On Transfer Student Success: Exploring the Academic Trajectories of Black Transfer Engineering Students from Community Colleges

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Dr. Bruk T. Berhane received his bachelor's degree in electrical engineering from the University of Maryland in 2003. He then completed a master's degree in engineering management at George Washington University in 2007. In 2016, he earned a Ph.D. in the Minority and Urban Education Unit of the College of Education at the University of Maryland. Bruk worked at the Johns Hopkins University Applied Physics Laboratory, where he focused on nanotechnology, from 2003 to 2005. In 2005 he left JHU/APL for a fellowship with the National Academies where he conducted research on methods of increasing the number of women in engineering. After a brief stint teaching mathematics in Baltimore City following his departure from the National Academies, he began working for the Center for Minorities in Science and Engineering (CMSE) in the Clark School of Engineering at the University of Maryland. In 2011, he began working directly under the Office of the Dean in the Clark School, coordinating outreach and recruitment programs for the college. In 2016, he assumed the role of director of the Office of Undergraduate Recruitment and Scholarship Programs. His duties entailed working with prospective freshmen and transfer engineering students. In 2018, he transitioned to the role of Assistant Research Professor in the Department of Bioengineering at the Clark School. His research interests transfer students who first enroll in community colleges, as well as developing broader and more nuanced engineering performance indicators.

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Shannon Hayes currently serves as the Assistant Director of Transfer Student Advising & Admissions in the A. James Clark School of Engineering. Prior to working in the Clark School, Ms. Hayes served as an Academic Advisor in the College of Education at UMD, where she worked with pre-service teachers. In addition to her professional role, Ms. Hayes is also a doctoral candidate in the Higher Education Program at the University of Maryland. Her research focuses on community college students and transfer student success.

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Sharon Fries-Britt is a Professor of Higher Education at the University of Maryland, College Park in the Department of Counseling, Higher Education and Special Education (CHSE). Her research examines the experiences of high achieving Blacks in higher education and underrepresented minorities (URMs) in STEM fields. Dr. Fries-Britt has published widely within peer-reviewed journals and she has served on

the editorial boards of The Journal of College Student Development, The Journal of Diversity in Higher Education and the College Student Affairs Journal. Recent work examines within group experiences of native and non-native Blacks in higher education as well as issues of campus racial climate. Dr. Fries-Britt is one of the faculty co-leads and authors of the recently published ACE report Speaking Truth and Acting With Integrity Confronting Challenges of Campus Racial Climate. Her research has been funded and supported by the Lumina Foundation, National Society of Black Physicists and the National Science Foundation.

Dr. Darryll J. Pines, University of Maryland, College Park

Darryll Pines became Dean and Nariman Farvardin Professor of Engineering at the Clark School on January 5, 2009, having come to the school in 1995 as an assistant professor and served as chair of the school's Department of Aerospace Engineering from 2006 to 2009. As dean, Pines has led the development of the Clark School's current strategic plan and achieved notable successes in key areas such as improving teaching in fundamental undergraduate courses and raising student retention; achieving success in national and international student competitions; giving new emphasis to sustainability engineering and service learning; promoting STEM education among high school students; increasing the impact of research programs; and expanding philanthropic contributions to the school. Today, the school's one-year undergraduate retention rate is 90%, the university's Solar Decathlon team placed first worldwide in the most recent competition against other leading universities, our Engineers Without Borders chapter is considered one of the nation's best, and the Engineering Sustainability Workshop launched by Pines has become a key campus event. Pines has testified before Congress on STEM education and created the Top 25 Source Schools program for Maryland high schools. He is also leading a national effort to develop an AP course in Engineering Design in partnership with the College Board. At $144 million, the school's research expenditures are at a record high, and the school is ranked 11th worldwide by the Academic Ranking of World Universities, which focuses on research citations. The Clark School has led the university in achieving and surpassing its $185 million Great Expectations campaign goal, going on to reach $240 million as of the most recent accounting. Pines also served on the university's strategic planning steering committee. During Pines' leadership of aerospace engineering, the department was ranked 8th overall among U.S. universities and 5th among public schools in the U.S. News and World Report graduate school rankings. Pines has been director of the Sloan Scholars Program since 1996 and director of the GEM Program from 1999- 2011, and served as chair of the Engineering Council, director of the NASA CUIP Program, and director of the SAMPEX flight experiment. During a leave of absence from the University (2003-2006), Pines served as Program Manager for the Tactical Technology Office and Defense Sciences Office of DARPA (Defense Advanced Research Projects Agency). While at DARPA, Pines initiated five new programs primarily related to the development of aerospace technologies, for which he received a Distinguished Service Medal. He also held positions at the Lawrence Livermore National Laboratory (LLNL), Chevron Corporation, and Space Tethers Inc. At LLNL, Pines worked on the Clementine Spacecraft program, which discovered water near the south pole of the moon. A replica of the spacecraft now sits in the National Air and Space Museum. Pines's current research focuses on structural dynamics, including structural health monitoring and prognosis, smart sensors, and adaptive, morphing and biologically-inspired structures, as well as the guidance, navigation, and control of aerospace vehicles. He is a fellow of the Institute of Physics, the American Society of Mechanical Engineers and the American Institute of Aeronautics and Astronautics, and has received an NSF CAREER Award. Pines received a B.S. in mechanical engineering from the University of California, Berkeley. He earned M.S. and Ph.D. degrees in mechanical engineering from the Massachusetts Institute of Technology.

On Transfer Student Success: Exploring the Academic Trajectories of Black Transfer Engineering Students from Community Colleges

Abstract

According to the National Science Foundation (NSF), half of Blacks who received a bachelor's degrees in an engineering or science discipline attended a community college at some point during their academic career. However, while research highlights the importance of supporting underrepresented racial and ethnic minorities (URMs) in STEM disciplines, there is a dearth of literature focusing on URMs in community colleges who pursue engineering and other science/math-based majors. Further, Black undergraduates in community colleges are often homogenized by area of study, with few efforts to disaggregate the data by major/discipline. Similarly, while engineering education research has begun to focus on the population of community college students, less attention has been paid to unpacking the experiences of racial subgroups of community college attendees. The engineering student transfer process has specific aspects related to it being a selective and challenging discipline (e.g., limited enrollment policies, engineering culture shock) that warrants a closer investigation.

The purpose of this paper is to examine the experiences of a distinct population of students who have recently transferred from several community colleges to one four-year engineering school. Specifically, we will present preliminary findings from interviews with three Black students who started their academic careers at several community colleges in a Mid-Atlantic state before transferring to the flagship institution of that same state. Interview transcripts were analyzed and coded by different members of the research team to document rich themes.

This research is part of a larger-scale, three-year, NSF-funded qualitative study, which examines the academic trajectories of two distinct groups of Black engineering majors: 1) Blacks born and educated in the United States and 2) Those born and educated in other countries. By looking at these two communities, we will build upon past literature that disaggregates the experiences of Black STEM students who represent multiple identities across the African diaspora. Through this lens, we hope to highlight the impact that cultural background may have on the transfer experience.

The theoretical framework guiding this study is drawn from the STEM Transfer model and posits that the persistence of Black transfer students in engineering is a longitudinal process influenced by the intersection of both individual and institutional factors. We draw from the STEM transfer model, noting that the transfer process commences during a student's community college education and continues through his/her transfer and enrollment in an engineering program at a four-year institution. The following factors contribute to our conceptualization of this process: pre-college background, community college prior to transfer, initial transfer to the four-year university, nearing 4-year degree completion.

Introduction

In the last ten to twenty years, scholars have placed a substantial amount of attention on the need to both grow and diversify the engineering profession [1], [2]. Although a number of recommendations have been offered in peer-reviewed literature and national reports, the majority of these articles and documents tend to conceptualize the pathway to engineering as one that moves directly from K-12 schools to four-year colleges and universities. While indeed many students - including undergraduates from underrepresented backgrounds - take this pathway, a considerable number of engineering students begin their post-secondary work in community colleges. In fact, according to the 2008 survey of recent college graduates conducted by the National Center for Science and Engineering Statistics [3], 50% of Blacks in engineering or

science fields took at least one community college course at some point in their careers. It is worth noting that among these recipients, some may have taken a community college course only through dual enrollment while in high school, or perhaps enrolled in a class at a community college while on summer break from a four-year institution. However, there is sufficient reason to assume that a significant amount of B.S. engineering degree awardees took at least one full semester enrolled in a community college at some point during their post-secondary careers. This is an important distinction because for many of these engineers, the community college pathway was the only viable option for them after completing high school.

The community college is also especially unique because it offers a considerable type of diversity with regard to its student population. This is especially true of certain states in the U.S. that have relatively large numbers of students of color [4]. For example, in California, of the 1.5 million community college enrollees, 63% represent a minority population [4]. In Texas, 57% of community college attendees are students of color, with around one-third of all minorities identifying as Hispanic or Latinx [4]. Other states with relatively large minority populations on community college campuses include Hawaii, Alaska, Florida, and Wyoming [4].

This paper explores the experiences of three engineering students identified as Black or African American, who transferred from a community college and are persisting in engineering majors. Inherent to our work is attention to multiple points that define undergraduates' academic journeys, recognizing that students can discontinue their college careers at any point along these trajectories. These points include: 1) Experiences within the community college context; 2) The transfer process from community college to four-year engineering programs; and 3) Persistence and adjustment within the four-year college environment. We intend to understand and make meaning of the ways in which diverse undergraduates of African descent navigate through each of these points in order to pursue their engineering degrees.

Literature Review

Although the transfer process is a key means of increasing the number and diversity of future engineers, it has been understudied in higher education and engineering education research literature [5]. While scholars have focused on the tendency of Hispanic/Latino STEM students to enroll in community colleges, Black undergraduates in community colleges are often homogenized by area of study, with little efforts to disaggregate their data by majors/disciplines [6], [7], [8].

Similarly, much of the research focusing on community college transfer students fails to disaggregate student populations by discipline, gender, or race. For example, a 2011 study [9] noted that little is known about disciplined-based efforts made to support undergraduates who transfer. Yet, some research has begun to explore STEM transfer students as a specific population. Given the large volume of STEM students who intend to transfer [3], [9], this focus is pivotal.

One study, conducted by Starobin, Smith, and Laanan [10], examines the experiences of female community college students who transfer to a four-year institution in a STEM major through a phenomenological lens. By tracing the lived experience of each participant from early

interactions with family and peers all the way through the community college and into the four-year institution, the authors provide a picture of female STEM transfer student pathways. Through this article, they make connections to both cultural and social capital, indicating that students with greater family support tended to be more successful [10].

Similarly, one study used qualitative research to examine the experiences of thirty women pursuing STEM degrees [11]. Each of the participants were interviewed twice: once when they were finishing at the community college and again one semester later. Some of the challenges faced by the students in this study included negative course experiences at the four-year institution, poor advising, and limited finances. Specifically, most students in the study mentioned that the classrooms at the four-year institution were different due to both the pace of the teaching and rigor of the curriculum. Participants in this investigation also noted that four-year classroom environments were a major challenge for STEM transfer students [11].

In her exploration of the impact of support systems on the experiences of community college transfer students in STEM majors, Jackson also [11] found that support systems came in different forms: family, community college and university faculty, and advisors. However, while students indicated positive experiences with community college faculty, Jackson's findings [11] did indicate that students experienced some challenges with faculty at the four-year university. For example, one undergraduate in Jackson's study described the four-year classroom as "chilly" [11]. Specifically, when the student participated during classroom discussions, she felt that peers reacted negatively; yet, when she approached the faculty member about this, he chose not to engage in the situation, failing to offer the student the necessary support. Other participants in her study shared similar experiences, citing that professors teach "because they have to and not because they want to" [11]. "Chilly" environments in math and science-based classrooms are a critical issue for many students [12]. Jackson's findings [11] indicate that these classroom environments may be particularly challenging for STEM transfer students. Moreover, it would be especially useful to understand the social and interpersonal dynamics at play among *Black* STEM transfer students. Additional studies could reveal challenges faced when learning to adapt to four-year institutions both as transfers, along with challenges as underrepresented racial minorities.

Adapting to the four-year classroom is just one aspect of the adjustment process for community college transfer students. This adjustment process was examined in depth by Laanan and his colleagues [13] in their work focusing on Transfer Student Capital (TSC). Laanan and his associates [13] assert that there are four factors that influence an undergraduate's academic and social adjustment after transferring: 1) The student's background, including reasons and motivations for transfer; 2) Community college experiences, such as course learning; 3) Transfer capital, including academic counseling experiences, as well as learning and study skills; and 4) Four-year university experiences, such as general perceptions of the university, course learning, experiences with faculty, and stigma as a transfer student. The authors tested the model by conducting a cross-sectional survey study. Using the survey, the authors analyzed the relationship between different components of the model with academic and social transfer adjustment, as measured through a composite indicator on the survey questionnaire. One of the more significant findings in the study focused on student expectations about the campus environment. According to Laanan et al. [13], "transfer students might expect that the university

campus environment to be as friendly, welcome, and satisfying as it was at their community college. To make students feel included and comfortable, it is important for [the four-year institution] to create a welcoming campus environment" (p. 196). This suggests that the four-year institution plays a significant role in retaining students and helping them through the transfer adjustment process.

Another factor that plays a role in the adjustment process is student identity, particularly for students broadly classified as Black. However, understanding the transfer student identities of Black undergraduates is another understudied area. Current literature often does not disaggregate the experiences of traditional Black STEM four-year college students from Black STEM community college transfer students, nor Black undergraduates born and raised in other countries from those born and educated in the United States [14], [15], [16]. It is worth noting, however, that one study found that among some Black collegians who transitioned from community colleges to a four-year institution, their transfer identities "trump[ed]" their racial identities [17]. This finding suggests that among some undergraduates, their student entry characteristics (i.e., transfer student status) may be more salient than their racial identities.

Beyond their academic, racial, or cultural identities, there are still other factors to consider in terms of how students view themselves. For example, as Chen has suggested, geographic context may play a role in the diversity of some community colleges within the U.S., and therefore how underrepresented racial and ethnic minority (URM) students are able to interact with members of other minority populations [4]. In addition, our own review of the literature indicates that most research on transfer students has been concentrated in areas such as Florida, California, and the Midwest [11], [13], [18], [10], [19]. There is a need for further work on how geographic region, as well as race, culture, and transfer identity inform the experiences of Black community college engineering transfer students [20], [21].

Our research seeks to fill a lacuna in previous research by identifying factors that may lead to the transfer and successful graduation of Black community college transfer students pursuing engineering degrees. In particular, given that Black undergraduates studying engineering are disproportionately concentrated in community colleges [22], the purpose of this study is to identify key factors that shape the transfer and persistence/retention experiences of this undergraduate population.

Research Questions and Study Design

This study is part of a broader, three-year, National Science Foundation (NSF)-funded qualitative research project that seeks to examine the experiences of Black transfer students in engineering. The primary research question guiding this current study is, *What do ethnically and culturally diverse Black engineering transfer students identify as key factors that shape their community college, transfer, and persistence experiences?* The study examines components that facilitate transfer, persistence, and the attainment of a Bachelor of Science (B.S.) engineering degree for Black students who begin their post-secondary careers in community colleges. In this paper, we describe findings from interviews conducted with two populations that we plan to explore throughout the project: A) Undergraduates who have recently transferred to a four-year engineering college, who likely have at least two additional semesters of coursework to complete

before earning their B.S.; later in this article we refer to this undergraduate population as Cohort A. B) Undergraduates who have earned a substantial number of credits at the four-year institution, and are now preparing to receive their B.S. in engineering relatively soon. We refer to this population as Cohort B.

All participants in our research are broadly classified as "Black" according to college/university registration information. However, our larger study intentionally explores within-group differences among students representing multiple regions of the African diaspora. We devote considerable attention to these within-group differences among participants in our longitudinal research design. For the purposes of this paper, we only note demographic differences among the small group of respondents, and plan to further unpack these and other emergent distinctions in subsequent manuscripts.

Exploratory Framework of Black Engineering Transfer Success

A number of prior studies have attempted to explore the factors that are crucial for the persistence and retention of Black undergraduates who are majoring in engineering, as well as of minority and majority transfer STEM undergraduates [23], [24], [25], [26], [27], [28], [29], [30]. To date, however, we are aware of no framework that has been developed that examines the persistence and retention mechanisms specifically relevant to Black transfer students in engineering. To ground our research and to establish an exploratory framework, we relied on several bodies of literature that guided our analyses of student experiences. These various bodies inform our understanding of the multiple dimensions of the undergraduate pathway, and include early academic experiences, individual background, and resources offered by post-secondary institutions. We present our exploratory framework as *An Exploratory Black Engineering Transfer Student Success Model* in Figure 1.

This model was informed by a number of well-established persistence and retention models [31], [32], [33]. It was also influenced by Wang's STEM Transfer Model [30], which suggests that transfer and retention is influenced by a series of factors. These factors include a student's self-efficacy, outcome expectations, and the four-year institution's willingness to welcome transfers onto their campus. After reviewing these prior works, we incorporated key components and elements of retention from these models, along with key components associated with Black engineering undergraduate success.

As our exploratory model illustrates, the process of Black engineering collegians transferring, persisting, and eventually graduating with bachelor's degrees in engineering is dependent on both individual and institutional components. This process, at the post-secondary level, begins with performance, outcomes, and overall experiences in the community college. After community college, the process continues with the students' abilities - and the institutional resources provided - to successfully navigate the transfer from the community college to the four-year institution. In the four-year engineering college environment, success is defined by retention and eventual graduation with a B.S. degree. Based on our review of existing frameworks and the prior studies referenced above, we suggest that the following four factors contribute to a full conceptualization of this process:

1) Pre-College Background. Students' pre-college backgrounds include family characteristics, such as socioeconomic status and the highest level of education attained by parents/guardians. Students' pre-college backgrounds also incorporate their K-12 experiences, such as the quality and level of preparation that they received in science and mathematics coursework. This also accounts for their pre-college STEM activities like participation in mathematics or robotics clubs.

2) Community College Prior to Transfer. Undergraduates' abilities to maneuver through the community college process and to prepare to transfer depend again on both individual and institutional variables. Individual variables include their academic profiles, such as their performance on mathematics placement examinations and ability to pass fundamental science courses. Institutional variables include the community college's capacity to support their academic goals and to provide resources that will support their transfer aspirations.

3) Initial Transfer to the Four-Year University. Once again, students' ability to transition and excel within the four-year engineering college context is largely dependent on their individual level of academic and social preparation (for example, the level of preparation that the community college provided for upper-level technical courses, and students' familiarity with how to form study groups) as well as institutional resources. Institutional resources may include summer bridge programs for entering transfer students or minority-focused STEM programs based within the administrative structure of the four-year engineering school [5]. These types of programs can reduce the risk or severity of "transfer shock" [25], while also encouraging new transfers to fully assimilate into the culture and community of the four-year engineering program.

4) Nearing Four-Year Degree Completion. As undergraduates move toward the completion of the engineering baccalaureate process, their academic profile and other individual factors, as well as department/college/university resources, continue to be of major importance. Students with a stronger academic and social profile as well as consistently robust campus resources are generally perceived of as being more likely to earn their undergraduate engineering degrees.

Institutional Context, Participant Recruitment, and Data Collection

As we indicate above, the findings presented in this article are part of a larger, longitudinal study of Black engineering transfer students. In the sections below, we describe the institutional context of the four-year college in which all students referenced in this article are enrolled. We focus more on the institutional context of this college, rather than the community college from which they transferred, because this paper attended more to the processes that undergraduates employed to transfer and persist. Again, future articles associated with this study will explore the experiences of Black engineering collegians *prior to* transfer. Since it is expected that these subsequent articles will include participants who are currently enrolled in several different community colleges, these future publications will provide more background and history of the different feeder community colleges to this engineering college.

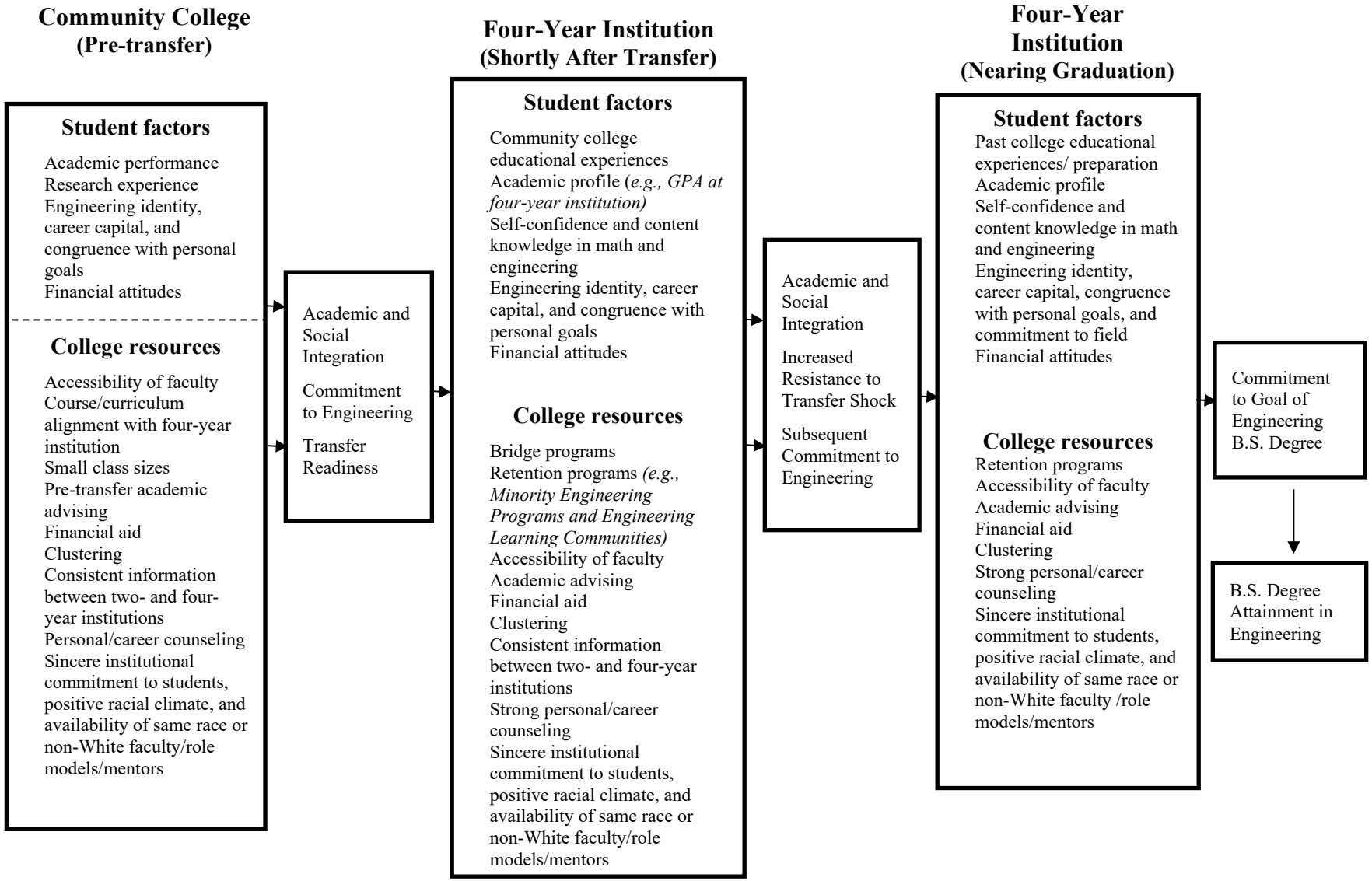

Figure 1. Preliminary framework depicting factors that facilitate the transfer, persistence, and graduation of Black engineering undergraduates who initially enroll at a community college

Institutional Context

The site for this study is Tech College of Engineering (a pseudonym), which is one of several colleges located on the campus of Landing University (a pseudonym). Tech College is a doctoral degree-granting college on the east coast, and ranks as one of the top ten institutions in the U.S. in terms of the number of baccalaureate engineering degrees awarded to Blacks. Over 1,000 engineering degree recipients over the past fifty years have been identified as Black, based on data from the External Relations and Alumni Engagement unit within Tech College. This institution offers a number of resources that are designed to support students of color in engineering, including a Minority Engineering Program (MEP) outreach and retention office and a student chapter of the National Society of Black Engineers. Tech College also features National Science Foundation-funded STEM programs, such as the Louis Stokes Alliances for Minority Participation (LSAMP), which provide resources like undergraduate research mentoring and preparation for graduate school.

Tech College of Engineering also benefits from its strong partnerships with several community colleges, including two relatively large majority-minority institutions that are less than 20 miles away. To support prospective and current transfer students, in recent years Tech College has implemented a series of initiatives, including the following: 1) An **annual meeting** with community college advisors and faculty who represent approximately ten community college feeder schools in the state in which Tech College is located. This meeting allows for colleagues to discuss trends and challenges related to engineering students who have or plan to transition to the four-year engineering program at Tech. 2) **Engineering transfer days** at area community colleges, which allow advisors from multiple engineering departments at Tech (e.g., mechanical engineering, electrical engineering) to collectively meet with prospective transfer students. This event functions very similar to a college fair. 3) **Summer scholarships** for incoming transfer students to take courses at Tech that allow them to quickly advance to junior standing. These specific courses are typically at the sophomore level but are not offered at some community colleges for various reasons. 4) **Information sessions** for prospective transfer students to learn more about Tech College, and the process required to transfer from community colleges to this institution. 5) An **annual recruitment day** for prospective engineering transfers, which is held on the Tech College campus. The day includes informational overviews, opportunities to meet departmental advisors, information on scholarships, and laboratory tours.

Participant Recruitment

As stated earlier, for the purposes of this paper, populations of student participants were recruited who were either recent transfers or who were nearing graduation at Tech College of Engineering. We define recent transfers as undergraduates who have earned less than 30 credits since transferring to Tech College; in this article, recent transfers are referred to as part of Cohort A. Undergraduates who have earned 30 or more credits since transferring to Tech College are classified as students who are nearing graduation; in this article, these students are referred to as member Cohort B. A table that provides a typology for these two cohorts is provided below in Table 1.

Cohort	Number of Credits Completed by the 2018-19 Academic Year
Cohort A: Recent Transfers	Less than 30 since transferring to Tech College
Cohort B: Nearing Graduation	30 or more since transferring to Tech College

Table 1. Cohorts Identified for Research Project

In order to identify potential Cohort A and Cohort B study participants, a member of our research team contacted the registrar's office on the campus on which Tech College is located to request a list of students who met certain requirements. These requirements included being identified by the campus as a Black or African American student in an undergraduate engineering major, and a student who previously attended a community college in the same state in which Tech College is located. The registrar's office then provided an email listserv of 76 students who met these requirements.

After the registrar's office provided these names to the research team, the lead author then emailed the listserv to solicit participants for the study. The solicitation email included a link to an online demographic survey, which queried students about questions related to their major, family educational background, and the racial and ethnic identities that best described them. Undergraduates were informed that in addition to completing the online survey, they would receive a gift that was valued at approximately $15.00 if they participated in all aspects of the project; these other aspects include interviews or focus groups, which will likely occur no more than two to three times per semester during their undergraduate tenure at Tech College. It is noteworthy to mention that students were considered fully enrolled in the project after completing the survey and agreeing to participate in a series of interviews and focus groups with the research team.

Data Collection

The research participants were all prompted to provide their informed consent to participate in the study through a web-based form, which was included in the link to the online survey. After completing the survey, students were invited to participate in individual interviews with the research team. Interviews were selected as the initial means of collecting data because they provide effective means of learning about individual experiences, and offer insights into how people make meaning of their lived experiences [34].

Interviews took place during the Spring 2019 semester. Two to three members of the research team participated in each interview. Interviews all lasted between 27 and 42 minutes. Research team members queried respondents about questions related to their early STEM educational

experiences in primary and secondary school, and then asked respondents to describe the types of support structures that they benefited from while enrolled in community college. In addition, interviews included questions related to the transfer process from their community college to Tech College. For example, one prompt was, *How were you able to navigate the transfer process to Tech College?* Finally, the research team queried interviewees on questions pertaining to the successes and challenges that they have encountered at Tech College of Engineering. Among the questions included prompts that asked, *"What motivates you to study engineering? To what extent does your gender, race, transfer, and cultural identity play into that motivation?"*

As a longitudinal study, the research team plans to continue to engage study participants in subsequent semesters, which will lead to additional articles. Rather than meet with students individually, however, the team will convene a series of focus groups of students representing each cohort in the future. This will allow groups to openly discuss their pathways and experiences, and allow the researchers to identify common themes among each subset of undergraduates. The team will continue to engage students across both cohorts, regardless of their academic trajectories. By implication, if Cohort A or Cohort B students wish to remain involved in the study after earning their baccalaureate degrees or do not remain in Tech College for any reason (e.g., some students may change their majors from engineering to computer science), they will still be considered part of their original cohorts. This broad approach to defining and maintaining cohorts will allow for a thorough analysis of the various academic - and even professional - pathways that transfer students may take in their careers.

Data Analysis

Data from all interviews were transcribed using Verbalink.com, which is a professional transcription service. After Verbalink processed the transcripts and made them available for viewing, full transcripts were then shared with each interviewee to note any errors or modifications that needed to be made. Sharing transcripts with interviewees serves as a form of member checking, which Tracy [35] indicates is one way to ensure robust qualitative research. The research team also wrote analytic memos after each interview and openly discussed broad themes that emerged from discussions with transfers. Miles, Huberman, and Saldaña [36] assert that analytic memos allow scholars to "reflect on and write about how [they] personally [relate] to the participants" (pp. 34-35). All transcripts were systematically and inductively coded individually by at least two members of the team; after coding transcripts individually, the team then convened as a group of two or more to openly discuss and categorize themes that captured crucial elements of participants' experiences.

In consideration of prior studies involving underrepresented racial and ethnic minorities (URMs) in STEM disciplines, it was expected that themes related to both the academic and social integration of participants in college would emerge as salient to the research question. These prior works suggest that themes related to **family support**, **peer engagement, faculty instruction**, **advising,** and **campus involvement** might be revealed to be especially important for allowing students to persist in their engineering majors. It was also expected that the self-perceived **racial** and/or **cultural/ethnic identities** of interviewees might be especially critical for fostering persistence as they pursue their engineering degrees. The team prepared for interviews

foregrounded by these established themes, but did not assume that any or all of these themes would be articulated with any certainty. Instead, the researchers used an inductive process for analyzing the data in order to allow both established and unexpected themes to emerge.

Demographic Profiles of Participants

All three participants in our study identify as Black females who were born and received their primary education in a sub-Saharan African country. Each of the female students moved to the United States and began their education at a community college before transferring to Tech College of Engineering. In order to transfer to Tech College and to meet the requirements of our study, each participant completed preliminary courses in physics, chemistry, and mathematics. Two of the participants, Emma T and Leila M, have earned fewer than 30 academic credits at Tech College and are designated as members of Cohort A in our study. It is worth noting, however, that Leila M has attended a total of four-post-secondary institutions, including two community colleges, prior to enrolling in Tech College. Leila also holds an undergraduate degree from the University of Lome, which is the largest university in Togo, West Africa. The GPA and the previous community college reported below for Leila only pertain to the most recent community college that she attended, not cumulative data for all prior institutions attended. It should also be recognized that Leila does not have a GPA at Tech College, since this (Spring 2019) is the first semester in which she is enrolled at this institution. Mira B, the third participant, has earned more than 30 credits and was therefore assigned to be a member of Cohort B. All three participants transferred to Tech College from two different community colleges in the state: County Community College and Local College (pseudonyms). More information about the participants, including their grade point averages at their community college, is provided below in Table 2.

In describing the participants in our study, we also acknowledge their demographic similarities. Our study was designed to recruit a cross-section of transfer students who represented a variety of engineering majors and demographic identities (e.g., female and male, U.S.-born and foreign-born). However, the students who initially agreed to participate in this study, who are profiled in this article, were unexpectedly similar in two key ways. First, all three participants identified as female students. This was a surprising finding, especially considering the fact that engineering at Tech College - like most engineering schools - has a far greater representation of male undergraduates than females. It is worth noting here that the researchers posed the question of gender identity, which is the third item in Table 2, as a multiple choice prompt with the following optional answers: 1) Female; 2) Male; 3) Non-binary; 4) Prefer not to say.

Upon further analysis, the research team recognized that gender-related prompts, as opposed to prompts about *sex*, should suggest responses such as Woman or Man. For the purposes of this article, the three respondents are referred to as “females” and not “women.” The research team will make every attempt to query these and future participants as to appropriate questions of *gender*, and also seek to include participants who represent other genders/sexes. Lastly, we acknowledge that in studies of engineering persistence, explorations of the experiences of female undergraduates in particular can offer insight into means of broadening participation. In the context of this specific article, however, findings related to gender are not discussed at great

length; future publications related to this study will explore the role of gender for these and other pre- and post-transfer students.

The second way in which our participants were more monolithic was that each of them was a first-generation American from a West African country. This result was less surprising when considering that the majority of Black transfers to Tech College each year happen to be first or second-generation Americans, rather than African Americans whose families have resided in the U.S. for multiple generations. However, as in the case of gender, the investigative team intends to engage more Blacks in the future who represent a broader cross-section of the African diaspora.

Findings

Because we sought to focus on various phases of the participants' educational backgrounds, we have separated our findings into two broad themes: Pre-College Background and Community College Experiences. Under each broad theme we have generated sub-themes that grew out of our data collection and coding processes.

Pre-college background

Although data analysis was limited by the small sample population (n=3), a consistent theme across all interviews were similarities in how respondents described their pre-college backgrounds. Responses from all three students were generally consistent with regard to the following themes: 1) Enrollment in private schools; 2) Exposure to challenging math and science curricula; and 3) Awareness of the college admissions process. These themes suggest that undergirding these students' abilities to navigate the community college environment and the four-year college environment was and is their foundational academic background.

Enrollment in private schools

All three participants in the study spoke of their parents' intentionality in putting them in private schools. Emma commented, "My parents wanted the best so they put me in a private school." Mira noted, "It [the private boarding school she attended] was supposed to be one of the best schools in West Africa... So, my parents sent me off to that." Finally, Leila explained why her parents chose private over public schools:

> A lot of people [in Togo] prefer to send their kid to private school, because...it's more expensive, but the kids are more well taken care of in terms of education and, like, tutoring, and giving them direction, and, like, mentoring them.

This intentional focus on a private school education reflects the parents' own capital in understanding the academic pathway to college, and navigating this pathway within their country's educational parameters.

Name (pseudonym)	Major	Country of Origin	Cohort to which Student is Assigned in Study	Previous Comm. College /Comm. College GPA	Number of Credits earned at Tech College/Tech College GPA
Emma T.	Bio-Engineering	Nigeria	2	County Community College/3.9	15/3.6
Mira B	Mechanical Engineering	Nigeria	3	Local College/3.75	66/3.25
Leila M	Bio-Engineering	Togo	2	Local College/3.58	N/A

Table 2. Participant Summary

Exposure to challenging math and science curricula

In terms of educational background, each student spoke emphatically about their extensive math and science training in their home country. All three female participants chose to take a math/science-heavy curriculum in their last two years of what would be considered "high school" in the United States. These classes included math, physics, and chemistry. Interestingly, Leila admitted having difficulty with both physics and math, yet persisted in the courses: "I had a lot of trouble with physics when I was at that age, and my parent had to, like, pay for tutoring

classes… I had a lot of tutoring sessions, but I was not still good at math." Emma explained that you could choose your classes in "A-levels" (secondary school classes) and she noted:

> … I did one year of A levels and I did all science classes A levels... And in the A levels I did biology, chemistry and math so yeah, those were the three subjects I did in A levels [college prep level].

Not only do the respondents' comments speak to their science and math preparation, but they also reveal their agency in selecting their academic course plans. This agency could potentially be a contributing factor to their success and ability to navigate community college and transfer to a four-year institution.

Awareness of the college admissions process

One salient finding from the interviews was the fact that all three respondents seemed to have exhibited some knowledge of what it would take to attend colleges and universities abroad before they left their native countries. Ultimately, the students elected to attend community colleges, but their decision to attend a community college seemed to be the best of multiple options that they had available to them. Leila explains: "...Initially, I wanted to do pharmacy and then nursing, so I changed major many times." In fact, as noted earlier, Leila already holds one college degree from the University of Lome, and when she emigrated to the U.S., she initially was admitted to and enrolled in another four-year university. Mira remarked:

> I was supposed to go to the University of Massachusetts at Amherst. So, I went visiting. I committed but my parents thought it'd be better for me to take a gap year coming here since I didn't really know the system.

Emma initially planned to attend a university in the United Kingdom. She commented:

> "I didn't like plan to come here [the United States] at all so I was like oh well, since that's a lot easier I'll just spend two years in a [community college] and then maybe transfer to a university and get my degree."

The students' ability to choose schools abroad, successfully complete the application process, and receive admissions demonstrate an adeptness in maneuvering through what can be a very challenging landscape. These skills seemed to allow them to participate in and navigate the various stages of securing schooling within the U.S. context once they transitioned to this country. For these students, community college was not their only choice, but was the best option available to them. In the next section, we elaborate on interviewees' decisions to choose to enroll in community colleges.

Community college experiences

According to research conducted by Sommers et al. [37] students have been identified as selecting community college for a variety of reasons. For example, many will enroll because they do not feel academically prepared for the four-year school. In contrast, some students will

select community college purely for the geographical convenience and the financial savings [37]. As noted above, the study participants seemed to share a somewhat different motivation for enrolling in community college.

Choice to enroll

When reflecting on their choice to enroll in the community college, Mira, Emma, and Leila all indicated that their enrollment was dictated more by their circumstances than by a mindful choice to enroll. For example, when sharing her choice to enroll in Local College, Mira shared "Community college...wasn't planned." Rather, Mira shared that, because she did not know the U.S. school system very well, she and her parents decided that it would be best for her to take a "gap year" before enrolling at a four-year school. Therefore, rather than taking coursework with the purpose or goal to transfer, Mira enrolled in courses as a means to acclimate to the U.S. school context.

Emma shared that her enrollment in community college was tied to her immigration to the U.S as well. As stated earlier, Emma shared that her goal throughout her primary education was to attend a university in the United Kingdom. As such, she was careful to complete A-Level exams (associated with the British secondary school system) in order to prepare herself for this pathway. However, at some point her family obtained their green cards to the U.S. and chose to move to this country. The timing of this move greatly impacted Emma's college pathway. She shared:

> So when I was in United States, I was 17 years old. I already finished high school. I already had one year of A level. And so there was no point of me going to high school or anything else, [I was] too old. And I hadn't applied to any universities in United States so I didn't really…I didn't want to like start doing SATs, all that jazz and then wait one more year. So I was like might as well just apply [to community college].

Emma went on to share that it was through family connections that she identified community college as a viable pathway.

For Leila, enrolling in community college was also a circumstantial decision, however, her path looked slightly different. When she initially came to the United States, Leila was hoping to earn a graduate degree since she already possessed a bachelor's degree. However, due to some problems with her admission, she ended up enrolling as an undergraduate student at a university in Missouri. She explained that she was originally unhappy with this choice and, as such, she was redirected to the community college:

> Initially, I wanted to do pharmacy and then nursing, so I changed [my] major many times. And that's why I decided to transfer to community college, figure out my options and what I wanted to do. So I changed major a lot of times, and community college was cheaper, that's why.

In other words, Leila wanted to use the community college as a platform to explore educational options.

Community college adjustment process

Following their enrollment in the community college, our participants then all had very different experiences adjusting to the community college environment. For Emma, the community college was a challenging experience because it was her initial introduction to the U.S. When reflecting on challenges at the community college, Emma shared:

> I guess my first semester was really challenging because I just moved to the United States so I was having a bit of a culture shock. So I wasn't really like used to how things were in the country and stuff like that. But aside from that, that was like probably the most challenging part. So like my first semester wasn't really that great but then afterwards it became better for me.

In other words, more than presenting academic challenges or an educational transition, Emma found the acculturation to the U.S. to be a more daunting experience.

Mira similarly encountered challenges at the community college. And, just like Emma, her challenges were not academic in nature. Mira explained:

> At the time, I was just trying to adjust to the social sphere here of making friends. I was always a really quiet kid. So, coming out and saying would you be friends with me was, honestly, the only challenge. I was doing pretty well with school. It wasn't too hard to study and do all the classes.

Leila's experiences were slightly different. She explained that the biggest challenge for her was working while in college:

> I always say my biggest challenge was working and studying at the same time. Because I was working fulltime and I was going to school full-time, and I did that for three semester before I got the scholarship. Yeah, so that was hard, I was – and I didn't wanna have any loans, so, yeah, it was really hard going to school and working at the same time.

Analysis of Findings

Pre-college background

The findings of this study underscore previous research on the capacity of schools throughout sub-Saharan Africa to prepare students for challenging STEM majors. In a 2017 ASEE conference paper, Berhane, Onuma, and Secules [38] described six Black engineering students who transferred from a community college. In this paper, Berhane and his colleagues [38] noted that half of their participants were first-generation Americans who emigrated from either West or East Africa. Respondents described taking "really hard" classes that were rooted more in understanding key concepts than in the notion of memorizing formulas; the more formulaic approach, according to one respondent, is more consistent with the U.S. instruction than in the instructional practices of her home country. In addition, interviewees in this earlier discussion

depicted the teachers at private schools as more reliable and better-resourced than educators in government-run schools. One participant in this article found mathematics coursework in his home country to be more challenging than introductory mathematics when he first enrolled in the U.S. at a community college [38].

While respondents described in this 2017 article [38] seem to intimate that their secondary schools almost over prepared them for STEM coursework in community colleges, the respondents in this new work seemed less likely to make this kind of assertion. This tendency to articulate less of an over-preparation or even overconfidence may be rooted in previous findings that have examined the engagement of girls in science. In their comprehensive review of literature on girls and science, Brotman and Moore [39] note the tendency for some schools - including schools outside of the U.S. - to reinforce gender stereotypes that are less inclusive of young women. This may be part of the reason that some girls, including those who consistently pass courses in secondary schools and in community colleges, have less positive attitudes about STEM-related fields than their male counterparts [39]. Again, the research team intends to discuss more details related to the relevance of gender in this project in future articles.

The findings described in this paper also reflect results from other fairly recent papers. To date, the body of literature on Black immigrants whose children have or continue to attend private school is small, but offers considerable findings. A series of studies published within past ten to twelve years reveals that high-performing Black foreign-born and U.S.-born students often enroll in private, college-preparatory, or magnet schools that offer greater resources than many public schools [40], [41], [42], [43], [44]. Among first-generation and second-generation Black Americans in particular, Massey et al. [44] report that they are much more likely to attend selective private or public U.S. colleges and universities, perhaps because of their secondary school preparation.

Placed within the context of these prior works, the outcomes that we report in this article suggest an important theme as it relates to the pre-college experiences for Black international/immigrant engineering students: Private schools offer students an often distinct experience which mediate or mitigate many challenges faced by students in government-sponsored schools. In countries such as those noted by the respondents in this study, private schools allowed them to benefit from a well-resourced education. Though not reflected in these findings, Blacks who attend private schools *in the U.S.* may also benefit from resources that often are not available to public school students. Postsecondary institutions with engineering and other STEM programs may therefore be enrolling more private school-educated students than they are aware of, suggesting a private school to STEM college major pipeline that has not fully been examined in the literature. Because of their families' socioeconomic statuses, these participants may be entering community colleges with more resources than students who come from more financially disadvantaged backgrounds.

At the same time, findings from this study should not be interpreted as a shortcoming of public/government-sponsored schools either in the U.S. or in other countries. The fiscal and social maladies that plague some public schools have been documented ad nauseam, and at least in the context of the U.S., public schools are highly correlated with the tax base in each locale [45]. Yet, in engineering as in other disciplines, there are, of course, numerous accounts of public school graduates that go on to lead careers as impressive as private school alumni. Like

the narratives of students broadly classified as "Black," we recognize the diversity and within-group differences of public school stakeholders.

Community college experiences

With respect to community college enrollment and persistence, the narratives that Emma, Leila, and Mira provide offer a reconceptualization of Black pre- and post-transfers. While scholars appropriately note that many community college enrollees do not believe that they are academically prepared for postsecondary studies [37], this notion may not be applicable for certain students. Building on our assertions above, the narrative that students are typically first-generation college students or from more financially disadvantaged households is not necessarily true in this instance [46]. Below, we briefly suggest a reframing of Black community college students in engineering and other STEM fields, particularly those who emigrate from sub-Saharan African countries like Nigeria and Togo.

One of the more salient findings from this work was the respondents' ability to exercise forms of capital [48]. Arguably, not only did Leila, Emma, and Mira have access to cultural capital associated with their countries or communities of origin, but they also had access to capital that afforded them access to non-trivial academic resources. Leila, for example, referenced "a lot of tutoring sessions." Once again, every participant in the study had the opportunity to attend secondary institutions that were conceivably better-resourced than government-sponsored schools. This also reinforces findings referenced earlier, which described how different forms of capital improved the instances of transfer and persistence among community college students [10].

According to the Capps, McCabe, and Fix [48], African immigrants to the U.S. are frequently better educated than many other Americans. This is largely due to visa requirements, which in the past required a minimum degree of educational attainment before such a document would be granted. As such, the purpose of this article is not to imply any notions of the superiority of one population (African immigrants) over another (African Americans whose families have lived in the U.S. for generations). Indeed, given any type of merit-based selection system, it is largely expected that a more limited and often better-resourced group of individuals will achieve at higher-than-average levels. Nonetheless, it seems prudent to at least question bodies of literature that repeatedly highlight *only* themes around under preparation and underperformance when depicting Black community college students [51], [52].

At the same time, certain previous depictions of community college students are still appropriate for these study participants. Karp and her colleagues [46], for example, describe the importance of academic and social integration for new community college students. This depiction generally presumes that there is no broader cultural integration necessary besides the need to adapt to the campus environment. In other words, this prior description of community college-level integration seems to take for granted that students have already adapted to U.S. societal norms. By contrast, our research indicates that collegians from other countries may have less difficulty academically but *more difficulty* in their acculturation processes within the U.S. in general. While these students are becoming new students on campus, they are also becoming *new to the American way of life*. Data from our study suggest that the latter may be a more considerable

challenge than the former. In the final section below, we offer statements as to the implications for institutions that enroll students who are, simultaneously, both new to community colleges and relatively new to this country.

Discussion and Conclusion

Community colleges have been the first destination for higher education pursuits among many diverse students in the U.S., including substantial numbers of international undergraduates [49]. In engineering education research, however, the body of work on community college has not fully explored the meaning of the intersection between international students and their experiences in community colleges. It is worth noting that community colleges are largely an American educational construct, with few, if any, analogous institutions in other countries. Moreover, the purpose of community colleges was for a long period seen as solely vocational, and in the mid-twentieth century these schools were known to "cool out" the future post-secondary aspirations of their attendees [50]. Within this context, and in consideration of the tendency for community colleges to enroll a broad cross-section of students, it would be valuable to explore the extent to which first-generation Americans are engaged on these campuses.

One common means of engaging Blacks within post-secondary institutions, including community colleges, has been through minority and multicultural programs [53], [54]. The programs, however, tend to assume an American-centered minoritized view of the individual. That is, a student of color may be viewed phenotypically in accordance with their perceived racial identity, rather than their internalized ethnic or cultural identity. Within this context of our findings, however, engineering and other STEM programs for students of color can potentially adopt some strategic approaches. Below, we offer a brief set of recommendations.

First, community college and four-year school administrators can develop optional surveys of undergraduates that query them for questions such as previous coursework taken. If indeed students have been exposed to rigorous tests like British or French national exams, community colleges should seek ways of identifying and valuing their prior learning. One option might be to provide opportunities for these collegians to tutor other community college students who may be having difficulty with mathematics or science courses. This will provide these new Americans with a sense of integration in their new learning environments and in the U.S. Additionally, it will potentially provide them with modest income to offset their inevitable expenses, and offer a service to their colleagues who may need assistance.

A second recommendation may be to support the development of informal learning communities. As Berhane [55] found, some first-generation Black engineering community college students were less willing to engage with peers from the U.S., and preferred peer groups with colleagues who shared a common language or ethnic identity. This does not suggest that peer groups should be exclusive, but this strategy can provide students the option to adjust to the U.S. while remaining connected to peers who represent a shared background. At the same time, these communities can develop some formal connections to the broader campus through activities such as undergraduate research programs, which some community colleges offer for students [56], [57].

Finally, as it relates to the oft-lamented narrative of Black students who are underprepared or underperforming, this paper provides insight into students who may be silently excelling on community college campuses. Administrators should be encouraged to recognize the richness and cultural wealth that transfers from African and other countries offer in the context of the U.S. [48]. This can potentially help campus leaders to avoid deleterious stereotypes of international and immigrant students, which have been problematized by prior scholars [58], [59]. Furthermore, community colleges in general and STEM/engineering departments in particular can be places that celebrate global diversity. Indeed, for the U.S. to maintain an international presence in engineering and in other STEM fields, the production of a globally competitive workforce is paramount.

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