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Establishing a research agenda for broadening participation of Black men in computing, informatics, and engineering

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ABSTRACT

The underrepresentation of Black men in computing, informatics, and engineering is at a critical state. Much research has been attributed to the increase in women's representation in Information Technology (IT), but little has explicitly focused on Black men. Additionally, the research with Black men in IT studies the population from a group level of analysis rather than an individual level. This conceptual and theoretical manuscript positions the author as an exemplar, a Black man and IT, and uses theoretical linkages of the Individual Differences Theory of Gender and IT. The result is a research plan to study the underrepresentation of Black men in IT, exploring individual and group level analysis, introducing qualitative artifacts, and showcasing successful Black men in IT.

1. Introduction

In the United States, a country that professes to promote the concept of social mobility, education is critical. The overall representation of all ethnic minorities in higher education is steadily increasing. Although still not approaching the participation percentage of White students, Black,[1] Asian, and Latino students have experienced significant increases in postsecondary education participation in the past 10 years. The data on growth rates of Black students, however, indicate more of a good news/bad news scenario. Even though the total number of Black students is increasing, the gender gap between Black men[2] and Black women in higher education has grown wider [1]. While Black women are experiencing notable growth in enrollment and graduation, the participation of Black men is declining, and is the lowest of all demographic groups .

The underrepresentation of Black men in higher education can be broadly explained in terms of three experiences: educational, environmental, and personal. In terms of education, Black men and women have been historically incorrectly deemed academically inferior to Whites [2–6]. Black students are more likely to attend schools that are ill-equipped, lacking resources that contribute to providing a quality education at the same level White students receive [7]. Compounding this inequality in education is that Black students' dropout rate is higher than that of Whites [5]. Furthermore, White students have a graduation rate from high school and college that is vastly higher than that of Black students [3]. However, framing the issues facing the Black community in terms of a lack of resources runs the risk of analyzing the issue from a deficit-based perspective, which is detrimental to student development and confidence and does not highlight and uplift Black students.

1.1. Literature review

1.1.1. Why black men?

The United States Department of the Interior's Office of Civil Rights website defines diversity as:

> A term that is used broadly to refer to many demographic variables, including, but not limited to, race, religion, color, gender, national origin, disability, sexual orientation, age, education, geographic

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[1] In this manuscript "*men*" is used as opposed to "*males*" in an effort to respect gender identity and refrain from addressing people by their anatomy. In using the term "men", this paper is referring to those who identify as a "man" and are enrolled in a Computing, Informatics, or Engineering (CIE) degree program.

[2] Throughout this paper, "Black" is used to refer to race and ethnicity of those who identify with the Black diaspora. It is to denote students born in and educated in the U.S. Thus, Black students who were born here to immigrant parents are eligible.

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origin, and skill characteristics. America's diversity has given this country its unique strength, resilience, and richness.

However, statistics show that diversity based on race/color and gender within Science, Technology, Engineering, and Mathematics (STEM) is particularly low [8–13].

The capacity to use IT enables individuals to participate fully in society. This is vital, particularly as capabilities, functioning, and well-being in society are a better measure of relative affluence or poverty than measures of income alone[14]. Kvasny [15] argued that IT can be used in ways that promote social inclusion and that technology capabilities and access are integral to inclusion. However, major surveys published show that Blacks have lower rates of home computers and Internet access [16]. In comparison, 46% of Blacks use their phones as their primary source of Internet access, compared with 33% of Whites [16].

The IT workforce is nearly 90% White and Asian men [17]. While addressing the National Education Association in 2010, President Barack Obama said, "We understand that our nation's prosperity is tied to innovation spurred on by students' engagement in STEM". He continued by saying, "For America to be technologically competitive in the future, our students must become more fluent in complex science and math." If the United States is to meet its need for world-class talent in STEM, it is essential that a diverse population be attracted to engineering and other technical fields [18].

The topic of diversity in computing, informatics, and engineering (CIE)[3] has been researched using a myriad of approaches. Of the many skillsets possessed by computing professionals possess and have received significant attention is mathematical ability. Additionally, one of the prevailing approaches to studying underrepresentation in computing starts at the primary and secondary education levels (K–12), analyzing mathematical success among young Black men in the United States, which is widely accepted as the foundation for computing [19–22].

In the educational landscape for IT careers, Blacks are vastly underrepresented in the IT fields of study in the United States. Although Black men represent 6% of the United States population, they only account for 2.2% of those employed in computing occupations [23]. Black students' interest in Computer Science is apparent and is no different than any other demographic group [24]. One approach focuses on postsecondary education and the overall Black male student experience, including the influence of university culture and self-efficacy [24–27]. The issue of underrepresentation is also evident outside the research space. According to a College Board report [28], the entity that administers the Advanced Placement (AP) exams, which grant undergraduate credit to high school students, indicated that of the 30,000 students who took the AP exam in Computer Science in 2013, only 3% were Black. In fact, 0% of Black students took the AP exam for Computer Science in 11 states, including Mississippi, where Blacks make up 37% of the population. Furthermore, less than a third of Black men and women who receive a degree in computing stay in their chosen field [29].

A diverse workplace, in terms of race, gender, and sexual orientation, has been shown to be effective in assisting underrepresented groups adapt to a new workplace, department, or division [30–31]. Additionally, diverse workplaces tend to have managerial staff that is more aware of and responsive to different cultures, which aids in the organization's approach, perspective, and ability to launch new products, create new ideas, assess emerging trends, and develop new marketing plans [30, 31]. Most importantly, and central to the focus of this project, is that cultural diversity has a positive effect on coalescing the many ways in which people from different cultures think, which can lead to more nuanced ideas [30,32].

Regardless of where one chooses to launch an investigation of underrepresentation in computing, whether at the primary, secondary, post-secondary or workplace level, there is one theme that remains constant—the lack of diversity in the field is a problem and there is a disconnect between Black students who may be exposed to Computer Science in primary and secondary education versus those who receive exposure at the college level. The gap among these numerous streams of research and policy is an examination of the issue of diversity of Black men in computing from their perspective. It is imperative to note that this proposed work is neither anti-woman in nature nor is it proposed to discount the experiences of other racialized, and marginalized groups, as each is unique and cannot be generalized or understated. Black women face a plethora of challenges; however, Black women, at 8.7%, account for double the 4.3% undergraduate population of Black people in computing [3]. The unique obstacles Black men in CIE face warrant further investigation [33–39].

According to Margolis et al. [40]; there is evidence to support that Black men in the American educational system have not been succeeding, (as gauged by matriculation and graduation rates), at the same pace as their White peers. Studies and theoretical approaches which analyze the factors that influence Black men's participation, may provide new insights into the disparity between Black men and their White counterparts. This paper seeks to establish how the underrepresentation of Black men in CIE can be studied to highlight success stories.

In terms of education, Black students have historically been deemed academically inferior compared to White students [41]. Black students are more likely to attend schools that are ill-equipped with the resources that contribute to providing quality education than White students [42]. Compounding inequality in education is the fact that the dropout rate is higher for Black than White students; White students have a graduation rate from high school and college that is vastly higher than Black students [41–43]. The next section delves into the factors that contribute to Black underrepresentation, such as the academic pipeline and achievement gaps, stereotypes and stereotype threat, workplace diversity, and minority participation in computing.

Jackson (2003) studied a number of national databases and discovered that there are wide gaps in educational attainment between Black and White men. Margolis et al. [40] studied the vast differences in educational settings for students of color. They posit that America struggles with a stratified intellectual class system for which there are unintended consequences of well-intended policies, and state that a lack of resources based on race, sex, and socioeconomic status become the accepted norm. Because STEM fields have been championed as a perennial pathway of success and innovation, technology and engineering have been strongly emphasized as the primary driving force of the economy [44,45,40].

While much of the research points to negative impacts of the academic pipeline, there is also research positioned as a counter-narrative. Mathematics knowledge is a skill that is paramount in the computing industry [40,46,47]. Veins of research have extensively studied the underachievement of young Black boys in primary and secondary school mathematics classes [48]. However, studies by Berry [20–21]; Walker [47]; and Jett [49] report that young Black men who are successful in mathematics, despite a lack of resources, have their identities positively shaped by their communities and experience with mathematics. DiSalvo et al. [50] found a significant correlation between young Black men and video games as a key motivator sparking an initial interest in computing. Additionally, young Black students who have the personality traits that lead to excellence in mathematics, interest in video games, and the persistence to overcome stereotypes and stereotype threats, have been found to be the most successful and perhaps best prepared for a career in computing [19]. This work seeks to examine the intersectionality of these constructs.

A stereotype is a widely held but fixed and oversimplified image or idea of a person or thing. Among the many stereotypes of Black men,

[3] In this manuscript, Computing, Informatics, and Engineering (CIE) is classified as Computer Science, Information Systems, Computer Engineering, and Information Science majors. In the interest of space saving, the catchall term "*computing*" is also used.

aggression is one of the most common [51–53]. However, the stereotype of aggression requires nuanced analysis to understand how that anger manifests. This stereotype could arise from several different lived experiences where Blacks find themselves defending their culture while overcoming systemic obstacles [54].

A second common stereotype, refuted by scholars, is that Blacks are intellectually inferior to Whites [43,55–56]. Scholars have contended that Black students are intrinsically highly motivated; this motivation is not related to how they perform academically or to their academic self-concept [41–43,57]. While most racial subgroups have seen significant progress in postsecondary enrollment, little or no progress has been made in increasing participation rates among Black men over the last quarter of a century [43].

Stereotype threat is defined as being at risk of confirming, as self-characteristic, a negative stereotype about one's group; essentially, stereotype threat is an internal characteristic. Black people are susceptible to stereotype threat [58–59]. Black students are generally stereotyped in the media as superstitious, lazy, happy-go-lucky, aggressive, intellectually inferior, ostentatious, active in sports, entertainers and poor performers in academics [51,60–61]. However, there is research within Information Systems (IS) that identifies methods—such as the role of mentoring, the influence of faculty of color, cultural awareness and minority student groups—by which Black students can overcome stereotype threat, and other obstacles to excel in their chosen computing field [62].

The academic pipeline refers to the individual, environmental, and institutional factors that influence, hinder, or divert an individual progressing along the path toward a goal [40]. Researchers have studied pipelines related to minorities and women for completion of secondary, post-secondary, graduate and professional education [63–65]. According to Jackson [66]; there are two factors that influence self-doubt about the computing domain: 1) making a group aware of their own ethnic and class-based identities through a negative stereotypic association, and 2) the group's ability to use technology effectively. These two factors can evoke self-doubt about the ability to gain mastery in this domain. The presence of individual and group identity may be a contributing factor that evokes self-doubt and affects the ability to gain mastery of a domain [66].

While stereotypes and stereotype threat are almost always seen as negative concepts, especially in the context of discussing Black men's participation in computing, there are several examples of positive computing role models and exposure to Black people in technology and computing that have negated the impact of stereotypes by allowing students to see themselves in those positions [19,62,67–68]. Still, opportunities remain to continue diversifying the computing workforce.

Several studies have examined workforce diversity and minority participation in computing, including gender-related differences and features of institutional culture that contribute to causing or closing gender gaps in the field. Some theoretical approaches have explained the low participation of women in technical fields by positing that women are either biologically limited (gender essentialism) or influenced by social messages (social construction) [69]. Other research posits that these explanations are insufficient to truly address the complexities of women's technical abilities, interactions, barriers, and the wide variation among women [70–71]. Research about women in computing is significant, with more recent research studying the identity of women who are currently in the field. The stereotype of poor mathematical skills attached to Black men has also been levied (and disproved) against women [72–74]. Other research has focused on the methods by which women are influenced by policies that place them at a disadvantage compared to men, such as a lack of paid maternity leave and support groups [72,75–76]. When researchers look at some of the same issues that impact women's underrepresentation and apply similar analyses to Black men, many similarities are found [100].

A study by Trauth et al. [77] administered a survey to explore the effects of gender, race, ethnicity, and socio-economic class on gender stereotyping in computing at twelve universities throughout the United States. Of the over 4000 survey participants, of whom 377 were Black men, the researchers found evidence of the influence of race on gender stereotypes about computing professionals. Researchers have also examined other issues influencing Black men's participation in computing [26,77–78]. According to Joshi et al. [79]; a significant amount of research has examined Black men through the prism of a deficit model, which primarily focuses on systemic and individual failure as a method to explain a lack of success, but this research approach is insufficient, as it does not take into account the positive factors that contribute to Black men's success.

Thus, recent studies have focused on analyzing positive factors for Black men, which contribute to their selection of computing majors and ultimately entering the computing workforce [17,26,29]. These studies have focused on not only computing skills, but also on methods of increasing these men's social capital and self-efficacy—critical factors for excelling in the field. Such studies provide the basis for interventions that could lead to reversal of the underrepresentation trend. These are the men who can provide new insights about Black men who do participate in computing and persist; perhaps their experiences illustrate strategies that may assist those in the future.

1.2. Pilot studies

Pilot studies were conducted during 2013 and the 2015–2016 academic years. In doing so, a paper that considered issues related to the diversity of the computing workforce was written, including computing education and the cultural phenomena around Black men's underrepresentation in computing and the degree to which they identify with the computing field within the United States of America. The data was gathered by interviewing fourteen Black men at two HBCUs. An autoethnography approach to examine the insights from the author's lived experiences and entrance into the computing workforce to identify individual and group themes that exist, relate them to existing literature, and provide evidence of those obstacles being overcome using the IDTGIT [35].

The aim of this research is to provide a perspective—through an autoethnographic account and appropriate applications of theory—that highlights factors that support or undermine the achievement of Black men completing computing degrees and entering the CIE workforce. Methodologically, autoethnography has not been widely adopted within the CIE disciplines, but has provided evidence that it is a viable approach for discussing lived experiences with the author utilizing himself as an exemplar and supporting research for evaluating autoethnographic findings. Scholars, even those with no direct affiliation with an impacted group, have a duty to ensure that we are being as inclusive as possible, that we understand and appreciate the value of diversity, and to take an active role in cultivating and empowering our students to enter, and remain, in the computing workforce.

Overall, the exploratory pilot study allowed the validation of the methodological appropriateness of qualitative research, develop interview questions appropriate for a larger sample size, such as the one that will guide this research, and provided preliminary findings as the basis to expand this line of inquiry.

An interview instrument was developed as part of a previous research project [70]; NSF Award 0204246), which was primarily

Table 1
Summary of initial findings [35–37] ().

Examples	Summary
Race	Participants were consistent in referencing race as one of the most considerable barriers with which they had to cope when entering the IT field. They reference the dominance of white men and a low number of Black men.
Age	Age was not something that the participants saw as being a barrier. Even though most did not have an IT work history, they knew about IT's potential to be a lucrative career. This could be due to the participants being native to IT. "Native to IT" and "digital native" are terms that reference those raised around technology such that it is ingrained in who they are. The interviewees that did mention age, mentioned it as a factor when they were completing internships. They found it challenging to have their perspectives taken seriously because they were young and Black.
Family	Interviewees reference family as critical in supporting their career decisions. Furthermore, some of these young men were fathers, and they consider their education and desire to enter a lucrative field such as IT as a way for them to provide for their children.
IT Identity	The participants overwhelmingly faced difficulty trying to "fit" into the IT professional model. They referenced race as a critical factor for the struggle to find a place for themselves within the IT field and even in their coursework, internships, and group projects.
Personality	These Black men were persistent in their desire to pursue their dreams. They remained upbeat in the pursuit of their goals and aspirations.
Exposure	There were varying levels of exposure to IT at an early age for the participants. Exposure is what accounted for their initial interest. Some of the means for initial exposure were video games or family and friends in an IT field.

designed to investigate the societal, environmental, and personal factors that influence the participation of women in computing. The result of the previous research was the IDTGIT. The interview instrument was revised to assess its effectiveness in understanding race and ethnicity related to the computing influence of Black men [36], and a pilot study was conducted between 2011 and 2014 [35–36]. Once theoretical saturation was reached, additions to the interview protocol were made, open coding for emergent themes was introduced, and additional interviews were conducted, transcribed, and published, including autoethnography as a methodological approach [35].

This research builds upon prior work because it will further revise the instrument and test its applicability in different geographical areas. A brief synopsis of thematic findings from prior work are summarized below in Table 1.

1.3. Theoretical framework

The work will use a theoretical lens to better understand the influences that impact Black men's participation in computing. Instead of solely grouping together individuals by gender, the Individual Differences Theory of Gender and IT (IDTGIT) approaches underrepresentation in the computing workforce from the vantage point of adding individual agency, identity, and experience in relation to life choices and societal influences [80].

Trauth [70] advocates for the investigation of influences that draw from a combination of socio-cultural themes and individual differences. Thus, the IDTGIT provides recognition of the importance of social influences, while emphasizing that personal characteristics, interests, and abilities are also significant shaping factors [81]. It is important to note, that despite the title of the theory, it has also been used successfully to study group variation [26,77–78].

The IDTGIT has been applied to understand the underrepresentation of women in computing [2,70-71,82-85] and Black men's underrepresentation in computing [86]). The theory was developed to understand the topic of underrepresentation of women in the technical workforce that essentialism and social construction could only partially explain. In Trauth and Quesenberry's [83] critique of essentialism, they argue that while some relevant differences in ability may be biologically based, they are not gender based. Further, essentialism does not add contextual factors, which may affect an individual's perspective of or interaction with technology.

The other perspective used to understand gender and computing is social construction, which describes gender as "two separate groups of men and women who are affected by two different sets of sociological influences. Social construction identifies social forces that may shape the lives of men or women but minimizes individual agency or different experiences that affect responses to those factors [70,82], given the differing theoretical perspectives of essentialism and social construction, which can be interpreted as describing only partial elements of the factors experienced by women in computing. As Trauth [71] points out, "current theories about gender and IT do not fully account for the variation in men's and women's relationships to information technology and the IT field" (p. 1759). It is this variation that Trauth has argued is central to different people's experiences of, decisions regarding, and relationships to technology.

The IDTGIT (Table 2), consists of three major constructs to explain gender variation in participation in computing: i) individual identity, ii) individual influences, and iii) environmental influences [81,82,87]. The individual identity construct consists of two sub-constructs: personal demographics (e.g., ethnicity, socio-economic class, family background) and career items (e.g., type of computing work). The second construct, individual influences, consists of two sub-constructs: personal

Table 2
Constructs of individual differences theory of gender and IT [77,80].

Construct	Subconstruct	Examples
Individual Identity	Personal demographics	age, ethnicity, socio-economic class
	Type of Computing work	software development, Information Systems (IS) design
Individual Influences	Personal characteristics	educational background, personality traits, abilities
	Personal influences	mentors, role models, significant life experiences
Environmental Influences	Cultural influences	attitudes about women & computing
	Economic influences	cost of living
	Societal infrastructure influences	availability of childcare
	Policy influences	laws about gender discrimination

characteristics (e.g., educational background, personality traits) and personal influences (e.g., mentors, role models, and significant others). Lastly, the environmental influences construct consists of four sub-constructs, related to the geographic region: cultural influences, economic influences (e.g., cost of living, cost of education), policy influences, and infrastructure influences (e.g., institutional climate) [82].

A critical level of discourse in the United States is the debate between collectivist and individualistic theoretical approaches as they relate to the behavior of people [88–89]. The IDTGIT allows for both group and individual levels of analysis. It is within the individual identity and individual influences constructs that individual agency constructs and themes are most likely to be present. Conversely, it is within the environmental influences construct that group levels of analysis represent aspects of collectivism and where the group, rather than the individual, can establish agency [89–91]. As such, the theory posits that people simultaneously possess individualistic and collectivist characteristics, and are neither self-centered nor altruistic; thus, individual and collective characteristics need not be mutually exclusive.

2. Methodology

This qualitative research project will investigate the CIE experiences and career decisions of Black men recruited from four-year institutions of higher education in different geographical areas across the United States of America. The author will employ purposive sampling to ensure the recruitment of a balance of majors and participants from different institution types. The data collection methods will include a semi-structured interview and artifacts. He will consider the institutional culture and aspects in his data collection. He will dissect data from participants' narratives and institutions to capture a complete view of institutional data. He discusses each data collection method below to draw parallels to the research and education goals and objectives of this project.

2.1. Recruitment

The main objective is to collect data to identify the intrinsic and extrinsic factors (e.g., financial support, mentors, motivation, peer interaction, spirituality, etc.) that have led to the success of Black men in computing. Pursuing this objective will unearth the critical incidents in Black men's educational pathways, facilitate a deeper understanding of the computing experiences of these students, and inform future educational objectives. Currently, students from two HBCUs, both in uniquely different urban areas in the South and Mid-Atlantic, and two PWIs, one in a rural area and the other in an urban area in the Mid-Atlantic, are participating in the project; three of the schools are public institutions (Table 3). Combined, the undergraduate enrollment across all four participating higher education institutions is over 70,000 students, of which 2% are Black students in IT-related majors. Of the 2% Black students in IT from participating institutions, over 70% attend the two HBCUs, while those same HBCUs have a total enrollment of only 20% of the total 70,000 students enrolled across the four schools.

The representatives who will serve as institutional liaisons will assist in recruiting participants for this work. A call will be sent out to the institutional liaisons to share with relevant parties (department chairs, faculty members, STEM student groups, etc.), and interested individuals will be invited to participate in this research project. Each participant will be compensated for their participation in the form of a gift card after the interview is completed. He will be as evenhanded as possible in the participant selection in terms of disciplinary affiliation, and will perform an iteration of the same protocol for each institution. Black men who have completed at least one year of undergraduate education and declared a computing major will be recruited, and there will not be a requirement for grade point average, since it can be a poor indicator of academic success [40,49,52,66]. He anticipates that most participants will be sophomore, juniors, and seniors, and he plans to maintain contact with them and ask follow-up questions as they continue to matriculate.

2.2. Data collection

Participants will complete at least one semi-structured, in-person interview, and subsequent follow-up interviews as they matriculate and enter the field to add a longitudinal element to the study, which will last 30–90 min, and chronicle their computing experiences and their career aspirations as Black men. The semi-structured interview approach will allow the participants to respond freely, allow their voices to be heard using their own words [92], and allow participants to reflect upon and (re)construct their experiences using first-person narratives. This approach will also allow the author to diverge (if necessary) and to solicit a more thorough or detailed response. Examples of open-ended interview questions include: How would you describe your college computing experiences? Why did you select your chosen major? How would you describe your campus culture in relation to race dynamics? During the interview process, and as themes emerge, He will probe the participants with respect to their experiences as Black computing majors, institutional practices that support STEM persistence, etc. The interview protocol will be continuously improved to explore other avenues suggested by the ongoing data analysis. As a method of member checking, focus groups will be conducted with a different set of Black men in computing to provide additional insight into the data collected during interviews, as well as to examine why some Black men leave computing.

Another data collection element will be to solicit qualitative artifacts from the participants [93]. Participants will be instructed to bring one or two physical artifacts related to their computing experiences and career aspirations to the interview to describe or discuss. According to Creswell [93]; qualitative visual artifacts include family heirlooms, photographs, e-mail messages, printouts of websites, and any other audio, visual, or written materials that would help to triangulate the data. Examples of artifacts might include awards, scholarship letters, research projects, examinations, and other artifacts whereby students are "doing" computing. These artifacts will allow the participants to freely and explicitly share their reality and articulate how they view their educational opportunities, achievements, and challenges [94]. These artifacts will inform the qualitative interpretations extracted from the other data

Table 3
Institutional matrix.

Institution	Type	Classification	Undergraduate Enrollment	CIE majors	Black CIE majors
Howard University	Private	Urban Research HBCU	6100	776	667
Morgan State University	Public	Urban Research HBCU	7447	464	385
The Pennsylvania State University	Public	Rural Research PWI	37,646	9725	278
Pittsburgh University	Public	Urban Research PWI	19,330	5027	126
Predominately White Institution (PWI)					

sources.

2.3. Research agenda

This research is particularly meaningful given the author's personal participation in computing. The author is a Black man who was raised in southwest Atlanta and attended Atlanta Public Schools, categorized as an urban school district. He completed an undergraduate degree in information systems engineering from a Historically Black College and/or University (HBCU). His industry experiences after completing undergraduate school led him to graduate school to address the concern of, "Why so few? Why are there so few people that look like me?". He mentions his own experiences specifically because they have caused him to engage in reflexive research concerning Black men in computing, which has shaped his position as a researcher [95–97]. Significant research has focused on pipeline-related issues for Black men, such as a lack of mathematical success, access to sufficient resources, and the existence of a school-to-prison pipeline, with Black men disproportionately impacted by these societal issues [19,27,98]. President Obama's program *My Brother's Keeper,* is an initiative designed to provide academic support for Black boys, and to ensure that they can achieve their full potential in school and beyond [44]. The unique traits of Black men who have overcome obstacles and broken barriers to support success in informatics and computer science among Black men and positively influence their career decisions in these fields, are highlighted in this work.

This section sets a research agenda to describe how the experiences and career decisions of Black men in CIE can be explored. The conceptual and theoretical findings have the potential to contribute to society's understanding of Black men majoring in CIE experiences and career decisions, to improve and enhance this population's educational outcomes. This work builds on the pioneering body of academic success literature, provides a linkage to the group-based, and individual, theories related to computing, and advances this work by examining students' CIE career decisions using qualitative methods. Through this work, the problem of the underrepresentation of Black men students in computing can be addressed, and interventions proposed to decrease the barriers that limit success and contribute to the field through the many avenues that seek to broaden partition of minority groups in CIE, including industry partners. Overarching research questions that will guide this research include:

Research Question 1: What factors are associated with barriers to and/or enablers of success in CIE for Black men majoring in CIE?

Research Question 2: How are postsecondary career aspirations actualized and cultivated among Black men in CIE?

Research Question 3: What characteristics do Black men in CIE exhibit that affect their career trajectories and can be used to inform policy decisions about recruitment and retention?

These research questions allow for the richness of qualitative research methods to provide insights to a broader audience germane to recruitment and retention of Black men in CIE. Given the financially lucrative CIE careers that nature of CIE, it is worthwhile to investigate Black men students' experiences in this domain. Thus, the proposed work will focus on students' CIE experiences and analyze their career decisions.

2.3.1. Research objectives and goals

To address the research questions, there are research objectives to understand, synthesize, document, and highlight the CIE experiences and career decisions of Black men majoring in computing.

2.3.1.1. Research goals. Goal: Identify and examine the experiences (i.e., barriers and successes) of Black men in CIE.

Objective 1: Collect empirical data to understand the factors that influence CIE success.

Objective 2: Collect empirical data to determine how Black men's aspirations for postsecondary and career paths in CIE were actualized and cultivated.

Objective 3: Mentor undergraduate students assisting in documenting and analyzing the experiences of Black men in CIE.

2.3.1.2. Education goals. Goal 1: Broaden the participation of Black men in CIE.

Objective 1: Facilitate the participation of Black undergraduate and graduate students as well as career professionals.

Goal 2: Disseminate results broadly.

Objective 1: Share results with educators, department chairs, deans, etc. and via publications and presentations. Objective 2: Integrate education and research in a course offered to all students at the university which focuses on race, gender, and the global computing sector.

3. Discussion

This relevant and timely research plan provides a view of the CIE experiences and career decisions from the perspectives of Black men at multiple four-year institutions. This aspect is significant because it provides a nuanced approach to collection, interpretation, and analysis of the experiences of Black men that can inform research and policy. Previously, much of the research examining students computing experiences has employed a quantitative approach. In contrast, this research is significant because it employs qualitative research methods in assessing the experience and career decisions of Black men in CIE. The inclusion of the different institution types adds to the robustness of this project. Black men in CIE matriculate at all types of institutions, and each type provides a different milieu and institutional climate.

While the educational community is learning a great deal about students' experiences as STEM majors in general, we know comparatively little about their computing experiences and career decisions as STEM majors. As such, the proposed research will contribute to the field's understanding of Black men in CIE to mitigate barriers and inform policy decisions. This work builds on the existing research described in the literature review and expands upon it by examining the experiences of Black men and their career decisions using qualitative research methods. The strengths paradigm of this proposed work has the potential to chart new directions, extend knowledge, and generate different avenues for this area of research [99].

There are several further reaching impacts associated with this research. One is its support of the participation of Black men in CIE and drawing attention to the success stories of Black men in CIE.

Another, for academic leaders, student affairs professionals, and other institutional stakeholders, is the potential for data from this project to inform policy at different types of institutions. The inclusion of the different types of undergraduate institutions can yield incalculable returns for higher education spaces beyond the institutions included in this work regarding institutional policies, strategic plans, and campus initiatives.

This work's contribution to theory extension and development for underrepresented minorities in CIE, researchers and practitioners concerning the computing education and career decisions of students of color is another contribution. This work may inform policy decisions and future STEM interventions for Black women, the Latino population, and other marginalized groups. Furthermore, its research findings could help policymakers develop policy solutions to address the underrepresentation of Black men in STEM. The positioning of Black men as "doers" of computing has far-reaching impacts for the STEM community concerning the academic determination and strength of this group.

Additionally, the implications of this research are not limited to higher education or the STEM intellectual landscape, as insights from the proposed work may be extracted to positively influence the educational experiences for all students, especially marginalized students,

across academic disciplines. As such, there are contributions for research and education in both the hard and soft sciences, as well as for society. Ultimately, this work could continue to build the STEM talent pool. There is only one reason we should seek diversity in our organizations, societies, workplaces, schools: it is the socially just and moral thing to do. Talking about how diversity ensures a large enough workforce and makes for better outcomes is self-serving at best. And yet, here is an entire manuscript dedicated to that goal because it would appear that we need to continuously cloak equality, diversity, and inclusion as anything other than it is morally correct.

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