

EXAMINING BLACK MALE STUDENT PARTICIPATION CHALLENGES IN A HIGH SCHOOL ACADEMY OF ENGINEERING

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In this study we followed a qualitative case study design to examine the perspectives of 20 school stakeholders (e.g., district and school administrators, school board members, teachers, school counselors, parents, staff, and advisory board members) regarding (in)equitable ways they promote and broaden the participation of Black male students in a high school academy of engineering. Using the concept of cultural matching and the formation of STEM identities, we understood that Black students at Madison River Academy did not participate in rigorous academic programs (e.g., the academy of engineering), partially due to a lack of the school stakeholders' abilities to provide culturally congruent, compatible, responsive, or synchronized learning environments that connected them with their home cultures and lived experiences. Findings from our case study demonstrate how the change in the historical mission of career academies has limited access to rigorous STEM opportunities and engagement of ethnically and racially diverse (particularly Black) students. In this academy, the lack of Black male student and teacher representation as well as mathematics were two barriers limiting the engagement of Black male students. Thus, we contend that it is critical that STEM academy school stakeholders, particularly school leaders, prioritize equity as a strategic goal for their STEM programs and recruit Black teachers who are willing to create culturally responsive curricular experiences to elicit interest in STEM for Black students.

KEY WORDS: access, Black males, career academies, equity, STEM

1. INTRODUCTION

Black males are underrepresented in the fields of science, technology, engineering, and mathematics (STEM) (Henderson et al., 2022). Moreover, the problem originates from the opportunity gaps that exist in the K-12 school system. In particular, Black student

math and reading scores tend to be lower than their other racial peers (Cintron et al., 2020; Ford and Moore, 2013; Hines et al., 2021), are often overrepresented in special education and underrepresented in gifted and talented programs as well as accelerated courses (e.g., advanced placement [AP]) (Ford and Moore, 2013); and have a lower high school graduation rate than their peers (Schott Foundation for Public Education, 2015).

Opportunity gaps for Black males hinder their academic achievement and success that leads to postsecondary pathways (Hines et al., 2021). Black males also tend to have negative schooling experiences, such as low engagement, low motivation, high dropout rates, and low test scores (Cintron et al., 2020; Ford and Moore, 2013). According to the National Science Board (2018), 5% of Blacks occupy science and engineering occupations, even though they make up 12% of the workforce. Further, Black students earned 7% of baccalaureate degrees in STEM during the 2017–18 academic year.

STEM career academies are one comprehensive high school reform initiative that could help broaden the participation of Black and other underrepresented groups in STEM. Yet, while researchers have found promising findings related to student participation in high school STEM academies for Black students, few studies have documented whether Black students, particularly Black males, participate in these STEM career pathways that are in high-skilled, high-demand, and high-wage fields. Relatedly, Fletcher and Haynes (2020) found that career academies in some schools can lead to a form of tracking. Tracking is the separation of students into distinct curricular tracks based on perceived or measured cognitive ability and has been cited as a vehicle that provides students with an unequal education (Fletcher and Zirkle, 2009). The purpose of this study was to examine the perspectives of school stakeholders regarding strategies they utilize to promote and broaden the participation of Black male students in a high school academy of engineering. Hence, it is critical that we better understand how school stakeholders of these STEM career academies enable or constrain equitable learning experiences and opportunities for underserved populations—such as Black males. STEM courses at the high school level help students discover their interests, enable them to be more competitive in applying to colleges and universities, and prepare them for the rigor and challenges of majoring in STEM during college (Bottia et al., 2015).

1.1 Research on Career Academies

Career academies are programs of study featuring small learning communities found within high schools (Fletcher et al., 2019). They focus on providing students with a college preparatory curriculum integrated within a career theme (e.g., engineering, information technology). Curricula in career academies feature the integration of academic and technical content to increase rigor and relevance to students' career interests. The academy model also emphasizes partnerships with relevant employers and postsecondary institutions through advisory boards. These advisory boards are designed to support students (e.g., funding, guest speaking, work-based learning opportunities) in the academy (Fletcher et al., 2018; Kemple and Snipes, 2000).

Fletcher et al. (2019), using a case study analysis, found that school stakeholders within a high school career academy had a positive influence on school culture, embraced a unique attitude of acceptance for all, and perceived their academy as a safe place for students. The academy elements that were associated with a positive school culture included the open enrollment policy, small school size, and student-shared interests by focusing on a STEM-related career theme. In addition, Moore (2006) found that (a) having a strong interest in STEM; (b) participating in high school CTE programs that emphasize STEM; (c) acquiring high aptitudes in science and mathematics; (d) gaining the support from parents and family members; and (e) fostering meaningful experiences and relationships with school personnel were all inspirational aspects motivating Black males to major in STEM areas in college. Even further, Fletcher and Cox (2012) found that Black students believed participation in career academies was the most meaningful aspect of their schooling experience and provided them an opportunity to gain a sense of community/belonging, acquire hands-on training, and explore their own individual interests.

Thus it is quite plausible that career academies have the potential to provide a positive learning experience for Black students. However, despite the historical mission of career academies to expand opportunities and the engagement of ethnically and racially diverse (particularly Black) students, more recent efforts to expand STEM curricula have resulted in more rigorous programs that require students to perform higher in core academic areas (e.g., mathematics and science) (Fletcher and Cox, 2012). These initiatives have resulted in demographic changes, with more Asian, Indian, and White students participating.

2. THEORETICAL FRAMEWORK

2.1 Cultural Mismatch

While the K-12 student population in urban schools is increasingly diversifying, the teaching workforce remains largely White (79%) and female (77%). Even though Black male students comprise 16% of the total K-12 student population, Black male teachers comprise only 2% of the total percentage of teachers (Goings and Bianco, 2016; Kena et al., 2015). Given that the vast majority of educators are White, middle-class, and female, their abilities to meet the diverse learning needs of ethnically and racially diverse students is a persistent challenge (Gay, 2018; Ladson-Billings, 1995; Nieto, 2010). Thus, many issues emerge based on a cultural disconnect or mismatch between school stakeholders and their ethnically and racially diverse learners (Achinstein and Aguirre, 2008). For example, White teachers often have inherent biases and, consequently, provide preferential treatment to White students in which they share cultural backgrounds, identities, languages, and norms (Danforth and Miller, 2018; Johnson and Sondergeld, 2020). Unfortunately, too many Black male students are not afforded schooling experiences where they can have meaningful student–teacher and student–school counselor relationships with Black male professionals in the school (Goings and Bianco, 2016).

2.2 Cultural/Ethnic Matching

However, findings from prior research studies have demonstrated that cultural/ethnic matching is linked to positive school outcomes (Achinstein and Aguirre, 2008; Dee, 2004; Easton-Brooks et al., 2014; Eddy and Easton-Brooks, 2011). The concept of cultural matching is a term used to describe how ethnically and racially diverse students gain access to learning opportunities if schools and school stakeholders offer more culturally congruent, compatible, responsive, or synchronized learning environments that connect them with their home cultures (Achinstein and Aguirre, 2008). Individuals who represent their students' identities can serve as role models and positive examples of adults for students.

Researchers (Dee, 2004; Easton-Brooks et al., 2014; Eddy and Easton-Brooks, 2011) noted that students, "when matched with a teacher of the same ethnicity. . . ethnic minority students performed higher on academic achievement tests than those ethnic minority students who are not taught by ethnic minority teachers" (Easton-Brooks, 2014, p. 101). According to Achinstein and Aguirre (2008):

Previous research reports that such a match may promote positive relationships and role models, support students in crossing cultural and linguistic boundaries in school, foster culturally relevant teaching for diverse students' learning, and ease the professional's transition to working in high-minority urban schools. (p. 1506)

Researchers have found that the academic success of Black students is substantially influenced by the social support and encouragement that they gain from their teachers (and other school stakeholders) (Brooms, 2016; Ladson-Billings, 1995). Those students who are schooled in environments with school stakeholders who employ culturally responsive practices often experience a positive school culture.

2.3 STEM/Engineering Identity and Self-Efficacy

It is a premise that human beings are consciously aware of their own lives, and it is through reflexivity that we become aware of a consciously constructed self (Muru-gami, 2009). Darling (2013) argued that self and identity are closely related concepts. Identities define us because they contain traits, personal characteristics, roles, ties to social groups and those who represent our likeness (Robnett et al., 2018), and they can be focused on our past (what was true once), the present (what still is true), and the future (our wishes, expectations, and fears) (Oyserman et al., 2012). Oyserman et al. stated that identities help people make sense of different and distinct parts of their self-concepts.

Prior research suggests that ethnicity can impact ones' feelings of acceptance, especially for Black male students who report more uncertainty about their belonging within STEM fields (Hotchkins and Dancy II, 2015; Robnett et al., 2018). Neverthe-

less, the concept of identity for Black students in STEM learning environments has not fully emerged. For Black students, an identity in STEM should contain relevant contexts and goals linked to how they perceive and understand their blackness in relation to their surroundings, peers, and professionals who embody their imagery (Morton et al., 2019).

Much of the existing research has acknowledged the need for understanding multiple STEM identities prior to one's career choice (Capobianco et al., 2012; Hazari et al., 2010; Matusovich et al., 2011; Pierrakos et al., 2009). The consideration of identities for Black students is important because their self-beliefs can impact their educational choices, and potentially the later development of a STEM identity. Understanding these identities can help educators to develop a better understanding of how ethnic matching, cultural mismatch, or representation entices Black students to STEM fields, as well as contributing factors leading to students' disinterests in STEM. For some Black students, they believe STEM fields conflict with their own views of themselves, career aspirations, and other self-beliefs (Rattan et al., 2015).

Hotchkins and Dancy II (2015) noted that Black students' self-concepts can have broad implications for personal development in terms of education, career, and community life. The implications could lead to experiences of underachievement and inadequate fulfillment. This argument also raises other concerns about Black student's lack of self-actualization. This lack may lead to low self-esteem, poor self-image, and negative self-concept. In light of this view, Flowers (2012) noted that high-achieving Black male engineering students at historically Black colleges and universities (HBCUs) who exhibited strong self-efficacy, attributed family, their interests in STEM fields, religion, and supportive institutional environments as central to their academic excellence. Therefore, student identity is a powerful lens for viewing and understanding how Black students perceive their likeness and persist in STEM fields.

Thus, STEM-related identities relate to how students' view themselves and decisions as to whether they believe that STEM is a good fit (Singer et al., 2020). According to Hazari et al. (2010), identity is comprised of three subconstructs: interest, recognition, and performance/competence. These constructs have been validated in previous studies in physics and mathematics using large-scale data (Cass et al., 2011; Cribbs et al., 2012; Hazari et al., 2013). Interest in a particular domain also plays a key role in students' identity and their choice of a STEM major. Having representation in these domains may also enhance Black students' interests in STEM disciplines (Hotchkins and Dancy II, 2015). For Black students, the recognition component of identity may consist of the student's belief that they receive positive external recognition from individuals such as parents, peers, and/or teachers. Students may receive positive recognition that they are the "kind of person" that fits within a subject area (e.g., "mathematics person" or "engineering person"). Students' performance/competence beliefs represent perceptions about their ability to perform effectively (e.g., on an exam in a subject) and be competent in a particular domain. Moreover, the context (e.g., cultural representativeness) that educators may foster for Black students in STEM learning environments has the power to elicit students' identity, efficacy, and interests in STEM (Bonous-Hammarth, 2000;

Osborne and Walker, 2006; Oyserman, 2015). To that end, educators should strive to design STEM curricula that are relevant to the contexts of the lives of Black students to promote their interests, engagement, and retention in STEM fields.

3. METHOD

In this study we followed a qualitative case study design to examine the perspectives of school stakeholders regarding (in)equitable ways they promote and broaden the participation of Black male students in a high school academy of engineering (Stake, 2006). We focused on the following research questions: (a) what are the perspectives of school stakeholders regarding strategies they utilize to promote and broaden the participation of Black male students in a high school academy of engineering, and (b) how do school stakeholders of these STEM career academies enable or constrain equitable learning experiences and opportunities for underserved populations, such as Black males. It is important to note that we use pseudonyms throughout this manuscript to replace the names of individuals and locations.

3.1 Research Design

The case study approach allowed us to document thick and rich descriptive information about the setting in which the high school academy of engineering operated (Stake, 2006). In this research we studied an academy of engineering (the case) operating within unique contexts (e.g., community, predominantly Black student population from middle to high socioeconomic status backgrounds, predominantly Black leadership team, and predominantly White teaching faculty).

3.2 The Case: Madison River Academy

Madison River Academy (pseudonym) is a comprehensive high school with an academy of engineering embedded in it. It is located in a suburban area (within an urban school district) within a Southeastern state. The focus of the academy of engineering program is on promoting the college and career readiness of students through college visits and work-based learning activities (e.g., internships). The academy also has extensive university and corporate partnerships from the local community. The academy has a student population of approximately 2,400 learners serving students from ninth through twelfth grades. The ethnic and racial backgrounds of students at Madison River Academy are 68.8% Black, 14.4% Latinx, 8.7% White, 4.3% Asian, and 3.4% Multiracial. Thirty-four percent of students qualify for free and/or reduced lunch. The gender makeup is 51% female. Madison River Academy had a 93% graduation rate (within four years) for the 2020–21 academic year. Sixty percent of students who graduate matriculate into college (20% to a two-year college and 40% to a four-year university). The school is led by a Black female principal with a background in the field of engineering.

3.3 The Curriculum

School personnel at Madison River Academy of Engineering used the Project Lead the Way (PLTW) curriculum for the academy of engineering courses. Students within the academy of engineering enroll in the advanced manufacturing and engineering pathway which comprises the following courses: introduction to engineering design, principles of engineering, and computer integrated manufacturing. Students are also required to participate in an internship prior to graduating from the academy.

We studied a NAF (formerly known as the National Academy Foundation) academy of engineering (the case) operating within unique contexts (e.g., community and school district) at a distinguished level according to the NAF standards of practice. NAF continuously evaluates their high school academies to assess their level of implementation based on standards of practice. They rate academies on three levels of implementation using the following hierarchy from highest to lowest: distinguished, model, and certified. NAF's educational design is based on these elements: academy development and structure, curriculum and instruction, advisory board, and work-based learning. The case study method was the most appropriate for studying the perspectives of school stakeholders regarding equitable ways in which they promote and broaden the participation of Black male students in a distinguished high school NAF Academy of Engineering for the following reasons. First, case studies focus on understanding the case and how it operates in the context of its particular situation. Second, case studies emphasize the functioning, activities, and practices that take place within the case. Third, case studies examine working parts and structures of a case as a system. In our case study we relied on indirect (interviewing participants) data-gathering methods, which were conducted virtually using Zoom due to the COVID-19 pandemic (Stake, 2006; Yin, 1994).

3.4 The Interviews

We (the research team) collected data electronically using Zoom. The academy director agreed to assist with the coordination of interviews with district and school administrators, school board members, engineering and core academic (e.g., English, mathematics, science) teachers, school counselors, parents, staff, and advisory board members (post-secondary partners and business and industry representatives).

3.5 Participant Selection and Data Sources

We conducted 20 semistructured interviews with administrators, teachers, staff, and school partners. We used a purposive sampling procedure to identify key stakeholders who supported the academy and students within it (Stake, 2006). More specifically, we relied on the knowledge of an insider informant—the academy director—to provide us with a list of participants to interview. The stakeholders (participants) served in a variety of capacities within the school, and we selected them based on their roles and contributions to the academy of engineering, according to our insider informant. The interviews

were with district ($n = 2$) and school administrators ($n = 3$), school board members ($n = 2$), academy teachers ($n = 2$), core academic teachers ($n = 4$), school counselors ($n = 3$), parents ($n = 1$), staff ($n = 2$), and advisory board members ($n = 1$). Individual interviews lasted approximately 45 minutes in duration. Questions from the individual interviews related to the academy mission, school culture, curriculum and instruction, internal and external supports, and strategies that promote the engagement of Black males in the academy of engineering. We also integrated the tenets of our theoretical framework to develop items in the interview protocol (for example, How, if at all, does the academy promote and/or support the interests and successes of African American/Black male students? See Appendix A for a sample interview protocol).

3.6 Protection of Vulnerable Participants

We gained Institutional Review Board (IRB) approval for our data collection. We secured letters of commitment from the participating school and provided all participants with consent forms to participate in this study.

3.7 Data Analyses

We audio-recorded and transcribed verbatim all interviews. We analyzed our data using thematic content analysis to capture contextual factors underlying the support that the school stakeholders provided to Black male students in the academy of engineering at the school (Boyatzis, 1998). We then identified recurring themes. The process we used to identify themes included (a) reading the transcripts in their entirety to seize a sense of the whole in terms of how participants talked about the academy; (b) rereading the transcribed interviews and demarcating transitions in meaning in the content of the text utilizing a lens focusing on the implementation and curricular practices of the academy; (c) reflecting on the meaning units to examine revelatory research content gained within each transcript as well as across participants' experiences; and (d) synthesizing the themes into statements which accurately represent the perspectives of the interview participants (Wertz, 2005). We relied on analytical triangulation by engaging in the collective reading and analyses of transcripts.

3.8 Positionality

It is helpful to acknowledge our own inherent biases, perspectives, and frames of reference as researchers, which most likely influenced and shaped research encounters, processes, and findings. All authors are faculty (four Black men and one Black woman). We have professional backgrounds in the field of career and technical/workforce education, engineering education, special education (with an emphasis in gifted education), and counselor education. All of us have studied issues related to the impact of student participation in high school STEM-themed career academies as well as inequities in access to academically rigorous programs in schools, particularly for ethnically and ra-

cially diverse students. More specifically, author 1 studies students' participation in high school NAF STEM academies. Based on his research agenda, we selected Madison River Academy because of its academy of engineering's prominence as a distinguished NAF academy.

3.9 Limitations

We also recognize the limitations inherent in our study. First, this generalizability of this study rests in our analytic interpretations regarding Madison River Academy as a case study. Generalizing to other schools and academies is based on similarities in institutional contexts. Second, in our interviews of school stakeholders for this study, we did not include the perspectives of students about their own experiences. Third, we relied on the assistance of an insider informant to provide us with participant information to recruit for the interviews of this study.

4. FINDINGS

During our interviews with the school stakeholders at Madison River Academy, we learned that the academy of engineering was perceived as a prestigious program with high academic rigor. School stakeholders shared with us that the majority of students who complete the academy of engineering pursue STEM-related majors in prestigious universities and eventually matriculate into STEM-related careers. While the academy of engineering was held in high esteem by the school stakeholders that we talked with, we found that although the student demographic at the school was 68.8% Black, the majority of students in the academy of engineering were Asian, Indian, and White. Based on our data interpretations, we found the following three themes: (a) representation matters: "I don't know that the students always see themselves in that"; (b) emphasizing that Black males are in STEM fields; and (c) equity as a common goal. The first theme of "representation matters" represents the viewpoints of the school stakeholders that Black males were underrepresented in the academy of engineering due in large part to the cultural mismatch of teachers and the academy not having peers that share their cultural identities. The second theme of "emphasizing that Black males are in STEM fields" signals the efforts of the school stakeholders to invite Black male STEM professionals into the classroom (or by videos) to interact with students. The third theme of "equity as a common goal" refers to the acknowledgment of the school stakeholders for the need to develop strategies to improve the lack of Black student representation in the academy of engineering and other accelerated courses (e.g., AP).

To that end, school stakeholders discussed that one of the challenges for recruiting Black students in the academy was the lack of students who share their own cultural, ethnic, and racial backgrounds. Stated differently, the school stakeholders believed that the lack of representation was a source of demotivation for Black student participation because they did not see themselves reflected in the academy and therefore did not envision themselves becoming an engineer (e.g., adopting STEM identities). Using the

concept of cultural matching and the formation of STEM identities, we understood that Black students at Madison River Academy did not participate in rigorous academic programs (e.g., the academy of engineering) partially due to a lack of the school stakeholders' abilities to provide culturally congruent, compatible, responsive, or synchronized learning environments that connected them with their home cultures and lived experiences (Achinstein and Aguirre, 2008).

4.1 Representation Matters: "I Don't Know that the Students Always See Themselves in that"

The school stakeholders shared with us that the academy of engineering courses were popular with high-achieving students because the courses counted for graduation credits but also for college credits; students were able to earn AP credits by taking the academy of engineering courses. Nonetheless, there were substantial equity issues related to rigorous and accelerated course taking (e.g., AP, higher level mathematics and science courses, engineering coursework), with large disparities among Asian, White, and Indian students. In addition, we learned that the AP and engineering courses not only were predominantly White in terms of student population, they were also taught by White teachers for the most part. Mr. Swanson, a White AP English teacher, spoke to the cultural mismatch issue by stating:

I can say it just as an AP teacher, if you're in a school that's 70% African American and 90% of your AP faculty is White—I don't know that the students always see themselves in that. I don't know.

Mr. Miller, a White mathematics teacher, also shared this sentiment. He spoke on the issue of Black students not having a sense of belonging and connection mainly due to a lack of teachers who were culturally aware and responsive in their pedagogical practices at the school. Mr. Miller stated:

A lot of the schools that I've been to, people who are teaching higher content look like me. That's an issue for [students] pursuing a class. And, you know it's gonna be difficult and challenging for students; it's certainly nice to have somebody who you feel like, at the very least, you can relate to because they look like you. It's something that, as a district, we're working on.

Within that context, Ms. Johnson, a Black school counselor, shared the following:

I do believe a big challenge is that they don't see themselves represented in mass numbers. We do have African American or Black students in the academy, males particularly, but they're not the majority, as far as the student demographics. I think that's a big challenge for males to see themselves as realistically being successful in the academy. We do have an African American teacher for one or

some of the classes. I think that helps, but I think it would be more helpful if they saw more of themselves represented and also can see it as a course or a pathway that they can be successful in, even if it is challenging.

The school stakeholders expressed to us that Black males did not seem to identify and “see themselves” as engineering students. Therefore, it is likely that Black male students did not feel a sense of acceptance and belonging, which is probably one of the contributing factors that has led to the limited participation of Black male students in the academy of engineering. We also learned that there was only one Black male academy of engineering teacher and none taught AP courses. The lack of Black male teachers likely contributed to a cultural mismatch and the difficulties in the teachers’ abilities to meet the learning needs of Black male students.

4.2 Emphasizing that Black Males are in STEM Fields

The engineering teachers, in particular, tried to create a more inclusive environment for Black students to see themselves as future engineers. The teachers talked to us about ways in which they were conscious about including more Black engineering professionals through the selection of videos featuring Black engineering professionals, having Black engineering professionals come to the school and serve as guest speakers, and inviting Black alumni to share their experiences in the academy of engineering. Ms. Johnston, a White CTE director for the school district, shared with us the vision of the school district in terms of making STEM more inclusive. During the interviews, she expressed that this was an especially passionate topic for her because she was married to a Black man and had biracial children. Ms. Johnston said:

I think our intent [within the school district] is absolutely to make sure that all of our students are introduced to our STEM fields and see themselves. Whether it's through speakers, their teachers, we really try to help our students understand that they are in those fields.

Mr. Coleman, a White mathematics teacher, told us that he invites Black male speakers into his classes not only to share information regarding their professional experiences, but also to serve as mentors for his Black male students. He recognized the motivational benefits for Black male students to see themselves reflected in the professional experiences of Black male engineering professionals. Individuals who represent Black male students’ identities can serve as role models and positive examples of adults for students (Achinstein and Aguirre, 2008; Brooms, 2016; Ladson-Billings, 1995). For example, Mr. Coleman noted:

Really having that physical interaction. I know in the past we've had students who've—speakers have shared their information and have taken on an unofficial mentor/mentee type role where the students can reach out. We're very

focused on making sure our students have the opportunity to learn from people that have—that can relate to their experiences because it makes it more impactful for students... Yeah, I know when I was talking about speakers earlier, I know they definitely try and identify speakers and professions where they can have people who look like our students and who can come in and speak to them. It's like—if I was an engineering person and a student asked me what it's like being a Black male in engineering, 'I have no idea.' [Laughter]

Mr. Baker, a Black male engineering teacher, noted:

Even in little things of showing videos of manufacturing warehouses and stuff, I try to make sure there's an African American presence 'cause there's not always. You got a school of 75% African American kids and the videos are all a bunch of White people. I can understand why that's a problem. You have to make them aware that engineering is for them, and I try to make it a point to show stuff like that and to subtly tell them that engineering is for them without just going out there and saying it.

Like Mr. Coleman, the White AP, mathematics, and engineering teachers that we spoke with admitted to having difficulties with truly knowing the life experiences and interests of their Black male students. Mr. Swanson contemplated how he might make his courses appeal to Black male students. He pondered:

. . . Maybe you incorporate more video games, maybe incorporate more gaming or music, 'cause I think about that as a teacher all the time. I try to plan my course, like what skills can we give these kids to make sense of their world, not mine, theirs. . . Like I said, I don't really know, but I'm starting to talk about that—I don't want it to be stereotypical when I talk about gaming and music and all that stuff, but when you talk about engineering there's a lot to that. There's a lot to their phone and where apps go and all these different software engineering, all this stuff that maybe would be a better hook.

This contemplation reminded us of the disconnect that often occurs between non-Black teachers and their Black students because of the cultural mismatch issue as well as the lack of a culturally responsive curriculum. Consequently, Black male students are generally not afforded positive schooling experiences where they can have meaningful student–teacher relationships with Black male professionals in the school who are culturally competent (Goings and Bianco, 2016).

4.3 Equity as a Common Goal

The school stakeholders we interviewed discussed several issues that they believed contributed to the lack of Black male student participation in the academy of engineer-

ing. Mathematics, most extensively, was identified as the most challenging issue that Black male students face related to participating in the academy of engineering. To that end, some of the school stakeholders, particularly the school counselors, struggled with whether the academy of engineering should be reserved for only certain students (e.g., high-performing students) who demonstrate high performance in upper-level mathematics courses. This would then restrict access to Black males who do not perform well in mathematics. Mr. Swanson shared his contemplations regarding the mission of the academy of engineering. He stated:

I have a lot of personal thoughts on everything we're talking about here... Certainly, the academy of engineering, everybody I know that was in the academy of engineering is in college or has gone to college. I guess my question back up is like, is the academy engineering just for the best, you know what I mean? Like, taking the best and making them better, but I don't know.

Ms. Jenkins, a Black school counselor, spoke about her trepidations regarding advising Black students of whether they should enter the academy of engineering. She hesitated to refer the academy of engineering to students who had not been successful in taking higher level mathematics courses because of past students who were not successful. She articulated:

I would like for the academy to be slightly more inclusive. We have students that say, oh, I want to be an engineer; or they've heard that engineers make a lot of money or engineering is a good field to go into, but they might not be a student who's really strong academically. As a counselor, I have to feel like I have to come up with other classes for them to consider that's not necessarily the academy of engineering because I know they wouldn't be successful in those academy courses. They are considered AP classes here because they get an extra quality point for their GPA. They say honors, but they're really an AP-level course. I wish that there was more so of a standard-level type class that can help give students a soft entry into the academy and help them see some success in an engineering course before they go on to those upper-level, AP-level type academy of engineering courses.

The equity issues at Madison River Academy are similar to the broader challenges with the expansion of STEM career academies nationally. As noted previously, despite the historical mission of career academies to expand opportunities and engagement of ethnically and racially diverse (particularly Black) students, more recent efforts to expand STEM curricula has resulted in more rigorous programs that require students to perform higher in core academic areas (e.g., mathematics and science) (Fletcher and Cox, 2012). Like what we experienced at Madison River Academy, these initiatives have resulted in demographic changes with more Asian, Indian, and White students participating.

And while it was clear throughout our interviews that the school stakeholders at Madison River Academy were having conversations about equity issues in the academy of engineering and accelerated courses, it did not appear that the school had a set strategy or policies to mitigate participation disparities. Ms. Jenkins told us:

I don't know if we have a specific strategy to recruit the African American students that we have, but at the very least, the counselors are having in-depth, one-on-one conversations during registration to see what students aspire to and to encourage them to stretch themselves, and a lot of times, that conversation is directed to our African American students to get them to expand their horizons and consider some career paths that are not necessarily the most popular amongst their classmates and their school, from middle school.

We were concerned that the discussions around increasing the Black student participation in the academy of engineering did not advance into a set strategy or policies to increase their representation, particularly given the school's student demographics. This also seemed to be the case for the school district, as we did not hear about specific strategies they were implementing to increase the participation of Black males in STEM, but we did hear that the school district was at least discussing the issue. To that point, Mr. Coleman said:

I know the district is really working on that. It's trying to put an emphasis on bringing in more Black males in STEM fields, especially higher level content.

The message that we took away from interviewing school stakeholders at Madison River Academy was that it was well understood that Black students (and Black males in particular) were not participating at a rate which reflects their participation in the overall school. While the school stakeholders were fully aware of the cultural mismatch issues with teachers and students in the academy of engineering and accelerated courses, there were no set plans in place to address the issues. And, while mathematics was one of the driving factors for the disparities, there was no strategy for mitigating its effect.

5. DISCUSSION

Madison River Academy of Engineering was an enlightening case study demonstrating equity issues with high school STEM programming. While we believe the school stakeholders at Madison River Academy had good intentions and had equity as a strategic mission within the school, we also know that the school lacked actionable plans to improve the equity issues addressing access for Black male students in the academy of engineering. In this case study we found Black male students had limited access to rigorous and accelerated course taking (e.g., AP, higher level mathematics and science courses, engineering coursework) compared to Asian, White, and Indian students. We

also found that the academy of engineering and AP courses had a cultural mismatch issue with predominantly White teachers in a majority Black school; this issue further exacerbated the equity issues found in the school.

We found that the school stakeholders believed that Black males were likely not able to identify and “see themselves” as engineering students. This issue is substantiated in the literature related to the formation of STEM identities, which demonstrate that the ethnic and racial background of students influences their feelings of acceptance and belonging, especially for Black male students who report more uncertainty about their belonging in STEM fields (Hotchkins and Dancy II, 2015; Robnett et al., 2018). Thus, we believe that it is incumbent on the school stakeholders at Madison River Academy to help Black males foster a STEM identity by connecting their learning in the academy of engineering and other prerequisite (e.g., AP and mathematics) courses to how they perceive and understand their ethnic and racial identities (Morton et al., 2019).

It is important that school leaders work with the mathematics and engineering teachers, in particular, to examine the curricula and pedagogical practices to ensure that the courses do not serve as a gatekeeper for Black male students to enter the academy of engineering. Even further, it is incumbent on the educators at Madison River Academy to create a positive and inclusive learning environment in the academy of engineering to elicit Black male students’ identity, efficacy, and interests in STEM (Bonous-Hammarth, 2000; Osborne and Walker, 2006; Oyserman, 2015). Based on STEM identity theory, we recommend that teachers at Madison River Academy provide Black male students with external recognition that they do indeed have qualities and characteristics that align with the type of person that flourishes in engineering and other STEM-related fields (Hotchkins and Dancy II, 2015).

We also know from the research on STEM identity that having representation in STEM courses may also enhance Black male students’ interests in pursuing the academy of engineering (Hotchkins and Dancy II, 2015), thus reinforcing the critical importance of increasing the number of Black male students in the academy of engineering. Even further, it is important to recruit Black male teachers, as they can serve as role models and positive examples for Black male students (Achinstein and Aguirre, 2008; Dee, 2004; Easton-Brooks et al., 2014; Eddy and Easton-Brooks, 2011). However, given that the vast majority of educators at Madison River Academy were White, their abilities to meet the diverse learning needs of Black male students was a challenge (Gay, 2018; Ladson-Billings, 1995; Nieto, 2010). Thus, there was a cultural disconnect or mismatch between school stakeholders and their Black male learners (Achinstein and Aguirre, 2008). Learning about the equity issues related to the academy of engineering was quite concerning to us given that self-beliefs can impact the educational choices and potentially the later development of a STEM identity for Black male students (Capobianco et al., 2012; Hazari et al., 2010; Matusovich et al., 2011; Pierrakos et al., 2009). Thus, we recommend that the school strategically recruits Black AP and engineering teachers. We also recommend that the school leaders facilitate professional development opportunities for their teachers to provide culturally congruent, compatible, responsive, or

synchronized learning environments within the academy of engineering and other accelerated courses that connect Black students with their home cultures and lived experiences (Achinstein and Aguirre, 2008).

5.1 Implications for Practice

To reiterate, we have listed below our recommendations for the school stakeholders at improve Madison River's Academy of Engineering as they attempt to ensure that they enact more equitable practices for Black male students:

- Teachers might help Black males foster a STEM identity by connecting their learning in the academy of engineering and other prerequisite (e.g., AP and mathematics) courses to how they perceive and understand their ethnic and racial identities;
- School leaders might work with the mathematics and engineering teachers, in particular, to examine the curricula and pedagogical practices to ensure that the courses do not serve as a gatekeeper for Black male students to enter the academy of engineering;
- Teachers might create a positive and inclusive learning environment in the academy of engineering to elicit Black male students' identity, efficacy, and interests in STEM;
- School counselors and teachers might provide Black male students with external recognition that they do indeed have qualities and characteristics that align with the type of person that flourishes in engineering and other STEM-related fields;
- School leaders might recruit Black male teachers as they can serve as role models and positive examples for Black male students;
- School leaders might facilitate professional development opportunities for their teachers to provide culturally congruent, compatible, responsive, or synchronized learning environments within the academy of engineering and other accelerated courses that connect Black students with their home cultures and lived experiences.

6. CONCLUSION

Findings from our case study demonstrate how the change in the historical mission of career academies has limited access to rigorous STEM opportunities and engagement of ethnically and racially diverse (particularly Black) students (Fletcher and Cox, 2012). In this academy, the lack of Black male student and teacher representation as well as mathematics were two barriers limiting the engagement of Black male students. It was quite plausible that Black male students did not "see themselves" as future engineers. Thus, we contend that it is critical that STEM academy school stakeholders, particularly school leaders, prioritize equity as a strategic goal for their STEM programs and recruit Black teachers who are willing to create culturally re-

sponsive curricular experiences to elicit interest in STEM for Black students. It is equally important that school leaders educate their school stakeholders (e.g., school counselors and teachers, in particular) to ensure that Black male students are not counseled out of the academy of engineering but instead are actively removing barriers and finding solutions to promote Black male student interest in the academy of engineering, thereby ensuring all school stakeholders understand and have a shared mission and that they implement strategies and policies to mitigate participation disparities.

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Teacher Interviews

Curriculum and Instruction

Date: _____ Location: _____

Interviewee: _____ Role/Title: _____

Time: _____ Interview Team (Initials): _____

Debriefing and Assurances

- Summarize the purpose of the research and visit
- Summarize purpose of the interview
- Provide assurances of anonymity and voluntary participation
- Secure permission to record the interview

1. **Personal Background:** Describe your professional background and role in the academy.
2. **Curriculum and Instruction Development/Planning:** Describe the curriculum and instruction development and planning process for the academy.
 - a. What are the intended learning objectives and student outcomes in the academy?
 - b. How do you identify the essential Engineering/IT knowledge and key competencies and skills?
 - c. How do you ensure that curriculum content is up-to-date with the current workplace demands?
 - d. What are the strategies or processes used to ensure that the curriculum and teaching approaches align with standards?
 - e. What are the key factors that shape the curriculum and instruction in the academy?
 - f. How are families involved in the academy?
3. **Curriculum Integration:** Describe the curricular strategies for integrating academic and IT-related knowledge, competencies and skills across the curriculum.
 - a. How do the academy teachers collaborate with other teachers in the school?
 - b. How is the Engineering/IT content, competencies and skills integrated across the curriculum?
 - c. How are work-based learning activities integrated into the curriculum?
4. **Instructional Strategies:** Describe the nature of the instructional strategies used at this academy to promote rigorous and relevant career readiness.
 - a. What differences, if any, have you observed related to the engagement of African American/Black male students compared to non-Black or females in the academy?
 - i. What, if any, instructional strategies that are culturally relevant to African American/Black students do you use for promoting their engagement in the academy?
 - ii. What, if any, targeted strategies that are culturally relevant to African American/Black male students do you use for promoting their engagement in the academy?
 - iii. How, if at all, does the academy promote and/or support the interests and successes of African American/Black male students?
 1. Are there any unique supports for African American/Black male students?
 2. What activities and programs are there in the academy that are targeted to engaging African American/Black male students?
 3. How does the academy promote a sense of belonging for African American/Black male students?
 - b. What, if any, instructional strategies are used at the academy to help students demonstrate what they are learning?

- c. What, if any, instructional strategies are used at the academy for promoting college and career readiness in engineering?
 - d. How, if at all, do you incorporate students' voices and interests into the curriculum?
 - e. Please describe any other youth development or afterschool programs the academy may collaborate with to achieve/meet unique local outcomes/needs.
- 5. Evaluative Perspectives on Curriculum and Instruction:** In your assessment to date, are the curriculum and instructional strategies promoting college and career readiness as intended?
- a. What are the strengths and successes regarding curriculum and instruction in the academy?
 - b. What are the challenges regarding curriculum and instruction in the academy?
 - c. What are the opportunities for improvement in terms of curriculum and instruction?
 - d. How is community both understood and built inside and outside of the school building?
- 6. Closing Statement/Question:** Thank you for your insights. Is there anything else you would like to add about the curriculum and instruction in the academy?