CHAPTER 2

THE CAREER ACADEMY AS A VEHICLE TO PROMOTE BLACK MALE STUDENT INTEREST IN STEM COLLEGE AND CAREER PATHWAYS

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ABSTRACT

The purpose of this study was to examine the learning experiences of high school Black males participating in an academy of engineering that was configured as a magnet school. We followed a qualitative case study design to explore the experiences of 16 Black male academies of engineering students. We identified three recurring themes from the interviews with the Black male academy of engineering students: Promoting Interests in STEM, Drawing Connections to Core Academic Concepts*, and* An Affinity for Hands-on Learning through the Engineering Curriculum*. The results of our study helped us to better understand how academies provide a platform for Black male students' interest in engineering as a viable college and career pathway.*

Keywords: Black males; high school students; career academy; engineering education; STEM; magnet school

Researchers have exposed the negative academic experiences and lack of engagement of Black male students in schools, especially urban ones (Brown et al., 2019; Wright, 2019). Compared to Black females and all other ethnic and racial groups, Black males have the lowest academic achievement (Hernandez-Gantes & Fletcher, 2013; Moore et al., 2008), academic engagement,

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graduation rates (Ford, 2010; Jackson & Moore, 2008), and college and career readiness skills (Fletcher & Cox, 2012; Whaley & Noel, 2012). These challenges are based on multiple factors associated with systemic racism in the United States (Danforth & Miller, 2018), which further reveals that educational systems are microcosms of the larger society. To that end, many Black students have had negative educational experiences based on a myriad of issues, including: attending schools that have a lack of resources; being targets of disproportionate disciplinary actions; not having access to highly qualified teachers; and experiencing negative interactions with school staff members (84% of whom are white) who do not provide culturally responsive instruction (Brown et al., 2019; Wright, 2019). Thus, many issues emerge based on a cultural disconnect or mismatch between school stakeholders and their ethnically and racially diverse learners (Achinstein & 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 & Miller, 2018; Johnson & Sondergeld, 2020). However, there are few studies that have examined the educational experiences of Black students who are schooled in settings with school stakeholders that match their backgrounds, identities, and cultures.

Even further, there are reports in the literature that in some cases, white urban school stakeholders restrict access and opportunities to participate in science, technology, engineering, and mathematics (STEM)-related career-themed curricula to underserved students, particularly Black males (Johnson & Sondergeld, 2020). The same holds true in gifted and talented education where Black students are underrepresented by as much as 50%; Black males are the most underrepresented at 65% (Ford, 2010). The lack of culturally responsive approaches in urban schools contribute to a troubling and quite problematic issue of a low participation rate of Black male students in high school STEM-themed programs and schools (Brown, 2019). Notably, these STEM related-programs provide pathways to high-wage, high-demand, and high-skilled occupations (Collins, 2018). The sense of urgency and concern to address the underrepresentation of Black males in STEM is shared by educators, employers, government agencies, and researchers alike. Thus, research is needed to examine the intersection of gender and race to discover ways to engage students from underserved groups in STEM college and career pathways (McGee & Robinson, 2019).

Given that only 5% of Blacks obtain science and engineering occupations (even though they make up 12% of the workforce, National Science Board, 2018), there has been a concerted effort to broaden the participation of Black students in the STEM pipeline, beginning at the K-12 level (National Science Board, 2018). One increasingly popular strategy designed to expand such opportunities is the development of high school magnet career academies in which STEM learning is the focus. Researchers have noted promising findings in regard to the academic success of Black male students taught within some public magnet high school contexts across the country (Kumah-Abiwah, 2019). The mission of these types of programs is to recruit STEM-interested learners to urban schools within a

county, and offer rigorously intense core academics, college preparatory coursework (e.g., accelerated courses), and work-based learning opportunities to participate in a wide array of STEM content and experiences. Another component of the mission of STEM-focused high schools stemmed from the 1954 *Brown v. Board of Education* Supreme Court case. In response, various school districts across the country attempted to desegregate and improve the racial balance of students by establishing magnet programs and schools to recruit students from across an entire county and provide them with transportation (Metz, 2003); yet, Black and Latinx students are oftentimes still underrepresented in these contexts (Kaser, 2006). According to Nasir and Vakil (2017):

> Although districts often tout the success and rigor of such programs, less attention has been paid to which students within the school have access to these spaces and how students are racialized and gendered within them. (p. 378)

Hence, it is critical that we better understand how academies provide a platform for Black male students' interest in engineering as a viable college and career pathway. 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).

PURPOSE AND RESEARCH QUESTION

The purpose of this study was to examine the learning experiences of high school Black males participating in an academy of engineering that was configured as a magnet school. In this particular case study, the school stakeholders, in many cases, matched the cultural identities of the students within the academy and school. In this chapter, we intend to provide a clear understanding of how equitable STEM spaces within urban schools can facilitate possibilities for supporting the talent development of Black male high school students in socially transformative learning spaces. Our study was undergirded by the following research question:

(1) What are the learning experiences of high school Black males participating in an academy of engineering?

REVIEW OF LITERATURE

The Schooling Experiences of Black Males

Researchers have demonstrated that Black males frequently experience negative schooling outcomes, often more than other student groups (Ford & Moore, 2013; Hines et al., 2020; Jackson & Moore, 2008). Black males are overrepresented and misidentified for special education, the least or last to be referred and identified for gifted and honors/advanced placement courses (Ford & Moore, 2013; Hines

et al., 2020). Moreover, Black males are more likely to be suspended, expelled, and receive harsher disciplinary infractions than their peers (Aud et al., 2011; Gregory, 1995; Skiba et al., 2011; Yeager et al., 2017). Parental involvement and high teacher expectations play a role in positive school outcomes for Black males (Hines et al., 2019; Hines & Holcomb-McCoy, 2013). Further, there is evidence that certain school environments and programs (e.g., high school STEM-themed career academies) are more effective at engaging Black students because of the hands-on nature of the curricula and the increased interpersonal supports of the small learning community (Fletcher & Cox, 2012).

Career academies are programs of study featuring small learning communities found within high schools (Stern et al., 2010). They focus on providing students with a college-preparatory curriculum integrated within a career theme. Thus, curricula in career academies feature the integration of academic and technical content to increase rigor and relevancy to students' career interests. The academy model also emphasizes partnerships with employers and postsecondary institutions (Castellano et al., 2007; Kemple & Snipes, 2000). The aims of career academies align both with the provisions of the Perkins V legislation – related to establishing programs of study – as well as Stone and Lewis' (2012) three-part definition of college and career readiness. First, academic knowledge in and of itself is not sufficient. Instead, high school graduates need to be able to apply what they learn through the occupational expression of academic knowledge. In essence, "graduates should know how to use mathematics or science to solve real workplace problems (Stone & Lewis, 2012, p. 15)." Second, many refer to employability skills as "21st century skills" or "soft skills." These skills include capabilities such as responsibility, collaboration, and critical thinking/problem-solving. Third, technical skills are specific competencies needed for each occupational area.

With the growing popularity of the career academy concept, the quality of implementation has varied greatly as schools and districts have rushed to join the bandwagon. To this end, there have been efforts to inform related implementation with the development of standards of practice by school networks such as National Academy Foundation (NAF). NAF has supported the implementation of the career academy model beginning in 1982 (Stern et al., 2010). NAF provides curricular support, professional development, and technical assistance to a national network of high school career academies in five career themes: Engineering, Finance, Health Sciences, Hospitality and Tourism, and Information Technology (NAF, 2014). For nearly 40 years, NAF has refined a model that provides youth access to industry-specific curricula, work-based learning experiences, and relationships with professionals. Over 5,000 business professionals serve as mentors, engage NAF students in paid internships, and serve on local advisory boards. During the 2019–2020 school year, over 120,000 students attended 620 NAF academies across 38 states, including D.C., Puerto Rico, and the US Virgin Islands. NAF academies reported that 97% of seniors graduated on time. In terms of student selection, NAF academies operate under an open enrollment policy. Therefore, any student may enroll and participate in an NAF academy. While some schools require that students apply to gain entry, students

are not selected based on prior academic achievement. However, in the case of some magnet schools that are oversubscribed, students may enter a lottery system and then may be selected at random.

The NAF model has grown into a fully developed school reform initiative used to support the expansion of academies across 38 states, but little is known about which specific indicators of participation contribute to student success. In fact, the Career and Technical Education Research Network funded by IES has determined that NAF is an organization that is ready for rigorous research based on their evaluability assessment conducted in 2020 (Hughes et al., 2020). Within the proposed project, we will target specific elements (e.g., academy development and structure, integrated curricula and instruction, and work-based learning) of the NAF model – informed by literature demonstrating how the aforementioned factors contribute to student outcomes. Understanding specific elements that contribute to student success are critical, and our abilities to understand them have implications for future researchers in terms of examining the causal impact of the factors on long-term longitudinal student outcomes.

Research on Career Academies

The career academy model represents a promising approach for promoting college and career readiness. The career academy model is widely used in high schools as it has been found to positively promote student success factors (Kemple, 2008; Kemple & Snipes, 2000). In general, researchers have documented that career academies have a role in reducing dropout rates, improving attendance, increasing academic course taking, and producing positive employment outcomes (Kemple, 2008). Using experimental research designs, prior researchers have found positive effects of participation in career academies on the attendance, on time graduation (Hemelt et al., 2019; Kemple, 2008), academic course-taking, dropout rates, and various labor market outcomes (Kemple, 2008; Kemple & Snipes, 2000) of high school career academy students compared to nonacademy students. However, researchers have also found that the standardized mathematics and reading scores (Kemple & Snipes, 2000), ACT scores (Hemelt et al., 2019), college matriculation (Hemelt et al., 2019), and degree attainment (Kemple & Snipes, 2000) of academy students were not significantly different from their nonacademy counterparts.

Related to learners from diverse backgrounds, Moore (2006) found that (a) having a strong interest in STEM; (b) participating in high school career and technical education (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. Moreover, Fletcher and Cox (2012) found that Black students believed participation in career academies was the most meaningful aspect of their schooling experiences 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 a positive impact on Black students.

The NAF academy model features three core elements – academy development and structure, integrated curriculum and structure, and work-based learning experiences. The first element of the NAF academy model that we will study is the academy development and structure component, which focuses on small learning communities using student cohorts, career-themed and sequenced coursework, and career-themed guidance. Academies are either organized as small school-within-schools or as whole school/wall-to-wall (where all students in the school participate) programs and emphasize block scheduling for students. The idea is to break down larger high schools into a small family-like atmosphere where students are assigned to the same teachers for four years – enabling students to form a community of learners as well as a close knit and caring environment (Stern et al., 2010). Researchers have found that the use of small learning communities is a contributing factor promoting a positive school culture (Fletcher et al., 2019). Related research has revealed the challenges of building positive and supportive cultures in large, comprehensive, urban high schools – particularly those that serve low-income and ethnically and racially diverse youth (Letgers et al., 2002; Murphy, 2010). The difficulty of establishing a positive culture in comprehensive high schools typically stems from their relatively large student populations and fixed departmental silos. Hence, one major recommendation that addresses the issue of large schools is the idea of establishing small learning communities. The term "small learning communities" denotes a variety of school structures and configurations – including schools within a school and magnet programs that are wall-to-wall (where all students participate in a given career theme) (Kuo, 2010). Researchers have found that students in small learning communities experience an increased sense of personalization and belonging, and lower levels of school vandalism (Page et al., 2002). Based on related evidence, Kuo (2010) recommended that: "policymakers and practitioners should continue to find opportunities to reduce the size of large high schools and increase the sense of personalization, belonging, and safety among students, teachers, and staff" (p. 395). In NAF academies, teachers receive instructional supports and technical assistance using industry validated curricula provided by NAF. Through this structured support, teachers form deep relationships with their students and make stronger connections between their teaching practice and real-world applications. The structure of each academy is designed such that students interact with teachers and peers in a small learning community who share interests in a given occupational area and are situated within a cohort. Thus, students have the same peers and teachers throughout their four years in high school – thus, forming a community. This allows for interdependent learning by which students learn from each other while simultaneously learning to work collaboratively. Between improved teacher relationships, enhanced relevance, and using problem-based learning, students are likely to have higher engagement in school – a relationship that we propose to investigate in this chapter – and a positive student experience – which we will also examine by interviewing academy and nonacademy students (Fletcher et al., 2020). We further will examine the

organizational/contextual elements that contribute to the academy development and structure of each school/academy.

The second component is the integrated curriculum and instruction, which promotes career and academic learning around a relevant career theme (e.g., Business and Finance, Engineering, Health Sciences, Hospitality and Tourism, and Information Technology) through project-based activities involving core academic content. Career academies integrate career-themed curricula with college preparatory coursework to encourage students to learn core academic subjects in an applied career-oriented fashion. The term "curriculum integration" is referred to in a variety of ways – as a method or process to connect skills, themes, concepts, and topics across disciplines and between academic and technical education (Pierce & Hernández-Gantes, 2015). Teachers that integrate curriculum connect multiple content areas to breakdown overarching theories, concepts, and big ideas that help students and enhance learning from one subject to another (Klein & Cornell, 2010). Curriculum integration may be implemented around an occupational theme such as IT or may involve concept connections within single subjects such as arithmetic, algebra, geometry, or across two or more subjects, such as mathematics and CTE (Pierce & Hernández-Gantes, 2015). The purposeful integration of academic and technical education is a signature feature of successful programs bringing meaning and relevance to curriculum and instruction (Castellano et al., 2012). The occupational context serves as the source of relevant learning tasks and applications involving authentic representations of what employees do in the world of work (Hernández-Gantes & Brendefur, 2003). Findings from the Math-in-CTE experimental study demonstrated that the integration of mathematical concepts in CTE courses – teaching mathematics in an occupational context – resulted in statistically significant higher scores for students on two of three mathematical assessments. However, the assessment scores within the third examination did not produce significantly different achievement compared to the control group (Stone & Lewis, 2012; Stone et al., 2008). Thus, it is expected that – based on the quality of such learning experiences – academy students will have enhanced college and career readiness engagement, academy students will take more rigorous course taking, and academy students will benefit from gains in academic achievement. In our project, we examined perceived learning experiences by interviewing students and determining the academic achievement, on time graduation, and their acceptance into college through administrative data. We further examined the integrated curricular nature of the academies/schools by examining the organizational/contextual elements through classroom observations and interviews of school personnel (including teachers).

The third component is providing students with work-based learning experiences. Career academy students engage in successively progressive work-based learning experiences from ninth through 12th grades that are developmentally and age-appropriate. It has been well-documented that students often find learning as void of meaning and are prone to question the relevance of instructional tasks (Castellano et al., 2012; Hernández-Gantes & Brendefur, 2003). To address this disconnect in teaching and learning, career academies emphasize learning in specific

occupational contexts to enhance the relevance of student experiences. The premise is that the authenticity of occupational contexts provides opportunities to make learning more meaningful for students (Newmann & Wehlage, 1995; Stipanovic et al., 2012). Through providing a range of work-based learning experiences, NAF academies address this call to encourage authentic learning in real-world contexts. Under the NAF model, work-based learning includes career awareness and exploration activities in ninth (e.g., field trips) and 10th (e.g., job shadowing) grades, and experiential opportunities (e.g., industry certifications and paid internships) in 11th and 12th grades. Kuh (2015) argued that students who participate in high-impact, work-based learning practices "invest substantial time and energy to educationally purposeful tasks, interact frequently with their teachers and peers, get feedback often, and apply what they are learning" (p. xi). That is, work-based learning enables students to apply what they know in real-world settings, while building exposure to, preparation for, and experience in their interested career path (Papadimitriou, 2014). In this regard, work-based learning experiences should help students acquire both the employability and technical skills needed to be college and career ready (Hernández-Gantes, 2016; Stone & Lewis, 2012). We will investigate this in our proposed study by collecting survey data from students regarding their participation in both college and career readiness activities (including work-based learning experiences) as well as their perceptions of the 21st century skills they attain through their school experiences.

METHOD

Research Design

We followed a qualitative case study design to explore the experiences of 16 Black male academies of engineering students (Stake, 2006; Yin, 1994). Our research approach was interpretivist in nature and attempted to capture the meaning of participants' experiences and their sense-making regarding participation. During discussions with the participants, we were able to understand and interpret the meanings of their decisions to engage in the academy of engineering. We used pseudonyms throughout our discussions to replace participant and school names as well as locations.

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 evaluate 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. 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).

Selection Criteria

We purposely selected Stanton Academy (pseudonym) because it was a distinguished NAF academy of engineering and its demographics – 99% African American and 95% economically disadvantaged student population. We believed Stanton Academy would help us uncover how a high-fidelity NAF academy helps to broaden participation of Black male engineering students. Hence, the richness of the academy context and students' experiences helped us to answer our research question.

The Case: Stanton Academy

Demographics. Stanton Academy is located in the city of Stanton (population of approximately 124,000) which is 55% white, 37% African American/Black, 4% Latinx, and 3% Asian. The median income was approximately $42,000, and 19% of the community members lived below the poverty line. The city of Stanton was home to a historically black college and university.

The Stanton Engineering Academy was a public school with a distinguished (whole school magnet) NAF academy (one of several career-themed programs) embedded within the school. It was located in an urban area within the Southeastern region of the United States. Stanton Academy was comprised of approximately 1,263 students and 71 teachers (who were majority Black). In terms of gender, 51% of students were female and 49% were male. Concerning ethnic and racial background, 99% of students were Black and 1% were Latinx. Ninety-five percent of students qualified for free and/or reduced lunch. The graduation rate was 81%. Stanton Academy relied on an application system for student admission to the academy of engineering and several other career-themed academies within the school.

Researchers' Positionalities

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 (three Black men and one Black woman). We have professional backgrounds in the field of career and technical/workforce education, special education (with an emphasis in gifted education), and counselor education. All three 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 racially diverse as well as students who come from economically disadvantaged backgrounds.

Data Collection

We conducted three virtual group interviews with 16 Black male academies of engineering students. The content of the interviews were related experiences of Black male academy of engineering students. Each interview lasted for 30–60 minutes in duration. The university's IRB approved all components of this study.

We relied on the knowledge of an insider informant – a school administrative assistant – to provide us with a list of participants to interview.

Data Analyses

All interviews were audio-recorded and transcribed verbatim. We used constant comparison analysis to capture the experiences of Black male academy of engineering students (Leech & Onwuegbuzie, 2007). We first read the entire dataset of transcripts. After doing so, we divided the dataset into smaller meaningful segments. We then labeled each segment with a code. Afterward, we compared each component and collapsed those with similar codes. Last, we developed themes for each code group. For example, in arriving at a theme, the entire research team first read every transcript individually. We then individually reread each transcript to search for patterns/codes related to the experiences of Black male academy of engineering students. We met as a research team to discuss the codes that emerged. We then went back to the transcripts to select quotes that match the codes – those that accurately depicted the experiences of Black male academy of engineering students. We finally were able to discuss and agree on possible phrases/statements that represent the codes, which became our themes. We relied on analytical triangulation by engaging in the collective reading and analyses of transcripts.

DATA INTERPRETATIONS

We identified three recurring themes from the interviews with the Black male academy of engineering students. The first theme is *Promoting Interest in STEM* which reflects the students' investment in engineering as a result of engaging in the engineering curriculum. The second theme is *An Affinity for Hands-on Learning through the Engineering Curriculum* which denotes the students' preference for engaging in hands-on engineering projects. The third theme is *Drawing Connections to Core Academic Concepts* which highlights the students' understanding of the integrated nature of the engineering curriculum and demonstrates their understanding of core academic concepts through engineering lessons.

Promoting Interest in STEM

The Black male academy of engineering students shared with us that the career academy served as a motivator for pursuing their interests in STEM college and career pathways. The students shared that the most memorable component of their academy experience was the work-based learning activities they engaged in, which provided them with a good understanding of the engineering profession as well as inspired them to pursue engineering as a college and career pathway. For example, Javon noted:

> It's given us a good view of what to expect in the engineering world and helped push us further along the path.

They specifically noted a variety of work-based learning opportunities that they participated in, which helped them discover whether engineering was the right field for them. These work-based learning experiences included resume development, mock interviews, discussions with STEM professionals, and internships. The experiences, especially the internships, helped to demonstrate what their roles and responsibilities would be in an engineering career, helped them to cultivate their employability skills, and assisted in their preparation for majoring in engineering in college. Derek talked to us about his academy experience and the work-based learning experiences that he found meaningful. He said:

> I would say the mock interviews; it actually got you ready for how competitive the real-world engineering interviews are. Like I had to compete with some of my classmates for interview spots, and I had to build a resume. That's probably the most memorable thing, and if we're able to be accepted into one of those prestigious institutions. It's amazing. The academy's prepared us quite a bit. We've done a lot of, like I said, mock interviews, professional development. We just learned how to best present ourselves to companies and institutions, put our best foot forward, and show what experiences we've had. It's just all around just been a great experience...The academy has provided us a lot of opportunities to see what the world has to offer...how many opportunities there are out there, and how to reach them. They've also provided us with a lot of experiences that will help us later on in life. We've done a bit of professional development, we've done internships, we've done interviews. We've just all around just got a good view of what the engineering world has to offer. I would say we got like a head start into what our futures will look like...Well, I've taken advantage of any opportunity given to me. Currently, I'm in the works of trying to make it back into my Exxon internship that I had last year. I'm just trying to move my way into the engineering world.

Samuel described to us how the academy prepared him for the world of work in engineering and inspired him to major in engineering in college. The students shared with us that the academy provided the impetus for career exploration in determining whether engineering was a viable career pathway for them as well as what type of engineering (e.g., chemical, civil, electrical, and mechanical) they were interested in pursuing.

Even further, the students talked to us about how the academy provided learning experiences related to establishing an engineering identity. In that regard, Samuel noted:

> Really they taught us really how to be engineers. Like how to think like one, how engineers should be, and how to be really professional in the engineering field too.

An Affinity for Hands-on Learning Through the Engineering Curriculum

Many of the students we interviewed told us that they had an interest in engineering because it is a profession that involves building things and that they enjoyed the hands-on learning activities they engaged in within the academy. The Black male academy of engineering students told us that they enjoyed the projects they completed in the academy because they were tasked to build things and enjoyed working with their peers in groups.

> The experience that I had it was something that I always wanted. 'Cause I always wanted to go to a school where we're doing hands-on learning. We're building stuff and all that. Then when we first came and I saw how classes working with engineering, and how we had groups, we had to do this project, complete this, I felt that it really was something that I enjoyed doing. It was a great experience.

Samuel echoed the sentiment about him enjoying working with his hands. He went on to say:

> Me, personally, I always liked to work with my hands, like especially for the degree I'm trying to get, which is mechanical engineering. It's really like working with your hands and trying to solve a problem. That's something that I really enjoy doing ever since younger. That's why I pursued the engineering field.

Similarly, Leroy stated:

> Agreeing with [Kevin], like participating – I'm a hands-on learner as well, so participating, it helps me understand more and remember more than just listening.

The students further noted that through the hands-on experiences they were gaining in the academy, they also had to problem-solve, collaborate, and develop their critical thinking skills. In addition, the students enjoyed the competitive nature of the engineering competitions they participated in within the academy of engineering. Derek shared with us that:

> Furthermore, to build off of what [Samuel] said, it causes you to think out of the box and be innovative in order to be able to think creatively and solve problems that we might see around the school, like [Samuel] said. For example, in civil engineering. . .we had to pick a geotechnical problem that we had to do on campus and solve what the most cost-available thing to solve the problem. Also, well, last year when I was in eleventh grade, we had an engineering symposium, where we had to compete against each other to see how we could move some balls down to the other end. That was pretty challenging. Everybody had really good ideas. Some ideas worked, and some ideas didn't work. It was just fun to see everybody be competitive. It really was challenging since everybody, like I said, was competitive.

Thus, students shared with us the enjoyment they received from the challenging nature of the engineering field as well as the competitions they participated in. In fact, the students' most memorable experiences in the academy of engineering were typically related to projects they completed in their engineering classes. More specifically, they enjoyed the innovative thinking needed to complete the projects as well as the experimental (trial and error) nature of problem-solving within their engineering classes. For example, Joshua shared with us his most memorable experience as:

> In the academy, it's both visual learning and hands-on learning. You will sit in class, write notes, understand the notes, and they'll teach you about notes. Then you will get a project on how to come up with a solution or how to build it. This one project we had was to build a bridge, and we only could use straw and tape. . .Paper clips. You couldn't use a certain amount of tape. You couldn't use too much tape. You had to come up with a different idea. To see if your bridge was able to work, we put a book on top, and if it held the book for longer than a minute, you passed. You had to come up with a solution on how to solve that. That's what I liked.

Similarly, Joshua said:

> To me, failure is what leads up to success. Let's say I have a problem I'm doing. I will keep trying and failing at it until I succeed and get it right. Let's say we're doing a project, and my project isn't working. I will keep trying different ways and then failing, it will keep edging out the wrong ways, and I will eventually find the right ways. That's how participation works out for me 'cause, if I keep failing, I'll eventually find the right way, which is what leads to success.

Jamal emphasized the high level of engagement the engineering classes offered which contributed to his motivation and investment in learning. He described how the hands-on projects in the academy of engineering motivated him to pursue engineering. He stated:

> My experiences with the program, I'm more of a hands-on person. I don't really like the – like sitting down, doing notes the whole time in class, which is why I like the program because. . .all right. I'm more of a hands-on person. I don't like writing down notes the whole time in class. That's why I like the program because there's a lot of projects that you do throughout the year, which not only it makes it fun, but it makes you want – it makes you more invested into engineering. It makes you want to do it more.

Similarly, Kevin articulated his interest in the academy of engineering because of the competitive and hands-on nature of the projects:

> Participating in this academy helps me because I'm a competitive person, so building these structures and catapults, cars and stuff, I always want to be the person that wins, so it teaches me to be competitive in a safe way.

The students were clear in their passion for the engineering classes and the engagement they had from building things, the hands-on nature of the projects, and the employability skills (e.g., collaboration, critical thinking, problem-solving, and creative thinking) they employed within the academy of engineering.

Drawing Connections to Core Academy Content

The Black male academy of engineering students also shared that engaging in the engineering academy helped them draw connections to core academic content (e.g., mathematics and science) as well as better understand concepts within their core academic classes through the applied nature of the engineering classes. For example, Cameron noted:

> My experience, it gave me, like, a first-time view of takin' knowledge and actually applyin' it to what you tryin' to do. Like learnin' somethin', and after that, seein' if you can recreate what you learned in a physical way. Then, like I said before, if you workin' with team and partners, try and be the person that make sure everybody do what they supposed to do. Make sure ain't nobody like [unintelligible 38:18] their havin' problems. 'Cause if a lot of people on the team don't like each other, they not gonna work together, and you can't build a whole house by yourself. Ya'll gonna have to do somethin' together, so that's it.

The students acknowledged that their engineering classes not only helped them within their own personal lives in the context of problem-solving but also helped them better understand their core academic subjects by applying core academic concepts to a real-world engineering context.

Thus, the engineering classes helped the students understand concepts in their core academic content areas. Darius explained the relevancy of the engineering concepts he learned to his personal life and the connections he made with other subject matter. He noted:

> Like what [Kevin] said, it helps us from our day-to-day lives. It's bigger than engineering. It helps us solve problems with family, friends, any of that. Just for academically, it helps also because it helps us with math, science, even sometimes English and reading sometimes. 'Cause it gives us different ways to think about how to go for a certain problem that presents itself. It all ties into one another.

James concurred with Darius and indicated how the engineering classes helped him in improving his performance in his core academic subjects. He stated:

> The [engineering] academy is academically challenging to me because I'm not really good at math, so the equations, they helped me better in math. For example, we take geometry, so we do some equations dealing with geometry, and it really helped me. It helped me boost my grades.

Kevin described the integrated nature of the engineering curriculum. He shared:

> My experience at this engineering academy at [Stanton Academy], it's a good experience. Teachers, they not only use visual learning, like on the board, but hands-on learning. We also use mathematic equations to determine what we're building, like what levers and stuff like that. A project that we did, we had to create a catapult out of popsicle sticks. We could only use a certain amount of, and we had to see which person in class's catapult shot the furthest.

Leroy described how he learns mathematic concepts in his engineering classes. He commented:

> My experience with the program is very good because it's fun, it's hands-on, and you learn a lot of things with calculations, with weight, grams. One time, one of the projects, we had to make a boat out of cardboard, and we had to calculate how big the boat could be without making it sink on water.

The students were unified in sharing the positive learning experiences they gained from the academy of engineering. They believed that the integrated nature of the engineering curriculum (e.g., using core academic concepts within their engineering projects) enabled them to perform better in their core academic courses.

DISCUSSION

The results of our study helped us to better understand how academies provide a platform for Black male students' interest in engineering as a viable college and career pathway. The academy of engineering at Stanton Academy was a positive learning space for Black male students as they appreciated the hands-on nature of the curriculum and participation in it reinforced core academic concepts as they were able to contextualize their learning in an applied setting (Bottia et al., 2015;

Fletcher & Cox, 2012; Fletcher et al., 2019, 2020). Thus, we found that the academy did indeed help Black male students connect academic and technical content to increase rigor and relevancy to students' career interests.

The career academy model represents a promising approach for promoting college and career readiness. The academy facilitated Black male students' preparedness for college and careers as it fostered their abilities to apply what they learned through the occupational expression of academic knowledge (Stone & Lewis, 2012). The academy also helped students increase their employability skills (e.g., collaboration, critical thinking, and problem-solving). Even further, the students were able to hone in on technical skills related to engineering.

Our findings challenge what we consider possible within urban schools that serve Black male students, and can inform how we utilize high school STEM curricular programs to broaden the pipeline of talent for STEM career pathways. Black male students at Stanton Academy benefitted from having STEM curricular programs that aligned with their learning preferences and promoted their academic success. Thus, Black male students in the academy of engineering were engaged in the academic learning environment as a function of having a shared culture (e.g., ethnic and racial background), common experiences, and heightened interests in connecting with each other. This case study enabled us to recognize that career academies have the potential to promote academically beneficial relationships with Black male students that address their needs as future engineers.

Recommendations for Practice

Based on our findings, we recommend that school personnel provide students with a robust set of STEM programs that provide students opportunities to select customized career pathways to pursue; career academies are one way to establish college and career pathways for students with their focus on work-based learning, college preparatory activities and curricula, and small learning communities around a career theme. We also recommend that school personnel work with their feeder middle schools in providing vertical integration programming by establishing a pipeline for students interested in various career pathways (e.g., STEM). Further, we recommend that school personnel provide students with rigorous curricular programs (e.g., advanced placement [AP] and dual enrollment options) in conjunction with work-based learning experiences (e.g., internships, job shadowing, and mock interviews) and college tours. These types of rigorous activities can assist Black male students in seeing beyond their zip codes and envisioning a pathway to high-demand, high-skilled, and high-wage college and career opportunities.

Further, it is important for Black male students to get access to mentoring from other Black male professionals in the school (e.g., school administration, school counselors, and teachers) as well as within their community (e.g., advisory board members, alumni, business and industry partners, community members, and parents). The cultural matching of school personnel helps with ensuring Black male students receive culturally responsive support and high expectations

for success. These efforts are likely to lead to Black male students who are inspired to pursue STEM in college and for their careers.

Recommendations for Policy

Our findings emphasize the potential of career academies to promote college and career readiness for high school students as a comprehensive school reform initiative. Career academies may be aligned with the Perkins V provision in regard to preparing students for both further education and careers in emerging professions that are high-skill, high-wage, and in-demand (The Strengthening Career and Technical Education for the 21st Century Act, 2018). Based on findings in this study, students at Stanton Academy (a high fidelity academy) are likely to benefit from a higher engagement with work-based learning opportunities as well as college readiness activities. Student preparation for STEM careers, work-based learning, and dual enrollment all meet the objectives of the current Perkins V legislation. As such, this study suggests that career academies might be meeting the needs of students in preparing them to transition into college and careers.

We also believe this study has implications for reforming and improving current Perkins V legislation. Policymakers might take into consideration – when reauthorizing the legislation – the need to delineate more clearly the specific components and what types of activities (e.g., curricular integration, advisory board, and particular work-based learning experiences) are needed to implement an academy at a high fidelity that is associated with preparing students to be college and career ready. We recommend that schools have a strategic plan for implementing work-based learning to ensure students gain awareness, exposure, and experience in their chosen program of study – that is age appropriate and progressively intensifies as students advance grade levels. Students should begin by examining career pathways within a career cluster and culminate their experiences by participating in internships to learn what it is like to be an employee of a job within their chosen career fields. For college preparatory experiences, we believe that a reauthorization of Perkins should detail what types of activities are most appropriate – from dual enrollment to college tours. This would enable schools and school districts to ensure that all students have access to the same types of college and career preparatory activities and enable the federal government, states, school districts, and schools to monitor their progress. It would also be helpful for the legislation to set participation rate targets for schools to ensure that all students have access to college and career preparatory activities, and that a large percentage of students participate.

Recommendations for Further Research

We recommend that future studies include longitudinal analyses to follow up with high school Black male students who participated in academies of engineering to examine their post high-school outcomes, particularly as it relates to pursuing STEM college majors and/or careers. We also recommend that researchers

examine Black male academy of engineering students' engagement in other important college readiness activities such as AP, honors, and international baccalaureate programs. Further, we recommend examining how participation in academies influences their achievement (e.g., ACT/SAT scores, grades, and GPAs).

LIMITATIONS

We also recognize the limitations inherent in our study. First, the generalizability of this study rests in our analytic interpretations regarding Stanton Academy as a case study. Generalizing to other schools and academies is based on similarities in institutional contexts as well as particular student demographics. Second, we relied on the assistance of an insider informant to provide us with participant information to recruit the Black male academy of engineering students to interview for this study.

CONCLUSION

Findings from our case study demonstrate that the career academy has the potential to provide a transformative learning experience for Black male students interested in pursuing engineering as a college and/or career pathway. Students in this academy benefitted from the hands-on learning nature of the curriculum. They were able to draw connections to core academic concepts to strengthen their understanding. In addition, the academy promoted their interests in pursuing STEM as a viable option post-high school. Within that context, this case study highlights ways in which the academy can serve as a pipeline of talent for Black male students interested in STEM.

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