technology literacy.

Technology identity (TI1-7). There was a high level of response with regard to having a technology identity. This category was high in terms of respondents' beliefs about having an identity associated with technology. The highest levels of importance were placed on technology helping respondents in the future (*M* = 3.79), and how the technology skills they possessed would help them acquire the job or occupation that they desired in the future (*M* = 3.77). The lowest response rate in the category were the responses to the question, “I am very confident when working with technology and computers” (*M* = 3.40). These responses are in line with the findings from the study that indicates that having a technology identity is positively correlated with having an aspiration for a career in technology.

Comfort with technology (CWT1-2). Descriptive analysis showed that students from the study showed a moderate degree of confidence with regard to their programming skills and understanding of technology being on par or better than that of their peers (*M* = 3.07). The nature of the high level of response could be due to the fact the majority of the respondents were primarily from HBCUs. Although there is research that suggests that part of the digital divide revolves around access, responses to the “growing up, I had access to technology in my home” were high (*M* = 3.47). This points to the idea that the digital divide is not about access to technology but more about the skills and knowledge needed in order to create and implement the technology.

Barriers (BTL1-4). Due to the fact that many of the survey respondents came from HBCU’s, there were not many who experienced or felt comfortable expressing their experiences with microaggressions. To the question about being “ignored” at their institutions by other students or instructors, students completing the survey did not report having this experience (*M* = 1.54). Students had also not heard someone speak negatively about someone’s racial or cultural background (*M* = 1.86). An interesting result was that there were some students who reported having an interest in technology but because their peers did not share that interest, they had to keep this interest hidden (*M* = 2.16). This supports the research that suggests that many Black students do not associate a computing identity as "cool" or accepted within their community. There was moderate to low level of response to the suggestion that students had received little support from their family with regard to their technology skills (*M* = 2.04).

Institutional support (IN_SUP1-3). Institutional support was a very important part of having technology aspirations among the students surveyed. Many of these students have made the decision to attend an HBCU in order to feel more comfortable on their educational journey. With regard to receiving support from their institution regarding the development of their technology skills, student responses were moderately high (*M* = 3.29). Students also reported that there were role models at their institutions that were accessible to them outside of their department or program (*M* = 3.18). It is important for these students to be able to talk to others outside of their programs when they have questions or concerns.

Dependent Variables

IT career aspirations (CA1-4). Although the primary focus of this study was technology literacy, the importance of having aspirations surrounding computer science and technology were also important. In all of the areas represented in this construct, student response was highly positive. To the question of "I desire a career in the area of computer science or information technology," the response was the highest (*M* = 3.52). This is representative of the students sampled as the majority of the group was enrolled in computer science degree programs. Planning to devote one's career to an area related to computer science or IT also scored high (*M* = 3.49). There are many students who planned to obtain an advanced degree in the areas of computer science or technology (*M* = 3.46). The numbers were slightly lower for students who could see themselves working as a computer programmer or computer scientist (*M* = 3.39). This lower number could be due to the fact that programming can be an occupation that is isolative by nature.

Technology literacy (TL1-4). Descriptive analysis of the variable of technology literacy showed that the respondents had a moderate degree of confidence with the idea of their technological literacy skills. This category may spring from the experiences the students have had with digital media and technology. In terms of working (expanding and compressing) with files on a computer, students responded highly (*M* = 3.46). In terms of understanding the proper steps for creating an electronic portfolio (*M* = 3.01), the scores were moderate to high. With regard to knowing how to maintain a personal website or blog, students did not express as much confidence (*M* = 2.96).

Interaction Variables

Interaction variables considered the relationship between the three variables of gender, institutional support, and technology literacy. The relationship is defined when the effect of one of the variables depends on a third variable. The independent variable of gender influences technology literacy when institutional support is applied. Institutional support moderates the effect of gender and technology literacy, thus creating an interaction. To compute the effect of the interaction, gender was multiplied by institutional support and a new variable was created (maleXInst_SUPP) and placed into the analysis. Other variables were hypothesized to have an effect, but they did not have a correlation to either of the dependent variables.

Path Analysis

Overview. The results of the path analysis are represented in Figure 3. Demographics did not impact IT career aspirations overall, but a technology identity and the decision to have a major in computer science did have an impact on IT career aspirations. Family support had an impact on respondents identifying with an identity associated with computing and technology. This identity led to technology career aspirations. It was also discovered that family support and ethnicity had an impact on institutional support, which had a direct impact on technology literacy. The path analysis is presented below:

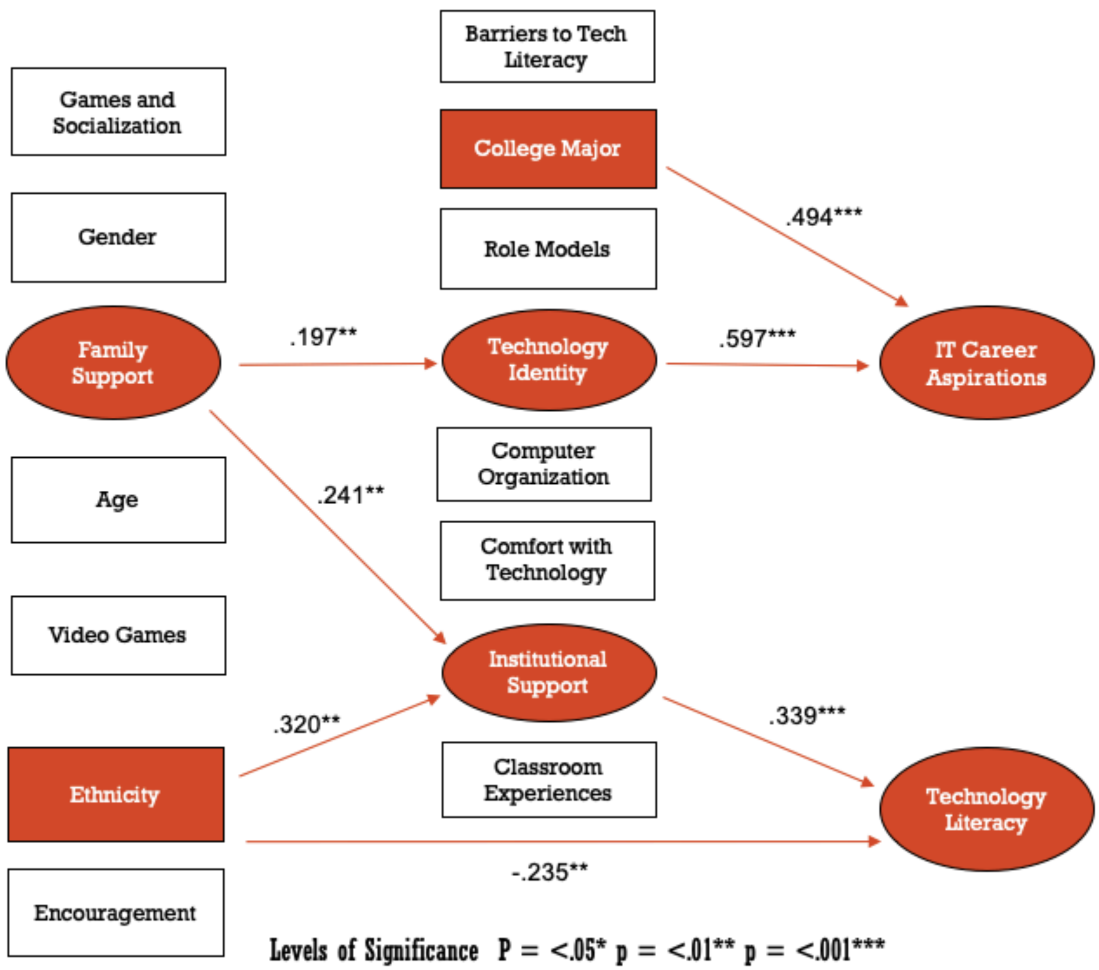


Figure 3. Path analysis model.

Regression Analysis

Backward, multiple linear regression analyses were conducted to evaluate which, if any, of the independent variables (IV) were predictors for the dependent variables (DV). Tables 7, 8, and 9 show the significant results

Table 7

IT Career Aspirations (DV)

Variable	B	Std. Error	Std. Coeff $\mathcal{B}$
(Constant)	-1.212	0.16	
College Major	1.425	0.172	.494***
Tech_ID	0.582	0.058	.597***

a. Dependent Variable: IT Career Aspirations

b. F (2,106) = 32.409, p < .001

c. Adjusted R^2 = .619, R = .791, *p < .05, **p = < .01*** p < .001

The post-survey measures of college MAJOR and TECH_ID (identity associated with technology) are predictors for the dependent variable TECH_ASP. The combined effect accounts for 61.9% of the variance and has a moderately large effect of $R = .791$. This result suggests that majoring in computer science and possessing an identity associated with computing highly increase aspirations for a career in technology.

Table 8

Technology Literacy (DV)

Variable	B	Std. Error	Std. Coeff $\mathcal{B}$
(Constant)	.459	.204	
Black	-.574	.232	-.235**
Inst_SUPP	.339	.096	.339***

a. Dependent Variable: Technology Literacy

b. F (2,106) = 6.590, p < .001

c. Adjusted R^2= .106, R = .350, *p < .05, **p = < .01*** p < .001

The post-survey measures of BLACK (ethnicity) and INST_SUPP are predictors for the dependent variable TECH_LIT. The combined effect accounts for 10.6% of the variance and has a moderately small effect of $R = .350$. This suggests that Black students are not likely to be associated with high levels of technological literacy.

Table 9

Gender X Institutional Support (MV)

Variable	B	Std. Error	Std. Coeff $\mathcal{B}$
(Constant)	0.514	0.205	
maleXINST_SUPP	0.407	0.111	0.351***
BTL_4	0.188	0.09	0.189*
Black	-0.625	0.232	-0.256**

a. Mediating Variable: Gender X Institutional Support

b. F (3,105) = 6.194, p < .001

c. Adjusted R2 = .126, R = .388 *p < .05, **p = < .01*** p < .001

The result of the linear regression indicates that *gender* is a predictor of the TECH_LIT post-survey factor. In other words, the degree to which levels of technology literacy were predicted by gender, M (3, 105) = 6.194, $p < .001$. The unstandardized slope (.407) and the standardized slope (.351) are significantly different to 0, ($t = -3.669$, $df = 3$, $p < .001$). For every unit increase in the gender variable (0 = *females*, and 1 = *males*), the TECH_LIT factor will increase .407. The adjusted R^2 value of .126 indicates that 12.6% of the variance is accounted for by the gender differences. The $R = .388$ indicates a moderately small effect.

Discussion

Demographics. The study found no significant relationships between the demographic variables of age, class level, or gaming (playing video games) in the tendencies of Black male students aspirations for careers in fields of technology or in the acquisition of technological literacy. In addition, ethnicity was not significant with regards to technology aspirations, although it was significant with regard to technological literacy in a negative way (*B* = -.235**). This is significant because 79% (*n* = 90) of the survey respondents answered that they associated with "Black" in terms of their ethnicity.

Gender influenced institutional support, but only for males. This support for males influenced technology literacy while females did not experience the same level of support

Interaction Variables. Interaction variables considered the relationship between the three variables of gender, institutional support, and technology literacy. The interaction or moderating effect occurs when the effect of one or more of the variables depends on a third variable. In this study, it was hypothesized that gender and ethnicity influenced technology literacy; therefore, interaction variables were included in the analysis. Because technology literacy was the foundation of the study, it was important to test all variables to see which had an impact.

To compute the effect of the interaction, gender (both male and female) was multiplied by the mediating variable (inst_sup4) and incorporated into the analysis in order to determine if there was a presence of one or the other. In addition, institutional support and having a tech identity were hypothesized to have a direct correlation to the two dependent variables that emerged from the factor analysis and were multiplied by gender to consider the strength of the relationship (maleXinst_supp). For that purpose, it was added to the model for testing. When calculated as an interaction variable with the value (maleXinst_supp), it was found that males were the only ones who benefited from institutional support (*B* = .351***). This emphasizes the notion that universities and education, in general, are still reflecting a male-centered orientation.

Mediating Variables

When running the regression analyses, mediating variables emerged. The relationship between ethnicity and technology literacy was mediated by institutional support. Figure 4 illustrates the standardized regression coefficient between ethnicity and institutional support was statistically significant, as was the standardized regression coefficient between institutional support and technology literacy. The direct effect of ethnicity on technology literacy by itself is negative (B = -.235**) while the direct effect of ethnicity on the variable of institutional support is a positive impact (B = .339***). By multiplying these to beta coefficients together, we get the total effect of ethnicity on technology literacy.

$$IE = (0.339) * (-0.235) = -0.079$$

The impact of ethnicity on technology literacy is still negative, but it is less negative because of the *indirect effect* institutional support provides. Institutional support is a mediating variable because it changes the total effect on one of the dependent variables.

Summary

The theoretical framework and the use of the statistical software were necessary to understand, examine, and explain the experiences of Black male undergraduate students and the development of technology literacy. The focus centered on this group because it is a group that has been seriously underrepresented in the areas of technology and computer science. The theory by itself was not able to fully address the issues faced by these students, but it provided some insight into this phenomenon. The research showed no relationship between the demographics of age, class level, or online gaming for the variables in the study. Male students, in general, received more institutional support with regard to technology literacy. This is an unusual finding as universities are viewed as actively recruiting women and minorities into programs that have been traditionally underrepresented.

In the analysis of technology literacy, the data suggest that the factors that are having an impact are not equally significant in terms of technology literacy acquisition. More importantly, video game playing and encouragement, considered to be important traits in terms of getting Black males involved in computing (DiSalvo et al., 2013), were not significant in terms of technology literacy acquisition. There was a surprising negative relationship between demographic trait or ethnicity and technology literacy.

Chapter 4 reviewed the survey data and results in detail to provide context for understanding the research questions. Chapter 5 presents the conclusions and discusses implications for practice and future research.

Chapter 5: Conclusions

This research centered around the conceptual framework (Figure 2) that was modeled after the anti-deficit achievement framework (Harper, 2010) to explore the factors that influence levels of technology literacy in Black male students. The study sought to shine a light on the factors that push some Black males to enroll in and persist in degree programs related to computer science and technology. Findings substantiate the relationship between the variables and emphasized the significance that a technology identity and the institution had on the levels of technology literacy and the technological aspirations for Black male students. This chapter represents an overview of the research, implications for practice, theoretical implications, limitations, implications for future research, and recommendations for future studies.

Research Questions

Question One. *What factors influence levels of technology literacy for Black males?* The study found that two of the traits (factors) from the college achievement phase *institutional support* and the demographic variable of *ethnicity* had a significant influence on technology literacy. The study revealed that there was a significant negative relationship between ethnicity (*Black*) and the variable technology literacy (B = -.235**). That is, Black students from the study did not exhibit a positive relationship with the variable technology literacy; in fact, Black males exhibited a negative relationship with technology literacy. This would signify that Black students had less technology than any other group in the study. Since ethnicity was significantly correlated with institutional support, it was important to see the effect that institutional support had on ethnicity. The direct effect of ethnicity on technology literacy is negative (B = -.235***) while the direct effect of institutional support on technology literacy is a positive impact (B = .339***). The total effect of ethnicity on technology literacy is the “direct effect” plus the “indirect effect.” By multiplying the beta coefficients together, we get the *total effect* of ethnicity on technology literacy.

$$TE = DE + IE: (-0.235) + (0.339) * (0.320)$$

$$TE = -0.235 + 0.108 = -0.127$$

The impact of ethnicity on technology literacy is still negative, but it is less negative because of the *indirect effect* that institutional support provides. Institutional support is a mediating variable because it changes the total effect on one of the dependent variables. This tells us that overall Black students have lower technology literacy, even accounting for the additional institutional support they receive, but it is less than if they did not get any institutional support.

When institutional support and gender were computed as an interaction variable, however, differences were observed. Institutional support and gender (MALE xINST_SUPP) positively influenced technology literacy (B = .407) at greater levels than any of the other variables. This suggests that males receive institutional support at greater levels, thus increasing their technology literacy. This was interesting because females dropped out of the regression and this study suggests that in terms of technology literacy, males were the only benefactors of institutional support.

Question Two. *To what extent is there a relationship between having technological literacy and aspirations for a career in computer science or technology for Black males?* The study also looked to determine if there was a relationship between having technology literacy and aspirations for a career in computing or IT. The study found that two traits from the college achievement phase, college *majo*r and having a *technology identity*, had a direct impact on technology aspirations. Choosing a major associated with computer technology was not surprising with regard to technology aspirations. An interesting perspective was that those students who had an identity associated with technology also aspired to have a career in the field of computer science or IT. Neither gender or ethnicity was found to have an impact on technology aspirations directly. After conducting the study, it was determined that there was no relationship between the variables *IT career aspirations* and *technology literacy*. Having technology literacy had no impact on whether or not Black males had IT career aspirations. That means that the two dependent variables are both important, but they are separate. This means that institutions of higher learning need to address both variables, but in different ways. Having high levels of technology literacy does not mean that one will have aspirations for a career in the field of technology or vice versa.

Other Conclusions

One. Family support was the only variable from the study that was significant for both an identity associated with computing or technology and institutional support. Family support was significant with regard to the variable *technology identity* (*B* =.197**). In addition, the variable *technology identity* was significantly associated with *IT career aspirations* (*B* =.597**). This signifies that support from family is crucial for developing an identity associated with technology. It is this identity that is needed or leads one to aspire for a career in IT or computing. Family support also had a significant impact on the variable *institutional support* (*B* =.241**). This signifies that Black families look to institutions for guidance and support when they encounter situations that are unfamiliar to them, such as areas of computing and technology. This tells us that the role of the family with regard to Black male students and the acquisition of technology literacy is more important than peer relationships and relationships established at the institution. This tells us that of all of the independent variables, family support was the only factor that had an impact on both technology literacy and IT career aspirations. Mahoney (2017) states that families can nurture and sustain their student's interest in academic achievement as well as their college aspiration (p. 20).

Two. From the study, it was determined that having an identity associated with technology was significantly correlated with IT career aspirations (*B* =.597**). This is significant because as previously discussed in the review of the literature, Black males typically associate with a masculine identity. The identity associated with technology, previously identified as the "geek" identity, is crucial for having IT career aspirations. For Black males, it is essential that they overcome these negative connotations attached to the computing identity in order to attain a career in the computer science field.

Three. The data suggest that factors impacting technology literacy are not equally significant. Specifically, video game playing and encouragement, which were considered important traits in terms of getting Black males involved in computing (DiSalvo et al., 2013), were not significant in terms of technology literacy acquisition. Many participants from the study answered that they believed that it was important to play games as evidenced by their positive responses to the survey question posed about online gaming:

Q 30. "I regularly participate in online gaming."

The descriptive data shows that 71% of the respondents ($M = 3.06$, $SD = .893$, $n = 81$) play video games online by themselves. These games have been targeted to Black youth but provide no value to aspirations and technology literacy with regards to career readiness. According to DiSalvo & Bruckman (2009), although many Black males participate in gaming, more youth, in general, participate in gaming. Because of this, gaming has lost some of its cultural significance and exclusivity. This was once seen as a gateway into a specialized community of practice, but has lost some of its luster as the number of people playing games has increased.

Discussion

There has been much talk about increasing minority persistence in computer science programs at institutions of higher learning. One possible way of broadening participation of Black males in fields of computing and information technology is through pedagogy. By altering the traditional approach to teaching computer science, educators may be able to draw more Black males into the field and keep them there. To specifically address the gaps in representation within the computing sciences, the National Science Foundation developed the broadening participation in computing program in 2005 (Charleston, 2012). There are some areas that should be investigated further to uncover possible solutions to the problem of underrepresentation of Black males in areas of computer science and technology.

Gaming. Since the study revealed that an interest in gaming is present among Black males, the focus on video game playing and real-world application should be re-examined to determine if this interest can be shifted to other areas of technology such as computer science and informational technology. Researchers (Dyson, 1997; Lee, 1991) have explored the benefits of bridging the worlds of formal learning and the communities in which children live (as cited in DiSalvo, 2008). Children have an informal knowledge base and skill sets that could be integrated into more formal educational settings. DiSalvo et al. (2011) notes that many Black males have a passion for video games, but unlike their peers, they do not transfer that engagement into a curiosity or agency with the underlying technology. Why is this group not transferring this passion for games into a passion for technology? Digital games are increasingly being viewed as a potential opportunity for learning in many different content areas because of their ability to capture children's interest (DiSalvo et al., 2008). According to a report by the Federation of American Scientists (2005), many of the skills that these players develop while using video games are some of the same skills that employers will be seeking in technology-driven fields (as cited in DiSalvo et al., 2008). In a study on Black male youth and gaming conducted by DiSalvo et al. (2008), many of the Black male participants indicated that family members had introduced them to digital gaming, purchased games for them, and served as playmates for console games. There is an interest exhibited by Black males for technology and games, and educational institutions need to use this interest to get more Black males interested in technology and computer science. Institutions need to develop programming that addresses this need and create interventions that encourage Black males to take their passion for gaming and transfer that passion into other areas of technology. Part of the problem is that Black males do not identify with computing as a social norm within their peer group (DiSalvo, Guzdail, Bruckman & McKlin, 2014). The research further states that this disidentification with computing can negatively impact academic performance and limit opportunities for upward mobility (DiSalvo et al., 2014).

Computer science pipeline. Research on the underrepresentation of non-Asian minorities in the fields of computer science and technology is increasing. Aspects of the academic pipeline impact how Black males interact with technology and continue to pose obstacles to their academic success (Cain & Trauth, 2013). An important part of entering a technology-related career is being a part of the computer science pipeline. Individuals who deviate from this pathway (following this pipeline), whether by choice or other factors, will encounter greater difficulty re-entering the pipeline at a later date, if they return at all (Elliott, Strenta, Adair, Matier, & Scott, 1996). Entering computer science or technology-related fields (beginning with a STEM major) is a sequential, linear process, so deviating from the pathway can cause many students to lose confidence and not persist. When looking directly at the computer science pipeline, the findings are not promising. African Americans, Native Americans, and Hispanics are grossly underrepresented in the fields of computer science (Mitchell, 1999). These groups are underrepresented in higher education generally and usually choose alternate pathways once they enter postsecondary education. The National Science Foundation (NSF) reported in 2007 that the percentage of computer science degrees awarded to Black males increased from 4.94% in 1997 to 7.55% in 2006 (as cited in DiSalvo, 2012). Although there have been gains, these numbers are not helping to fill the computer science pipeline with regard to research jobs, academia, or higher-paying jobs in computer science or IT. If the numbers of Black males and other underrepresented minorities present in the computer science pipeline does not increase, the digital divide will continue to expand.

Support. Opara, Etnyre, and Rob (2005) believe that at many educational institutions, non-traditional teaching and learning practices can foster Black males' participation in high-tech programs and careers. These practices include mentoring and encouragement of internships as early as one's sophomore year in college. Researchers believe that reducing social and educational barriers to high-tech careers can also help university educators move these students into high-tech careers in which they have been underrepresented (Opara, et al., 2005). To encourage interest in computer science and technology-related programs and careers, researchers suggested increasing the number of science and mathematics courses taken during the pre-college years (Oakes, 1990).

One of the areas where Black males can find support is from their peers. According to Palmer and Maramba (2011), when students participate in peer groups, their knowledge of classroom content is reinforced, the classroom hierarchy is removed, and they can feel more comfortable and ask questions, thus accessing the content (as cited in Mahoney, 2017). These hierarchies, if present, may limit the opportunities that Black males have with technology, causing them to possibly opt out of computer science degree programs.

Stereotypes and perceptions. Researchers (Steele & Aronson, 1995; Steele, 1997; Davis Aronson, & Salinas, 2006; Hamilton, 2009) say that when capable Black college students fail to perform as well as their White counterparts, the explanation often has less to do with preparation or ability than with the threat of stereotypes about their capacity to succeed (as cited in Cain & Trauth, 2013). According to Jackson et al. (2001), simply making those aware of their own ethnic and class-based identities through a negative stereotypic association between these group memberships and the ability to use technology effectively can evoke self-doubt and the ability to gain mastery in this domain. When Black males do not identify with the culture that surrounds technology, it is difficult for them to develop an identity associated with technology.

According to Harper (2004), it appears that committing one's time to the advancement of the Black community and assuming responsibility for bringing about changes that would improve the quality of life for minority students were primary ways in which some Black males were able to shape and develop positive ideas surrounding identity. This notion, if reinforced in Black males, may be a way to increase their numbers in fields such as computer science and IT. The findings from this study concur with the beliefs set forth in the theoretical frameworks used as the guide for this study.

K-12/pre-college experiences. There has been much research that suggests that Black males are not prepared for the rigors of computer science degree coursework. There are opportunities for K-12 leaders to help impact Black males' decisions to look at computer science as a field they can be a part of. Teachers can expose students to new/emerging technologies while also engaging in culturally relevant pedagogy. Black males have an interest in technology when they are young, and it is important to cultivate those interests at a young age. Increasing the access to technology for students is also where K-12 leaders can have an impact. Lessons and curricula could be delivered using technology, and students should be encouraged to use technology to complete assignments. Creating collaborative learning environments based on constructivist principles can help Black males become more comfortable in multiple educational settings.

HBCUs. There has been a growing body of research examining the academic and social experiences of Black male college students (Goings, 2016). Fries-Bitt, Burt, and Franklin (2012) found that within the HBCU context, high-achieving Black males were more likely to experience a warm and supporting environment where their lived experiences and identities were affirmed by their peers, faculty, and staff (as cited in Goings, 2016). Since HBCUs receive specialized funding and grants specifically for the purpose of increasing representation in STEM fields such as Pell grants and the Historically Black Colleges and Universities Undergraduate Program (HBCU-UP), these institutions can use that funding to create programming that provides opportunities for Black male students to interact with computer science and technology concepts in a non-academic setting to provide holistic experiences. These programs can help address the academic and social needs of Black males by providing opportunities for them to socialize, network, and gain more confidence in their academic endeavors.

Implications for Black Male Students

The use of technology to increase levels of technological literacy in Black males can provide unique opportunities in education and future employment. According to Strayhorn (2015), a *sense of belonging* is important for Black males in STEM fields. Strayhorn further states that faculty and peers play a crucial role in promoting this sense of belonging. To help this process, there are some things that Black male students can do:

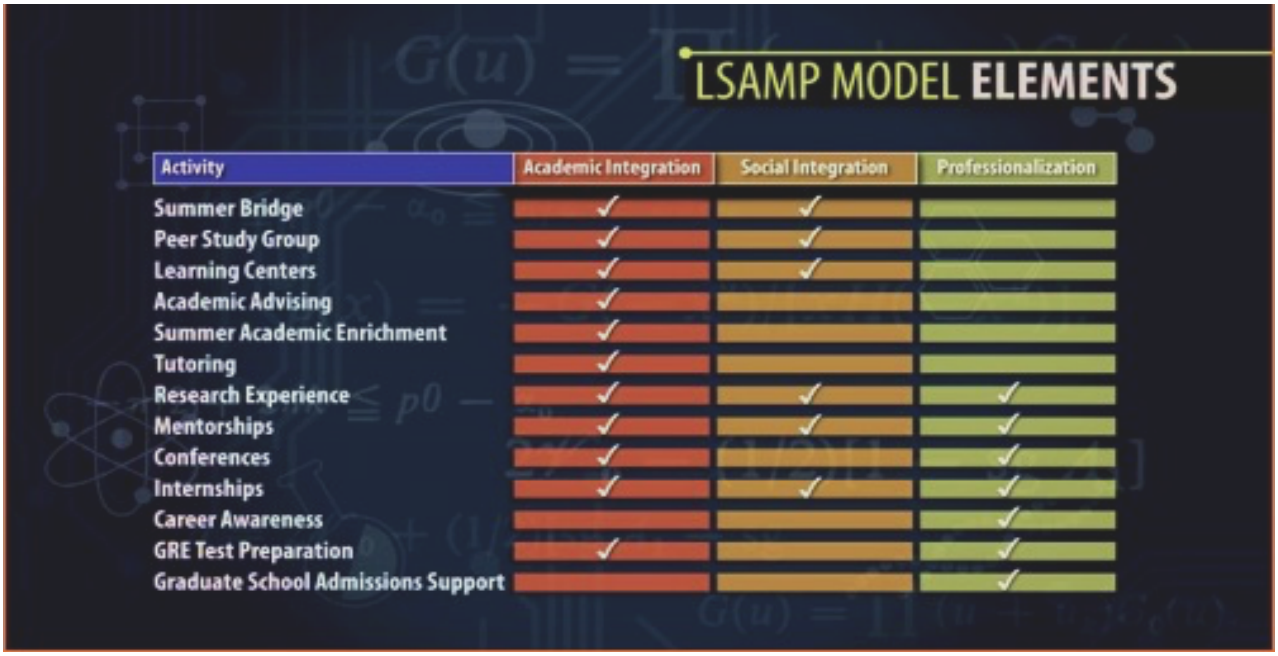
- look into becoming part of computer organizations on campus,
- look at the possibility of joining a fraternity on campus,

- find a community organization to join for support and possible networking, and
- reach out to department leaders and learn about research opportunities and identify possible department mentor's/role models.

Implications for Institutions of Higher Learning

Universities and colleges should make sure that their instructors are doing their part with regard to instructional practices to help Black male students become more engaged in the educational process. By reflecting on pedagogy and practice, instructors can help students increase efficacy around the development of an identity associated with technology. Institutions must also be purposeful in their recruitment of Black male students into their computer science degree programs and intentional in their support in order to ensure success.

Institutions could also provide bridge opportunities for Black males as they undertake the journey to computer science or technology-related degree completion. One such program that has had an impact is the Louis Stokes Alliances for Minority Participation (LSAMP; see Figure 4). The overall goal of the program is to assist universities and colleges in diversifying the nation's science, technology, engineering and mathematics (STEM) workforce by increasing the number of STEM baccalaureate and graduate degrees awarded to populations historically underrepresented in these disciplines. This model is based around Tinto's (1975) model of student retention which focuses on how students integrate both academically and socially on university and college campuses.


LSAMP MODEL ELEMENTS

Activity	Academic Integration	Social Integration	Professionalization
Summer Bridge	✓	✓	
Peer Study Group	✓	✓	
Learning Centers	✓	✓	
Academic Advising	✓		
Summer Academic Enrichment	✓		
Tutoring	✓		
Research Experience	✓	✓	✓
Mentorships	✓	✓	✓
Conferences	✓		✓
Internships	✓	✓	✓
Career Awareness			✓
GRE Test Preparation	✓		✓
Graduate School Admissions Support			✓

Figure 4. Louis Stokes Alliances for Minority Participation Elements

Google chrome (http://lsmce.org/lsamp-community/lsamp-model/)

Theoretical Implications

The anti-deficit achievement framework (Harper, 2010) is based upon the idea that by focusing on the achievements of Black male students instead of their deficits or failures, researchers and policymakers can develop programming and policies that increase the presence of Black males in areas of computer science and technology. This study had previously been utilized to shed light on the factors that have been attributed to African American success in education. For this study, the framework has specifically been used to examine students in computer science and technology-related degree programs. The analysis of the data uncovered findings that led to the conceptualization of new theories. Initially, family support, online gaming, peer support, gender, and age were the expected traits for high levels of technology literacy. However, loading the items into factor analysis and linear regression produced a different result. Only family support was indirectly significant to both technology literacy and IT career aspirations. Institutional support emerged as an important measure of technology literacy. This provides a different lens through which to look at technology literacy, compared to focusing on the factors surrounding the individual. A closer inspection of institutional support is in line with the rapid changes in the structure of higher education. Learning occurs in many different forms today, and it is important to study the institutions to make sure that the support being provided by the institution is in the correct format.

Ethnicity, gender, and technology identity were significant to the findings, and the role of gender and ethnicity in studies of technology and computer science is compelling (Cain & Trauth, 2013). The constructs for technology literacy and the anti-deficit achievement framework were confirmed and deserve merit in the context of broadening participation in computing via increasing Black male levels of technology literacy. The significant level of institutional support on the dependent variables was unexpected but has emerged as a topic of further investigation.

Having a computer science or technology-related major was important, but the relationship between family support and technology identity were more important in understanding aspirations for a career in IT. The inclusion of self-efficacy or social constructionist (i.e., individual differences theory of IT) theories would provide a better framework for technology literacy that could have deeper implications for institutions of higher learning. This notion leads to the modification of the conceptual framework for future study (Figure 5).

Conceptual Framework

While Harper's (2010) framework pays close attention to precollege socialization and readiness factors such as familial factors and college achievement factors such as classroom experiences, it does not adequately acknowledge how self-efficacy or an identity associated with technology help some Black male succeed where others have not. What is it that, in spite of all the obstacles present, push these students to persist in fields of computer science and technology? Since this study sought to highlight successful Black male students in computer science and technology-related degree programs, the first two sectors of the framework (pre-college socialization, and college achievement) were the focus. The sections on pre-college readiness and college achievement do not account for the internal drive and motivation necessary for success in these highly competitive areas. One question that might be added to the framework is "What motivates Black males to persist in computer science degree programs when they encounter obstacles?" Since these experiences might affect their experiences at university and college campuses, the researcher believes that it should be included in the framework. Answers to this question and those similar in nature may provide insights into what services and/or supports these students utilize to persist in their programs of study.

While the framework pays close attention to the areas surrounding pre-college and their time in college. It does not address the role that having an identity associated with technology plays in the decision for some Black males to enter into computer science and technology-related degree programs. While looking at the results from the study, the framework should be modified to address how Black males see themselves in the space of education, and what factors contributed to the development of a technology identity. The framework should also seek to uncover the internal forces that push these students to enroll in highly competitive areas, even though there are many obstacles placed in front of them. In order to address these issues, the researcher suggests modifying the framework (see Figure 5).

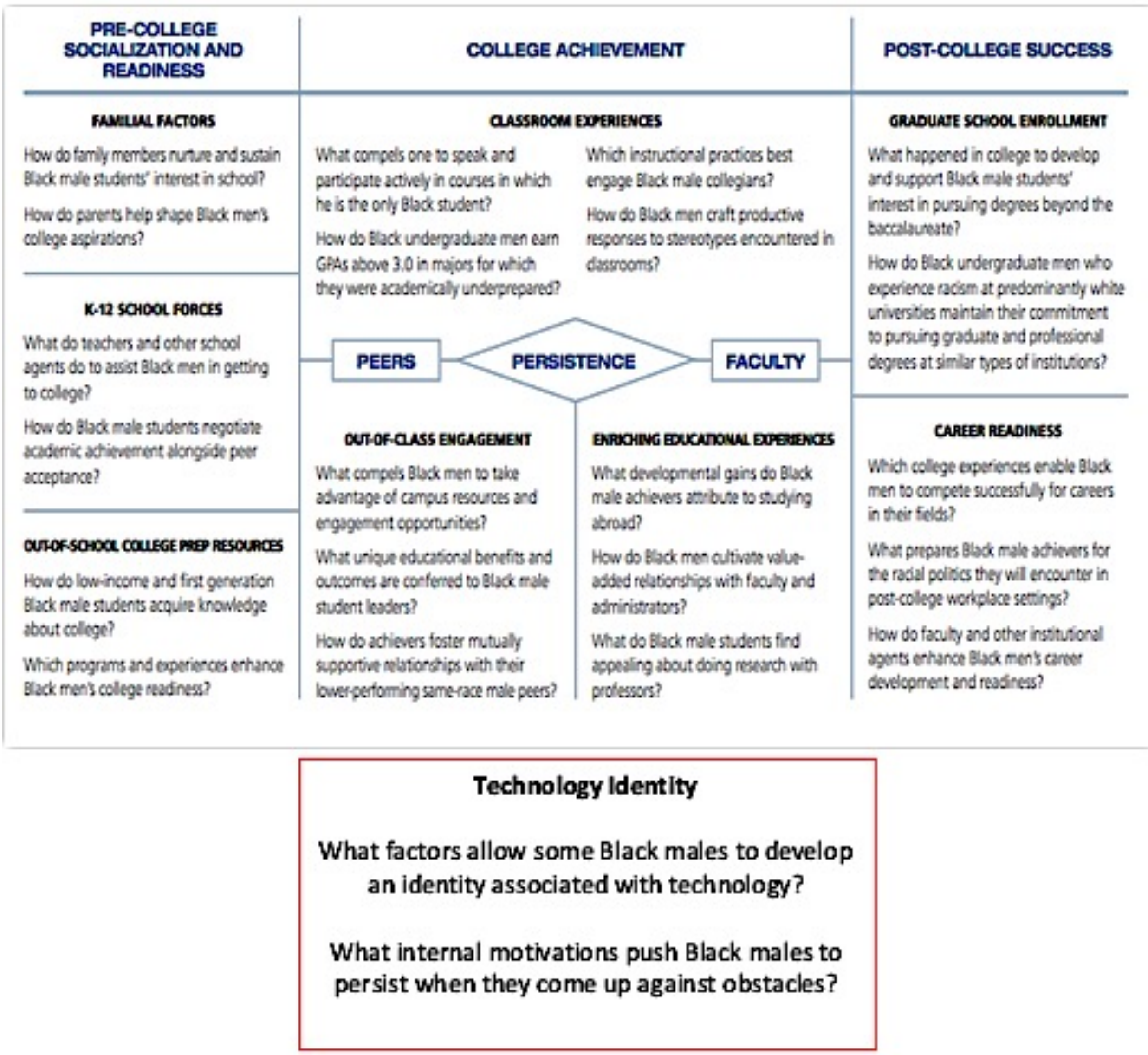


Figure 5. New Proposed Framework with modifications to Harper's anti-deficit achievement framework.

Implications for Practice

What this research uncovered is that in terms of the acquisition of technology literacy, Black males are lagging behind their peers (Cain & Trauth, 2013; Charleston, 2012; DiSalvo et al., 2011; Warschauer & Matuchniak, 2010; Amiel, 2006). To accurately assess the advancement of Black male students in the fields of computer science and technology, data need to be available based on gender and race. There is limited quantifiable research based on these characteristics. A continued focus needs to be created in order to assist Black males in the development of an identity associated with computing to ensure that they find a sense of belonging in this arena. There needs to be an intentional recruitment of Black males into areas of computer science and technology. Computer science programs need to be nurturing and collaborative while also making the computer science curricula race inclusive. This will also help Black male students recognize and understand the benefits of being members of this profession. A network needs to be established to provide mentorship, support, real-world experiences, career exposure, and intentional recruitment of Black males into computer science and technology-related degree programs. At the university level, the numbers of role models need to be increased to provide the social and emotional guidance needed to not only allow Black male students access into these fields but also persist once they gain access. Instructors must engage in culturally competent pedagogy to understand and empower Black male students in their classes. They can do this by providing opportunities for group work so that these students can learn from and teach their peers, and making sure that there are multiple instances for them to display their knowledge. Informal exposure in non-academic settings to computer science faculty members can help break down some of the walls and isolation that Black male students may experience. By empowering this group of students, they can begin to see themselves as part of the computing workforce. This is important because the different perspectives that emerge from a diversified workforce are more likely to yield widely applicable solutions to the most pressing problems and challenges facing our nation (Peckham et al., 2007). In an attempt to reduce the disparity that exists for minority students in the computing sciences, the National Science Foundation (NSF) established the Broadening Participation in Computing (BPC) Alliances between 2002-2009 (Charleston et al., 2014). The BPC Alliances have made the field of computing more real and more attainable for many students. The Alliances highlight at least two key characteristics of good alliances: the ability to collaboratively adjust approaches, structures, and practices; and the ability to develop new communication infrastructures to more effectively plan, implement, evaluate, and broadly disseminate effective practices. (Chubin & Johnson, 2011).

Although some Black males considered themselves to have an identity associated with computing, it was not enough to compensate for the missing values that were in the relationship with technology literacy. This is in line with studies that find computing identity developed by environmental factors and technology experiences to be leading indicators of technology comfort and higher levels of technology literacy (Rivoli & Ralston, 2009; Tsui, 2007; Oakes, 1990).

Research (Archer, Osborne, & DeWit, 2012) suggests that many Black students come from disadvantaged backgrounds, where parents and the home may lack "science specific" capital to support student interest and engagement with STEM. This capital, where the family's values, attitude, and behaviors are in alignment with science, could enable these students to develop an identity from which technological aspirations could be formed, along with the desire to pursue these aspirations. Because many Black students come from disadvantaged homes, their families may not know how to encourage and support their interests in STEM (Chang et al., 2008). Due to the fact that family support was integral to both technology literacy and IT career aspirations, connecting with families is crucial moving forward.

While some in-college traits impacted technology literacy levels among Black males, the research study confirms that the environment and support networks had a more significant effect on these levels. This emphasized the need for institutions to drive recruitment and participation in computing for Black males through institutional programming, policy development, and environmental study. HBCUs should be studied so that other institutions can implement successful practices that lead to Black male success.

According to the National Center for Science and Engineering (2013), only 9.2% of the technology workforce is considered Black or Latino(a). Improving the educational and occupational outcomes for Black male students requires that educators recognize and understand the potential barriers that exist and may keep Black male students from acquiring levels of technological literacy necessary for advanced degree attainment and employment in the field of computer science. This need for more diversification in the technology workforce has been demonstrated (Martin & Scott, 2013; Scott, Clark, Sheridan, Hayes, & Mruczek, 2010; Simard, 2009; Tyson, Lee, Borman, & Hanson, 2007; Stockard, Klassen, & Akbari, 2005).

Implications for Educational Leadership

The study showed that the digital divide is still very much present in the Unites States. One way to address this divide is to increase the presence of Black male students in areas of computer science and technology. Leaders need to make sure that computer science curricula are race inclusive and expands the access and usage of technology both at the K-12 and the university levels. Districts and universities that serve large minority student populations need to offer multiple ways in which technology can be accessed and manipulated. Leaders must be intentional with their recruitment efforts to include Black male students in the areas of computer science and technology. The path analysis model in the study showed that the variable *classroom experiences* at the university level was not significant. This does not mean that what happens in these classrooms is insignificant. It means that university leaders need to reexamine the types of supports and classroom experiences Black males are reporting, because those pedagogical experiences are not making a difference. Culturally relevant pedagogy would make a difference, and faculty at the university level need to implement these pedagogies. The path analysis model also pointed out that even though the classroom experiences are not making a difference, the support from the institution is still highly significant with regard to this phenomenon. Educational leaders must continue to not only offer support, but increase the amount, to ensure the presence of Black males in the area of computer science increases.

Limitations

Although there were important findings uncovered in this study, there were limitations. First, it is difficult to generalize the findings for all institutions due to the small sample size (n = 114) compared to the number of surveys distributed (approximately 1,400), and that the largest percentage of respondents were from HBCUs and not representative of larger institutions. More institutions included in the study would have made the results more conclusive. The small population of Black male students enrolled in computer science and technology-related degree programs in this study are not representative of the numbers that could be present at larger research institutions. The distribution of the survey to faculty members instead of directly to students proved problematic. This was done because of the necessity of gaining IRB approval from multiple institutions in order to gain access to their student populations.

Fine-tuning of the survey instrument and clarification of variables would help to rectify the challenges that arose when trying to collect responses. The pilot survey did not reveal any problems, but because of the "volunteer" nature of survey instruments, many surveys were deemed unusable because they were incomplete. The problematic nature created by not clearly defining variables/constructs would also resolve some issues. For example, technology literacy and technology identity could both be more clearly outlined for the survey respondent, thus providing a more stable rationale for the study. More survey items should be created to improve the reliability of all variables in the study.

Although the constructs that came from this study did stand up to Cronbach's alpha testing, proving it was reliable, the study may have been better served with some combination of existing survey instruments possessing established question clusters. From a student perspective, "survey fatigue" is a real, as students are bombarded with survey requests constantly. Completing the survey may not have been a priority for them, and this may have been a limiting factor. From a research perspective, because the survey was about technology literacy and Black males, there were many departments and institutions that were excluded from the study.

More data gathering techniques with regard to the survey on pre-collegiate experiences and their relationship to technological aspirations and technology literacy would further refine the survey. Institutional support (technology literacy) and technology identity (IT career aspirations) are both an important measures in this study, as they emerged as a mediating variables. Looking at these variables in more detail would be beneficial in the future.

Considering technology literacy in connection with other institutional departments (not exclusively computer science) is a recommendation for future research.

Implications for Research

Based on the results of the study, the following implications for future research are worthy of consideration and should be of interest to both educators and policymakers. One opportunity would be to revise the survey instrument and find a way to distribute to students at other institutions. Sending the survey to both Black male students at predominantly White institutions (PWIs) and Black male students at HBCUs and then comparing the experiences and perspectives of the two groups would provide greater insight. Updating the survey to include more questions about self-efficacy, identity, race, and gender would be a way to approach some of the issues surrounding higher education today.

Another area of research could be to draw on the strength of a qualitative approach in a longitudinal study. This study could be for a particular group of Black male students at a specific institution to determine their academic experiences. Their experiences and interactions with the professors and other university staff members would provide a holistic view that would deepen the understanding of engagement in the courses and determine the specific nature of those relationships. This could help university personnel determine pre-college readiness and implement programs and interventions that would allow Black males to be successful in computer science. The interviews, focus groups, and observations during this process could provide valuable information and give voice to the "lived" experiences of these Black male students. What is missing from the current study, is how Black male students actually define themselves in this technological space.

Due to the variety of population sizes of the institutions in this survey, a more representative population might have the potential to uncover information that could be used for program development with regard to Black male recruitment and retention in computer science programs. The perceptions surrounding computer science and the actual results of the survey raise interesting questions moving forward. Most importantly, using anti-deficit thinking when conducting new research is critical, as the deficit-model paradigm that surrounds Black males has broad implications for the institutions, society, and the future of education.

Other questions that arose in terms of technology literacy and technological aspirations involve K-12 (pre-college) preparation and specific departments at colleges and universities and their ideas about who the computer scientists should be. Further research could include the following variables: a sense of belonging, research experiences, and parental educational levels. Since technology is a driving force in our society, both locally and globally, it may be possible to combine areas of research in order to further understand Black male presence in areas of computer science and technology.

Summary

This study extends on previous research by showing that considerations of race are hardly absent from students' experiences in computer science degree programs. The experiences can open up opportunities for them to enter into the computing workforce. The results of the study revealed that there is still a lot of work to do with regard to increasing the levels of technology literacy among Black males. The study also revealed that there was a great deal of interest centered around computer science and technology-related degree programs among Black male students. College and university leaders are seemingly aware of the need to broaden participation in the areas of computing and technology. In recent years there has been a push to increase the numbers of traditionally underrepresented populations into other STEM disciplines (science, engineering, and mathematics), but technology is still an area where the numbers need to be increased. While there is interest by Black male students in the area of technology and computer science, there is still a challenge in front of leaders of institutions. Many Black male students do not identify with technology because this field involves jobs and careers that can sometimes be isolative in nature. The culture of the Black family is built upon interdependence rather than independence. There are strong pulls to enter into professions where Black students can reach back and help their communities. Not only do these students not see many people of color in computer science and technology positions, but there also have not been many opportunities for them to experience success. One point to make is in regard to the small sample size of the respondents. The fact that the researcher struggled to receive responses, even from students at HBCUs whose student body populations consist primarily of Black students, points to the problem of the study. The numbers of Black males in the areas of computing and technology are small, and there needs to be an even more intentional focus on increasing their numbers.

When thinking about the future of the United States, it important to take into account diversity and the inclusion of traditionally underrepresented groups. There needs to be a new model of inclusion which will require institutional leaders to investigate their practices and procedures. The need to understand Black male students and the ways they approach education and STEM careers (specifically technology), must be reevaluated in order to ensure progress in these areas continues. Additional studies to examine institutional practices, recruitment strategies, and support mechanisms for Black males in technology areas would provide great insight into ensuring their success. The results of the study posed new questions for future research and are needed to further advance Black males into areas of computer science and technology.

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Tables

Table 1

Computer Science Occupations in the U.S. with Faster than Average Growth for 2016-2026

CS Occupations with Faster than Average Growth	Degree Needed	Number of Jobs 2016	Employment Change 2016-2026	Percent Change
Software Developers, Applications	Bachelor's	831,300	1,086,600	30.7%
Information Security Analyst	Bachelor's	100,000	28,500	28%
Computer and Information Research Scientist	Master's	27,900	5,400	19%
Web Developer	Associate's	162,900	24,400	15%
Computer and Information Systems Manager	Bachelor's	367,600	44,200	12%
Database Administrator	Bachelor's	119,500	13,700	11%

Table 2

Overview of Variables

Independent Variables:	Demographics (D)
	(D_1) 1. Program of Study
	(D_2) 2. Age
	(D_3) 3. Gender
	(D_4) 4. Ethnicity
	(D_5) 5. Class Level
	(D_6) 6. College of Registration
	(D_7) 7. Major
	Family Support (F_SUP)
	(F_SUP1) 1. Growing up I was encouraged
	(F_SUP2) 2. I received support from my family
	Digital Gaming (DG)
	(DG_1) 1. Playing for "fun"
	(DG_2) 2. Exchanging Strategies
	Games/Socialization (SOC)
	(SOC_1) 1. Social nature of Games
	(SOC_2) 2. Playing in Online Group
	(SOC_3) 3. Tech Skill Development
	Comfort with Technology (CWT)
	(CWT_1) 1. Skills on par with Peers
	(CWT_2) 2. Access Growing Up
Mediating Variables:	Institutional Factors (IN)
	(BTL_1) 1. Ignored at Institution
	(BTL_2) 2. Negative Perceptions
	(BTL_3) 3. Keep interests Hidden
	(BTL_4) 4. Family Support (Low)
	(IN_SUP_1) 1. Institutional Support
	(IN_SUP_2) 2. Role Models
	(IN_SUP_3) 3. Encouragement
	Technology Identity (TI)
	(TI_1) 1. Confident working with Technology
	(TI_2) 2. Future resides in Technology
	(TI_3) 3. See myself as a Computer Scientist
	(TI_4) 4. I can be successful in my Program

Dependent Variables:	IT Career Aspirations (ICA) (ICA_1) 1. Desire a Career in CS (ICA_2) 2. Desire a Career in Tech Area (ICA_3) 3. Advanced Degree in CS (ICA_4) 4. Computer Programmer (desire) Technology Literacy (TL) (TL_1) 1. Working with Files/Software (TL_2) 2. Creation of Electronic Portfolio (TL_3) 3. Comfort with different Digital Media (TL_4) 4. Maintenance of Personal Website/Blog

Table 3

Descriptive Analysis of Demographic Variables

Characteristic	Frequency	Percent
SEX		
Male	76	67%
Female	38	33%
RACE/ETHNICITY		
Black/Non-Hispanic	90	79%
Non-Black	24	21%
FIELD OF STUDY		
Computer Science	99	87%
Other	15	13%
AGE		
18-24	100	88%
25-34	12	11%
35-44	1	1%
CLASS LEVEL		
Freshman	28	25%
Sophomore	21	19%
Junior	24	22%
Senior	31	28%
N/A	10	9%
COLLEGE OF REGISTRATION		
College A	54	47%
College B	16	14%
College C	16	14%
College D	13	11%
College E	6	5%
Other	9	6%

Table 4

Comparison of Institutional Data

	A	B	C	D	E
Geographic Region	Southeast	Southeast	Midwest	Southeast	Southeast
Enrolled Students	10,700	500	22,000	2,100	10,200
Institutional Type	Public	Private	Public	Private	Private
Institutional Environment	Community Engagement	Community Engagement	Community Engagement	Community Engagement	Community Engagement

Table 4.1

Black Male Technology Literacy Study Participating Institutions

Institution Type	*College or University*
Public Research Universities	Georgia State University
Private Historically Black Colleges and Universities	Clark Atlanta University Howard University Morehouse College Tuskegee University Voorhees College Dillard University Lane College
Public Historically Black Universities	North Carolina A & T State University
Comprehensive Public Universities	Eastern Michigan University

Table 5

Principal Component Analysis

		Pattern Matrix									
		Component									
		1	2	3	4	5	6	7	8	9	10
Technology Identity	TCHID1	.692									
	TCHID2	.830									
	TCHID3	.783									
	TCHID4	.751									
	TCHID5	.656									
	TCHID6	.609									
	TCHID7	.705									
Technology Aspirations	TASP1		.817								
	TASP2		.784								
	TASP3		.796								
	TASP4		.813								
Barriers	BTL1			.765							
	BTL2			.590							
	BTL3			.729							
	BTL4			.678							
Socialization around digital games	SOCGM1				.742						
	SOCGM2				.883						
	SOCGM2				.827						
Classroom Experiences	CLSSEX1					.712					
	CLSSEX2					.725					
	CLSSEX3					.798					
	CLSSEX4					.602					
Technology Literacy	TL1						.726				
	TL2						.701				
	TL3						.652				
Institutional Support	INSUP1							.636			
	INSUP2							.767			
	INSUP3							.802			
Family Support	FSUP1								.845		
	FSUP2								.813		
Comfort with Technology	CWT1									.602	
	CWT2									.799	
Digital Gaming	DG1										.885
	DG2										.781
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization											
a. Rotation converged in 8 iterations.											

Table 6

Variance of Constructs

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	4.617	11.840	11.840
2	3.337	8.556	20.396
3	2.615	6.704	27.100
4	2.531	6.489	33.588
5	2.526	6.476	40.064
6	2.463	6.315	46.380
7	2.445	6.269	52.649
8	2.000	5.128	57.777
9	1.947	4.992	62.769
10	1.880	4.821	67.590

Table 7

IT Career Aspirations (DV)

Variable	B	Std. Error	Std. Coeff $\mathcal{B}$
(Constant)	-1.212	0.16	
College Major	1.425	0.172	.494***
Tech_ID	0.582	0.058	.597***

a. Dependent Variable: IT Career Aspirations

b. F (2,106) = 32.409, $p < .001$

c. Adjusted R^2 = .619, R = .791, *p < .05, **p = < .01*** p < .001

Table 8

Technology Literacy (DV)

Variable	B	Std. Error	Std. Coeff $\mathcal{B}$
(Constant)	.459	.204	
Black	-.574	.232	-.235**
Inst_SUPP	.339	.096	.339***

a. Dependent Variable: Technology Literacy

b. F (2,106) = 6.590, p < .001

c. Adjusted R^2= .106, R = .350, *p < .05, **p = < .01*** p < .001

Table 9

Gender X Institutional Support (MV)

Variable	B	Std. Error	Std. Coeff $\mathcal{B}$
(Constant)	0.514	0.205	
maleXINST_SUPP	0.407	0.111	0.351***
BTL_4	0.188	0.09	0.189*
Black	-0.625	0.232	-0.256**

a. Mediating Variable: Gender X Institutional Support

b. F (3,105) = 6.194, p < .001

c. Adjusted R2 = .126, R = .388 *p < .05, **p = < .01*** p < .001

FIGURES

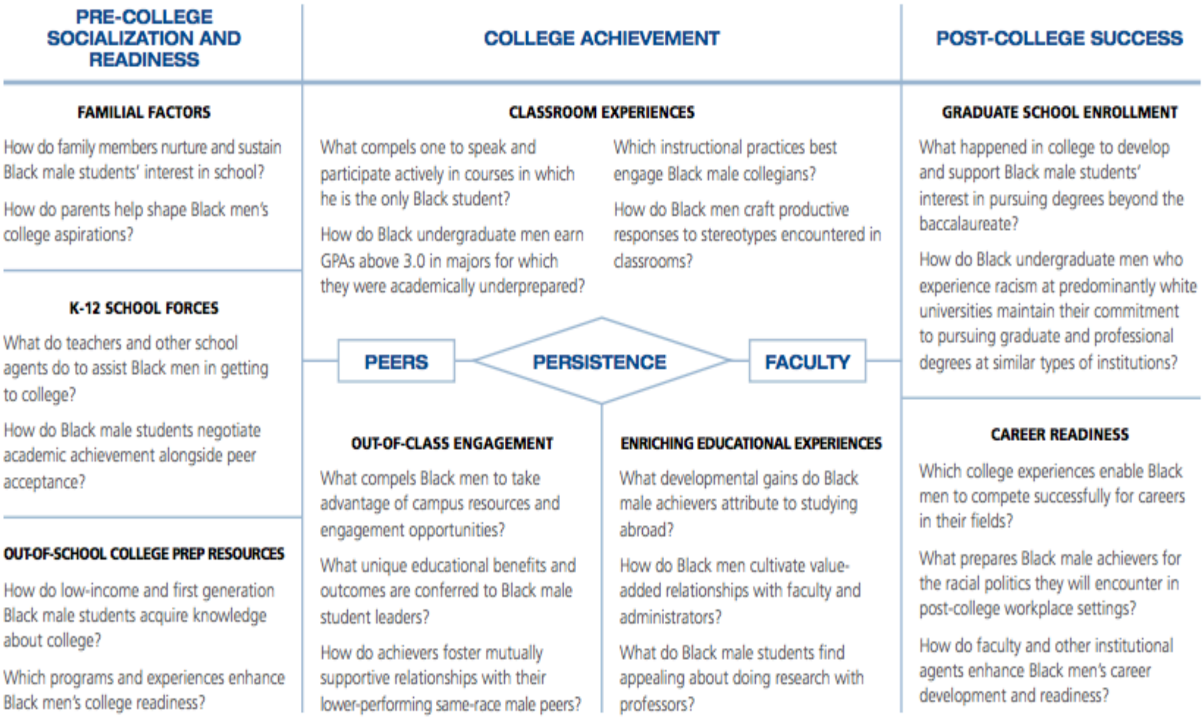


Figure 1. Anti-Deficit Achievement Framework Model

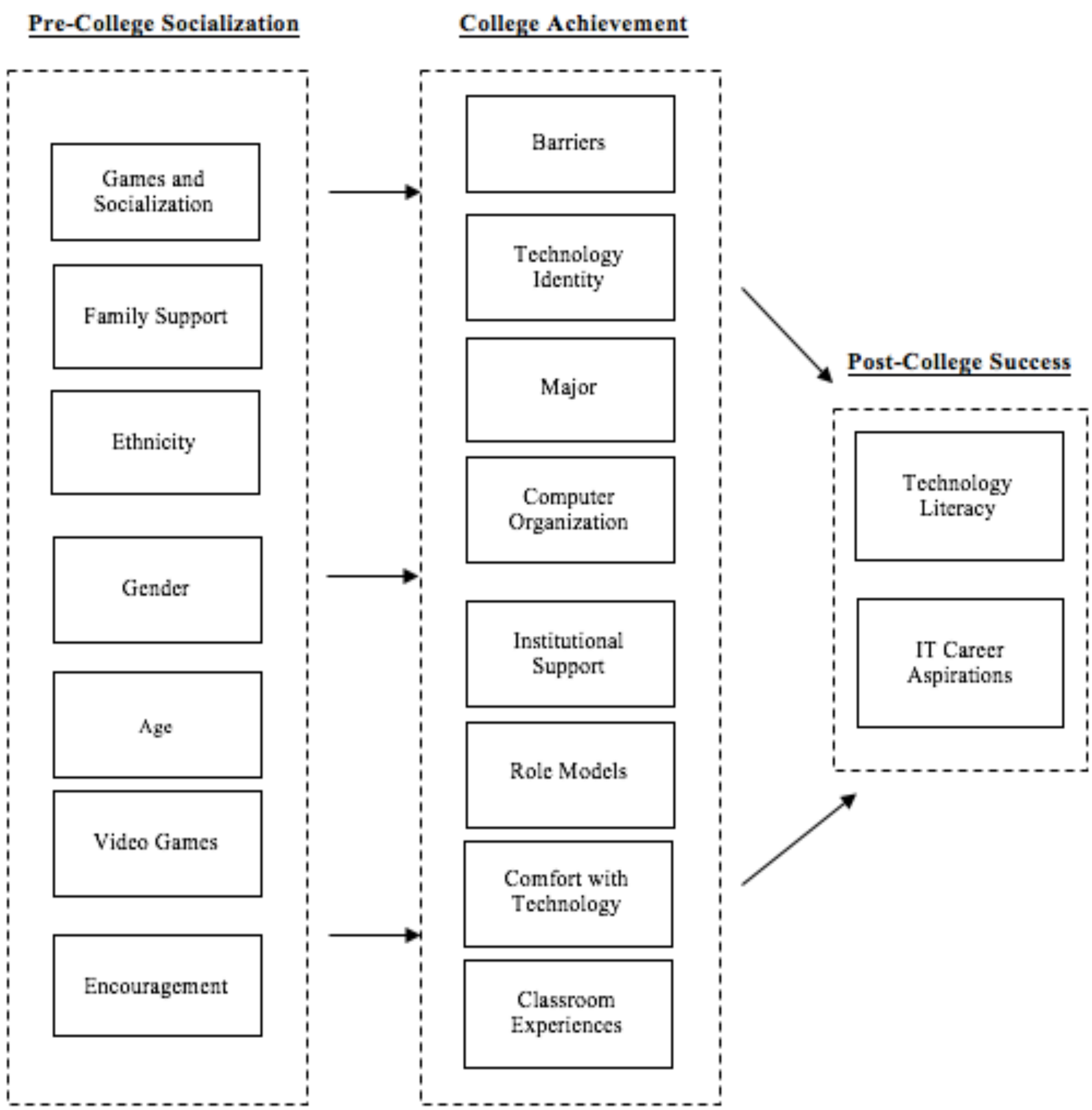


Figure 2. Technology Literacy Conceptual Map

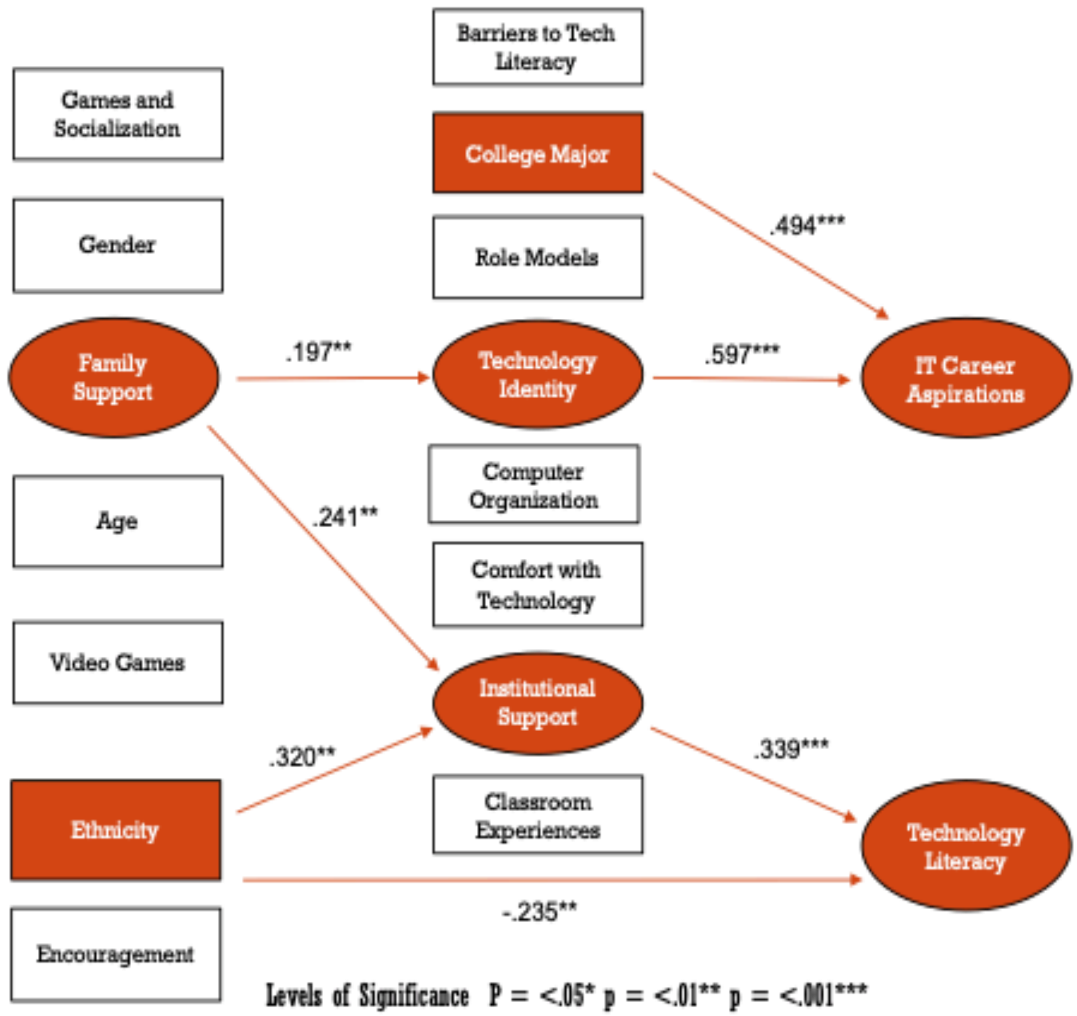
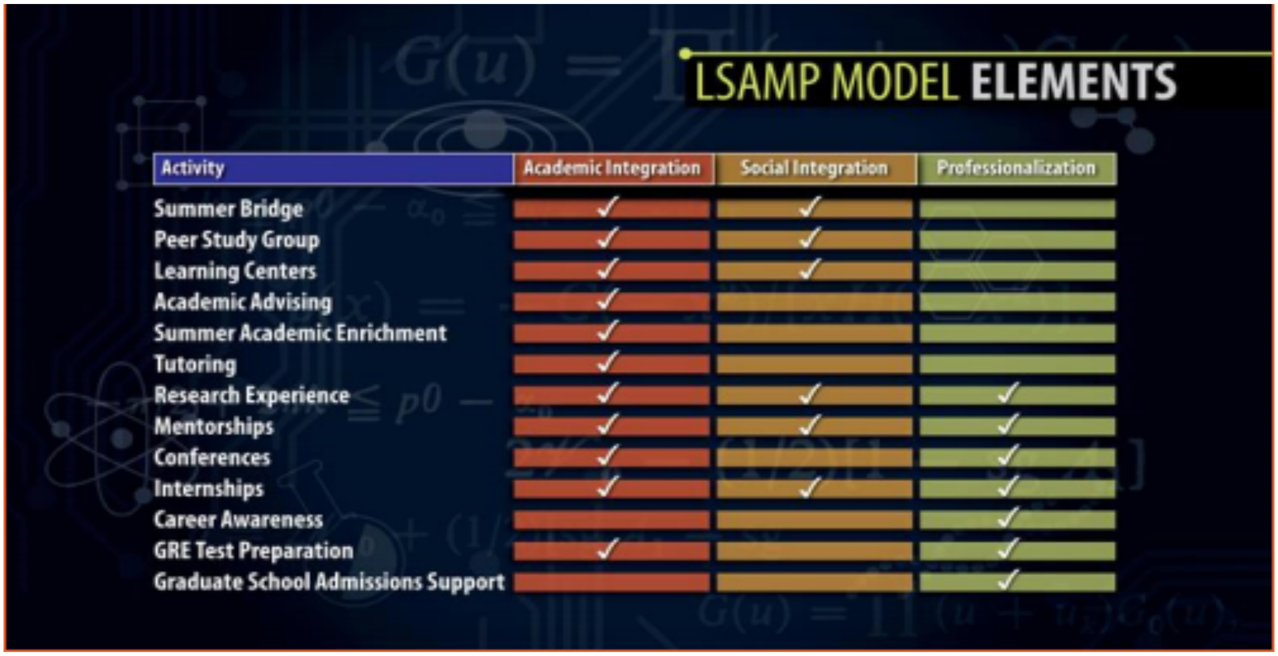


Figure 3. Path Analysis Model



LSAMP MODEL ELEMENTS

Activity	Academic Integration	Social Integration	Professionalization
Summer Bridge	✓	✓	
Peer Study Group	✓	✓	
Learning Centers	✓	✓	
Academic Advising	✓		
Summer Academic Enrichment	✓		
Tutoring	✓		
Research Experience	✓	✓	✓
Mentorships	✓	✓	✓
Conferences	✓		✓
Internships	✓	✓	✓
Career Awareness			✓
GRE Test Preparation	✓		✓
Graduate School Admissions Support			✓

Figure 4. Louis Stokes Alliances for Minority Participation Elements

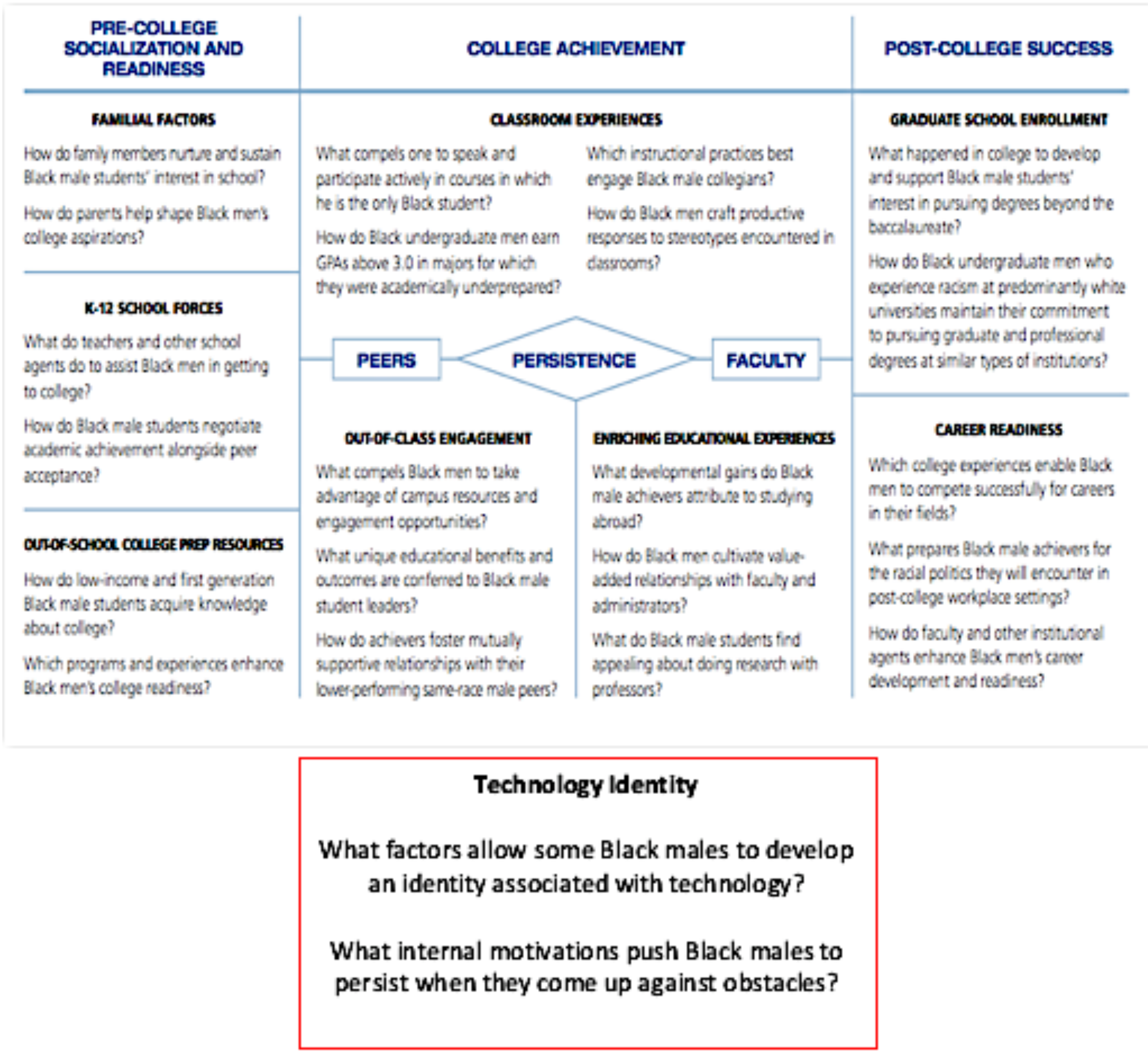


Figure 5. Proposed Modified framework to Harper's Anti-Deficit Achievement Framework

APPENDICES

Appendix A: Survey Instrument

Carlton B. Bell

Eastern Michigan University

Directions: Please respond to the following demographic questions:

SECTION I: DEMOGRAPHIC INFORMATION

1. What is your major or program of study? ______________________________

2. What is your age? (Please circle one)

    a. 18-24
    b. 25-34
    c. 35-44
    d. 45-54

3. What is your gender? (Please circle one)
    a. Male
    b. Female

4. What is your Ethnic origin (or race)?

    a. White/Non-Hispanic
    b. Hispanic/Latino (a)
    c. Black/Non-Hispanic
    d. American Indian/Alaskan Native
    e. Asian
    f. Pacific Islander
    g. Multiracial
    h. Other

5. What is your current class level?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Graduate Student
    f. Community College Student

6. Please enter the full name of your college or institution (no abbreviations).

    ____

SECTION II: TECHNOLOGY ATTITUDES AND ASPIRATIONS

Apply the following statements to the topic of *technology attitudes*. Please use the scale provided to register your level of agreement with each statement. Select/circle **one** in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

7. Technology is an important part of my life.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

8. Learning about technology will help me in the future.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

9. Developing my technology skills will help me acquire the job/occupation that I desire in the future.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

10. I enjoy learning about technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

11. I enjoy sharing my knowledge of technology with others.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

SECTION III: TECHNOLOGY IDENTITY

Apply the following statements to the topic of *technological identity*. Please use the scale provided to register your level of agreement with each statement. Select/circle **one** in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

12. I am very confident when working with technology and computers.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

13. Understanding technology is important for what I want to do in the future professionally.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

14. I plan on obtaining an advanced degree in computer science or IT.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

15. I am planning to devote my career to an area related to computer science or technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

16. I desire a career in the field of computer science or information technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

17. I can see myself working as a computer scientist or computer programmer in the future.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

18. I have been made to believe that I am capable of being successful in my program.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

19. I feel that I am "behind" my fellow students with regards to the understanding, usage, and implementation of technology, which causes some anxiety/fear.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

SECTION IV: CLASSROOM EXPERIENCES

Apply the following statements to the topic of *classroom experiences*. Please use the scale provided to register your level of agreement with each statement. Select/circle **one** in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

20. The digital skills required to pass my courses have been clearly identified in the course documentation (syllabus).

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

21. I am encouraged to use online peer communication (discussion boards, Facebook, etc.)

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

22. I have worked in teams during class and used technology to complete assignments/tasks.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

23. In my courses, I am exposed and introduced to emerging trends or ideas in technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

24. In my courses, I often create spreadsheets and integrate them into reports.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

25. In my courses, I often participate in online discussion forums, social networking sites, or virtual communities.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

<u>SECTION V:</u> TECHNOLOGY LITERACY

Apply the following statements to the topic of *technology literacy experiences*. Please use the scale provided to register your level of agreement with each statement. Select/circle **one** in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

26. I know the steps required to send, share, present or upload digital media.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

27. I understand how to create and edit a spreadsheet (a table or grid that displays data into columns and rows) and use that data to create charts and graphs.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

28. I regularly participate in online discussion forums, social networking sites, or virtual communities.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

29. I know how to maintain a personal website or blog.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

30. I use multiple forms of technology daily (such as email, text messaging, social media, or video conferencing.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

31. I understand the proper steps for creating an online/electronic portfolio.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

32. I know how to compress and expand files on a computer.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

SECTION VI: DIGITAL GAMING HABITS

Apply the following statements to the topic of *digital gaming habits*. Please use the scale provided to register your level of agreement with each statement. Select/circle **one** in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

33. Socialization around digital games and/or having experience with them is important.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

34. It is important to play digital/computer games with my peers so I can develop my technology skills.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

35. I believe that it is important to play online/video games alone to develop my technology skills.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

36. I regularly participate in online gaming (play games or run simulations).

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

37. I exchange strategies about games or simulations with others.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

SECTION VII: BARRIERS TO TECHNOLOGY LITERACY

In **school** (presently, or in the past), how often have often have you experienced the following related to *barriers to technology literacy* with instructors or peers? Select **one** circle in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

38. There are other members of my racial or cultural group in my classes related to computer science or technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

39. I believe that my computer programming skills and understanding of technology are on par or better than those of my peers.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

40. I have been ignored at my institution by students, instructors, or support services because of my racial or cultural background.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

41. Someone (past or present) has assumed that I would not be successful or that I was not intelligent because of my racial or cultural background.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

42. I have heard people at my institution speak negatively about someone's racial or cultural background.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

43. I have been made to believe that I am capable of being successful in my program by the faculty and other members of the department.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

44. I have observed and/or interacted with people from my racial or cultural background who hold prominent positions in computer science or technology at my institution.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

45. Growing up, I had access to technology in my home.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

SECTION VIII: SUPPORT

Apply the following statements to the topic of *support* at your current institution or in your personal life (family and peers). Select one circle in each row.

1-Stongly Disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

46. I have peers who encourage me to develop my technology skills.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

47. I have peers who not share my interest in technology, so I have had to keep that interest hidden.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

48. Growing up, I was encouraged to experiment with technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

49. I am encouraged by my family to learn about and explore new concepts related to technology. (SU 4)

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

50. I have received little support from my family with regards to developing my technology or computer skills.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

51. I have received support from my institution with regards to developing my technology skills.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

52. There is someone at my university who encouraged me to talk openly about my hopes, anxieties, or fears about pursuing a degree in computer science or technology.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

53. There are role models at my institution that are accessible to me outside of my department or program.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

54. I am a part of a computer or IT-related organization at my university.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

55. I am a part of a Greek letter organization at my university.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

56. There is someone of my racial or cultural background that holds a prominent position in the computer science department at my school/university.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

Thank you for completing the survey!

APPENDIX B: Eastern Michigan University IRB Approval to Conduct Research

RESEARCH @ EMU

UHSRC Determination: EXEMPT

DATE: September 21, 2015

TO: Carlton Bell
Eastern Michigan University

Re: UHSRC: # 746133-1
Category: Exempt category 2
Approval Date: September 21, 2015

Title: Access Granted: A Study if Technology Literacy in Black Males

Your research project, entitled **Access Granted: A Study if Technology Literacy in Black Males,** has been determined **Exempt** in accordance with federal regulation 45 CFR 46.102. UHSRC policy states that you, as the Principal Investigator, are responsible for protecting the rights and welfare of your research subjects and conducting your research as described in your protocol.

Renewals: Exempt protocols do not need to be renewed. When the project is completed, please submit the **Human Subjects Study Completion Form** (access through IRBNet on the UHSRC website).

Modifications: You may make minor changes (e.g., study staff changes, sample size changes, contact information changes, etc.) without submitting for review. However, if you plan to make changes that alter study design or any study instruments, you must submit a **Human Subjects Approval Request Form** and obtain approval prior to implementation. The form is available through IRBNet on the UHSRC website.

Problems: All major deviations from the reviewed protocol, unanticipated problems, adverse events, subject complaints, or other problems that may increase the risk to human subjects **or** change the category of review must be reported to the UHSRC via an **Event Report** form, available through IRBNet on the UHSRC website

Follow-up: If your Exempt project is not completed and closed after **three years**, the UHSRC office will contact you regarding the status of the project.

Please use the UHSRC number listed above on any forms submitted that relate to this project, or on any correspondence with the UHSRC office.

Good luck in your research. If we can be of further assistance, please contact us at 734-487-3090 or via e-mail at human.subjects@emich.edu. Thank you for your cooperation.

Sincerely,

Jennifer Kellman-Fritz, PhD
Chair
University Human Subjects Review Committee

APPENDIX C: Student Consent Form

Student Consent Form

I agree to participate in a study that is being conducted by Carlton Bernard Bell as part of a research study about the technology experiences of Black male undergraduate students. I understand that the survey will last approximately 10-15 minutes and that the questions will focus on my technology experiences while obtaining an advanced college degree. I will be asked questions about my experiences, difficulties, and levels of support during my pursuit of an advanced degree in a technological area and any other issues that I would like to discuss about my college experience.

I understand that my participation in the study is completely voluntary; that I may choose not to answer certain questions, and that I may withdraw and discontinue participation at any time if I choose to do so. I further understand that my confidentiality will be protected at all times, and that any identifying characteristics about me or (insert my family here or name of organization, workplace etc.) will be deleted. The results of the survey will be assigned a numerical code and kept in a locked filing cabinet in Ann Arbor at Carlton's residence and in a password protected computer file. I agree to allow anonymous research findings from my survey to be included in Eastern Michigan University presentations and/or disseminated in future publications, conferences, and professional settings.

Survey Respondents Name: ____

Signature: _____________________________Date:_____________________

For further questions or concerns, please contact:
Carlton Bernard Bell (cbell5@emich.edu)
3081 Randolph Court Drive
Ann Arbor, MI. 48108
OR contact the Dissertation Chair
Dr. David Anderson
Department of Leadership and Counseling
Eastern Michigan University
Ypsilanti MI 48197
Tel: (734) 487-3185
danderson@emich.edu

This research protocol and informed consent document has been reviewed and approved by the Eastern Michigan University COE Human Subjects Review Committee. If you have questions about the approval process, please contact Dr. Beth Kubitskey (734.487.0042, Administrative Chairperson of the COE HSRC, mkubitske1@emich.edu).

APPENDIX D: Email to Participants

Dear (Insert Name)

I would like to ask for your participation in a web-based survey. I am currently in the process of my dissertation research on the reasons why some groups of students have lower levels of technological literacy than their peers.

A link to this web-based survey is located below. Even if you have never used advanced levels of technology, it would be beneficial to this study if you could take a few minutes to complete this survey. The survey will take between 15 and 20 minutes. Your replies will be confidential and you may choose not to answer any question and simply leave it blank.

If you choose not to participate in the survey you may respond via email to cbell5@emich.edu and your name will be removed from the email distribution list, or you may simply not complete the survey and ignore any future email reminders.

For those of you interested in receiving a copy of the summarized results, there will be an opportunity for you to submit your name and email address indicating your interest. If you do not feel comfortable supplying your name and email in this manner but would still like a copy of the results, you can leave these fields blank and email me directly at cbell5@emich.edu for a copy of the results.

Thank you in advance for your assistance. If you have any questions or concerns, please contact me at xxx-xxx-xxxx or at cbell5@emich.edu. You may also contact this dissertation chair, Dr. David Anderson at Eastern Michigan University (734-487-xxxx or danderson@emich.edu).

Link to survey:

Sincerely,
Carlton B. Bell

APPENDIX E: Focus Group Consent Form

Consent to Participate in Focus Group

You have been asked to participate in a focus group conducted by a doctoral candidate from Eastern Michigan University. The purpose of the group is to discuss why some groups of students develop higher levels of technological literacy and develop career aspirations surrounding information technology and computer science. The information learned in the focus group will be used to design a survey that will be given to university undergraduate students who are in degree programs that are focusing on information technology or computer science.

You can choose whether or not to participate in the focus group and stop at any time. Although the focus group session will be audio recorded, your responses will remain anonymous and no names will be mentioned in the report.

There are not right or wrong answers to the focus group questions. The investigator (Carlton B. Bell) would like to hear many different viewpoints surrounding the topic. The hope is that everyone in the group can be honest even when responses may be different from other members of the group. In respect for one another, it is asked that all responses made by any participants be kept confidential.

I understand the above information and agree to participate fully under the conditions that have been stated:

Signed:____ Date:__________________________

APPENDIX F: Focus Group Confirmation Letter

Focus Group Confirmation Letter

September xx, 2015

Dear ____________________,

Thank you for your willingness to participate in the focus group discussing the technology literacy levels of university undergraduate students. As previously discussed, the investigator (Carlton B. Bell) would like to hear your ideas and opinions about the topic. You will be in a group with 5-7 other teachers, administrators, and students. Your responses to questions will be kept anonymous. You will be given a $10 gift card at the end of the focus group discussion in appreciation for your services. The date, time, and place are listed below. Please look for the investigator once you arrive for directions to the room where the focus group will be held.

DATE
TIME
PLACE

If you need directions to the focus group or will not be able to attend for any reason please call the principal investigator, Carlton B. Bell at 734.756.1104 or via email at cbell5@emich.edu. Otherwise, we look forward to seeing you.

Sincerely,

Carlton B. Bell
Eastern Michigan University

APPENDIX G: SAMPLE REQUEST LETTER TO CONDUCT STUDY AT INSTITUTION

Letter of Information

Access Granted: A Study of the Technology Literacy Levels of Black Males

Informed Consent Agreement

Brief Information:

Hello! My name is Carlton Bernard Bell and I am a Doctoral Candidate at Eastern Michigan University in the Department of Leadership and Counseling. The research study in which I explore focuses on the technology literacy levels of Black males as they pursue a degree in a computer science related area from a four-year institution. The study involves one survey that will take approximately 20 minutes in which you will be asked questions about your experiences with technology in the past and at your current university. Participation in the study is completely voluntary and you will be assured of complete confidentiality if you choose to be a part of the study.

Benefits of the Project:
This research project will contribute to the research area that surrounds technology and those pursuing advanced degrees in this area. The benefits to you as a participant may be an opportunity to reflect on your own perceptions about self-identity and self-efficacy as you answer questions during the survey process. There are no foreseeable risks to participating in the project.

Dissemination of Results:
Findings from the research project will be published in my dissertation at Eastern Michigan University as part of the requirements for a doctoral degree. The findings may be written up for presentation at the Graduate Research Fair at Eastern Michigan University, or used in later professional presentations at conferences or submitted for publication. Any dissemination of findings will be anonymous and complete confidentiality will be ensured. If you would like to participate in the research study, please read and sign the consent form on the following page:

APPENDIX H: SAMPLE APPROVAL LETTER TO CONDUCT STUDY AT INSTITUITON

MOREHOUSE COLLEGE

INSTITUTIONAL REVIEW BOARD

830 Westview Drive, S.W.
Atlanta, Georgia 30314-3773
TEL. (470) 639-0221
doreen.stevens@morehouse.edu

PI Name: Carlton Bell
PI Address: Eastern Michigan University
PI Email: cbell5@emich.edu
PI Phone: (734) 756-1104

Re: NOTIFICATION OF PROTOCOL APPROVED

TITLE: Access Granted: A Study of the Development of Technology Literacy in Black Males

DATE: September 7, 2017

IRB Protocol #: 329030298

This approval is valid from August 29, 2017 – August 28, 2018

Your research proposal referenced above and the associated informed consent process was reviewed and APPROVED by Expedited Review. (NN)

Your approval period is noted above. Thereafter, continued approval is contingent upon the submission of a renewal form that must be reviewed and approved by the Institutional Review Board prior to the anniversary or expiration date of this study. Any serious reactions resulting from this study should be reported immediately to the Committee, to the Departmental Chairperson, and to any sponsoring agency or company.

Failure to receive a notification that it is time to renew does not relieve you of your responsibility to provide the IRB with a "Request for Renewal" in time for the request to be processed and approved before your expiration date.

Please note that this protocol has been assigned the above referenced IRB protocol number. All inquires and correspondence concerning this protocol must include: 1) The IRB Protocol number, 2) Name of the Principal Investigator, and 3) Full Title of Study.

Additional information may be forwarded by return email to doreen.stevens@morehouse.edu.

If you have any questions or concerns, please contact Doreen Stevens, IRB Administrator, at 470-639-0221, or go to the Morehouse College website to review IRB guidelines and procedures.

Thank you

cc: danderson@emich.edu

APPENDIX I: DISSERTATION PROPOSAL APPROVAL FORM

RECEIVED
APR 22 2015
200 Boone Hall

EASTERN MICHIGAN UNIVERSITY
Graduate School
Doctoral Dissertation PROPOSAL[1] Approval Form

Student Name C. Bernard Bell Date of Meeting 4/14/15
Program of Study Educational Leadership ID# E 00026487
Dissertation Committee Chair Dr. David Anderson

TENTATIVE TITLE OF PROPOSED DISSERTATION

Access Granted: A study of the levels of Technology Literacy of Black Males

COMMITTEE REPORT ON DISSERTATION PROPOSAL

After review of the dissertation proposal, the Doctoral Committee certifies that:

[X] The proposal is satisfactory and the candidate may proceed.

[ ] The proposed research does not involve the use of human subjects OR

[ ] The proposed research involves human subjects and will be sent to University Human Subjects Review Committee prior to data collection.

[ ] The proposal is not satisfactory and the following deficiencies must be corrected:[2]

Description of deficiencies ______

COMMITTEE SIGNATURES

Chair [signature]
Member Representing the Graduate School [signature]
Member [signature]
Member [signature]
Member ______
Member ______

ACKNOWLEDGEMENT OF PROPOSAL APPROVAL

Date 4/27/15 Program Director/Coordinator/Dept. Head [signature]

Date 4/28/15 Graduate School [signature]

Signed original to Record's student file. Copies to: Graduate School, chair, and department/college file

[1]To be completed only after student has been officially notified of having passed the qualifying examination.
[2]After the deficiencies have been corrected a new form must be submitted indicating that the proposal is satisfactory and the candidate may proceed.