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The Authentic Voice of Gifted and Talented Black Males Regarding Their Motivation to Engage in STEM (Science, Technology, Engineering and Mathematics)

by ADRIENNE COLEMAN

Abstract

This study explored the factors motivating gifted and talented Black males to engage in science, technology, engineering and mathematics (STEM). The specific problem addressed was the lack of motivation among Black males to engage in STEM education and STEM careers. The purpose of this study was to examine the factors motivating Black males engaged in STEM in an effort to inform administrators, educators, and programs seeking to increase Black males in STEM. Qualitative methodology was used to conduct focus groups with 20 gifted and talented Black males who currently attend the Illinois Mathematics and Science Academy (IMSA), as well as interviews with 25 gifted and talented Black male IMSA alumni. The STEM motivation trends developed are these: STEM is a progressive field which leads to success; learning/discovery of knowledge; solve problems to advance humanity; obligation to Black community/break negative stigmas; passion for STEM/STEM enjoyment; competitive nature of STEM; and money. This study led to the design of a 5-step motivation-based program to encourage Black males to engage in STEM.

Introduction

Evidence states that the vast majority of Black male students are academically underachieving, are typically not exposed to gifted classrooms, and have limited exposure to Science, Technology, Engineering, and Mathematics (STEM) experiences with “an interdisciplinary or trans-disciplinary approach to learning where rigorous academic concepts are coupled with real-world problem-based and performance-based lessons” (CA Department of Education, 2013, para.1; Dixon, Griddine & Tucker, 2010; Rowley & Bowman, 2009; B. L. Wright, 2009). The outcome is a STEM achievement gap in which the Black male is rarely involved in STEM education and STEM careers (C. G. Wright, 2011). This is possibly a result of societal challenges leading to an array of negative consequences and misunderstanding of the Black male student (Nasir & Shah, 2011; Parson & Kritsonis, 2006). “According to the Washington-based Joint Center for Political and Economic Studies think tank, the U.S.

workforce could employ as many as 140,000 additional African-American college graduates in STEM fields annually if the gap in college completion in STEM by Blacks closed to roughly match that of White and Asian American STEM graduates” (Roach, 2014). This study on gifted and talented Black males engaged in STEM is important in motivating Black males to engage in STEM education and pursue STEM careers. It examines why certain Black males have the motivation to engage in STEM, and how that motivation is defined and manifested.

Purpose of the Study

The study examines the factors motivating gifted and talented Black male students to engage in Science, Technology, Engineering and Mathematics (STEM) at the Illinois Mathematics and Science Academy (IMSA), a residential academy for gifted/talented students.

The internationally recognized Illinois Mathematics and Science Academy develops creative, ethical leaders in science, technology, engineering and mathematics. As a teaching and learning laboratory created by the State of Illinois, IMSA enrolls academically talented Illinois students (grades 10-12) in its advanced, residential college preparatory program, and it serves thousands of educators and students in Illinois and beyond through innovative instructional programs that foster imagination and inquiry. IMSA also advances education through research, groundbreaking ventures and strategic partnerships...IMSA utilizes an accomplishment-based selection process that incorporates classroom performance, participation in extracurricular activities, and leadership history with more traditional indicators of talent such as test scores and grades. For this reason, students with the highest test scores may not emerge as the strongest applicants in the pool for the purpose of selection. Along with these criteria, geographic and demographic variables are considered to ensure a diverse student population. (IMSA, 2015).

In order to continue bridging the gifted and talented Black male STEM engagement and career gaps, the racially based STEM achievement gap needs to be understood and studied further: "There must be a re-examination of the scientific community environment . . . more African American males, diversity and thought about the aging scientific community" (Baptiste & Boyer, 2000, p. 60). Black male gifted and talented students indicate that the following habits contribute to their success: strong sense of self, sustained motivation for achievement, a determination to succeed, aspiration to access higher education, and significant relationships (Parson & Kritsonis, 2006). This study focuses on better understanding the sustained motivation of Black males to engage in STEM. It delves further into what that motivation is and ultimately informs the design of a 5-step motivation-based program encouraging Black males to engage in STEM.

Significance of the Study

This study serves as a foundation to minimize the achievement gap by developing a framework that motivates Black males to engage in STEM. The literature has shown that Black males earn less than other subcultures. According to the U.S. Census Bureau, the median income for Blacks is \$58,000, almost \$20,000 less than Whites; but for Blacks in STEM careers, the median income is \$75,000 which is only about \$10,000 less than Whites (Landivar, 2013). When Black males do not pursue an education in science, technology, engineering, and mathematics (STEM), they are unable to excel in careers that typically provide a higher standard of living (Riegle-Crumb, Moore, & Ramos-Wada, 2010). Caucasians and Asians view STEM careers as a world of opportunities; whereas, Blacks see it as challenging and inaccessible (The Center on Education and Work, 2008). The U.S. Congress Joint Economic Commission stated between 2010 and 2020 the overall employment in STEM occupations will increase by 17%, yet not enough students are pursuing degrees and careers in the STEM fields to meet the increasing demand (Casey, 2012). Thus, this racially based STEM education gap needs to be examined in order to engage more Black males in STEM careers, and ultimately improve the Black economy.

This study also contributes to positive literature on gifted and talented Black males and may help to inform STEM curriculum (Dixon, Griddine, & Tucker, 2010; McGee & Martin, 2011). The genuine Black male voice tends to be absent from research; "it is important that we listen to what they are telling us about who they are, what they think, and what they hope to achieve" (Rowley & Bowman, 2009, p. 323). Also, "research into the motivation of gifted minority students is so scant that there remain many

untapped avenues of investigation as we attempt to develop a more complete understanding of the interaction between giftedness, race and ethnicity" (Rodgers, 2008, p. 118). This study serves as the authentic voice of the gifted and talented Black males regarding their motivation to engage in STEM. With an understanding of gifted and talented Black males' motivation, the standardized test averages of Black males may increase, high school drop-out rates may decrease, matriculation to higher education may improve, STEM engagement may be enhanced, and visibility in STEM careers may increase. Diversifying the STEM field may indirectly impact the socioeconomic status of the Black population with opportunities to earn more money, have more consistent employment, and obtain leadership positions (Casey, 2012; Oakes, 1990; Vigdor, 2013).

LITERATURE REVIEW

The Black Male STEM Gap

Not only has the Black male experienced academic achievement and gifted education gaps, but also a science, technology, engineering, and mathematics (STEM) education gap. This STEM gap is evident in high school classrooms, STEM majors, and STEM careers. According to national and international mathematics assessments, 50% of Black American high school students are scoring 39 points lower than White American students (Butty, 2001; Spencer, 2012; Stinson, 2006). Black students are academically four years behind their White counterparts and score below approximately 75% of White America in mathematics (Robinson & Biran, 2006). Black students are less likely to take advanced courses in mathematics because 45% of them begin high school in a class lower than algebra; if you do not begin high school taking Algebra and Geometry, it is most likely you will not be able to enroll in advanced classes (Noble & Morton, 2013; Riegle-Crumb, 2006; Riegle-Crumb & Humphries, 2012; Sheppard, 2006). Fewer than 10% of Black students complete the high school mathematics sequence, which includes algebra, geometry, trigonometry, and pre-calculus (McGee & Martin, 2011). The literature further suggests achievement in mathematics and science in fifth through eighth grades determines high school course decisions and enrollment in advanced mathematics and science courses; which also influences access to postsecondary and occupational STEM opportunities (Singh, Granville, & Diak, 2002). Other factors inhibiting the Black student from advancing in STEM include lack of STEM exposure in K-12, lack of a STEM mentor, unqualified teachers, mathematics phobia, failure of students to see the application of science to their lives, and watching too much television (Dumais, 2008; QEMN, 2010; Toldson & Brown, 2009).

However, there are some students who have been successful in STEM during high school despite adversities, attributing their success to parental involvement, teacher support, motivation to succeed in mathematics, and personal character traits such as ability to focus, desire to succeed, determination, curiosity/inquisitiveness, and belief in self (Berry, Thunder, & McClain, 2011; Sheppard, 2006). This is corroborated in two studies conducted on successful Black middle school students who identified several themes leading to their success in mathematics, including early educational experiences (prior to kindergarten), recognition of ability, belief in ability, support system, motivation to learn, positive identity and alternative identity (Jackson & Wilson, 2012; Jett, 2011). Another study looked at 16 successful mathematics high school students that chose to stay at an underperforming school because they trusted the school and believed it would prepare them for the real world (Sheppard, 2006). The students made the following comments:

The fact that I am considered a successful mathematics student has a lot to do with my math teacher, Mr. Greece, because math was my worst subject. There were times when I would want to give up, maybe it's just not for me, but he told me don't give up, it's not hard, you can do it. . . .

I have to give credit to my mathematics teacher because I believe that I am a success because of their teaching. . . .

My success also comes from me wanting to prove people wrong because when I get home I get called stupid. . . .

One of the keys to my success is that I am curious. Curiosity killed the cat, but in my case, curiosity made the cat genius. . . .

My parents have a big influence on me. My mom likes to brag to her friends and family about how well I'm doing. That inspires me to try harder. (Sheppard, 2006, p. 4)

These studies indicate that some Black students can become successful in STEM with an appropriate network of support and confidence in academic ability.

At Historical Black Colleges and Universities (HBCU), Black students who do major in STEM say their families and the faculty are a pivotal motivating force (Williamson, 2010). One HBCU has a STEM Scholars Program that is strategic in ensuring that Black students are retained and graduate by incorporating a supportive family environment through living learning communities, hiring caring teachers, communicating high expectations, instituting academic rigor, and developing the students' professionalism (Kendricks & Arment, 2011).

Other HBCUs have joined the Learning Communities for Science, Technology, Engineering, and Mathematics (LCSAA), developed to increase the representation of African Americans in STEM fields (Freeman, Akston, & Winborne, 2008).

Black students at non-HBCUs majoring in STEM seem to confront an array of challenges during their pursuit of STEM. There was a study conducted of 23 Black mathematics and engineering college students who were victims of a stereotype threat, "a type of confirmation bias in which the threat of being viewed through the lens of a negative stereotype leads to a suppression of academic performance" (McGee & Martin, 2011, p. 2). The Black students were told statements, such as "You would never fit in," "Make sure you get an Asian roommate," "Yes, there is engineering, but you should pick a major that you are more likely to graduate in," and "Really, wow, I didn't think you would be able to answer a question like that, and no one helped you" (McGee & Martin, 2011, p. 2). A case study conducted on a Black male with a Ph.D. in mathematics discussed how he utilized such stereotypical perspectives to his advantage:

Rob relishes telling the tale of how he manipulated the White students in the mathematics competitions by exploiting their perception that his being Black made him mathematically inferior: he transformed his competitors' preconceived notions of Blacks and mathematics into a leg up for himself. . . . Rob performed "acting Black and dumb" by scratching his head, staring buckeyed and pretending to look at his White teammates for answers. . . . he did not lose one single game. (McGee & Martin, 2011, p. 54)

These studies demonstrate how students can overcome racism, classism, and other challenges to academically achieve and become successful in STEM.

Despite some Black students overcoming social injustices that inhibit their STEM engagement, few Black males actually enter STEM fields. Less than 15% of the STEM workforce is multicultural and the Black male is noticeably absent (Baptiste & Boyer, 2000). The National Academy of Science has voiced their need for a larger STEM workforce to "maintain the economic supremacy of the United States and have articulated the need for individuals from all backgrounds" (Riegle-Crumb et al., 2010, p. 459). In response, the United States Innovation Committee on Science, Engineering and Public policy has charged the educational system with creating a more diverse pool of people interested in STEM (CEW, 2008).

History of Black Males Engaged in STEM

Even though there is a current cry to diversify STEM fields, there are numerous Black males who have contributed to and been innovators in STEM fields. However, this information is rarely shared with Black males, and is not present in professional literature, nor often portrayed in media. The majority of the Black males in this study stated that a lack of STEM vision and the negative stigmas about Black males are the reasons that a STEM gap exists. They stated Black males don't see images of themselves as scientists or doctors, nor do they see many positive images of themselves in popular media. Thus, it is important that Black males know from historical and current perspectives that other Black males have engaged in and been successful in STEM. Below is a historical timeline of gifted and talented Black male scientists, engineers, and mathematicians along with their contributions to STEM:

- Early 1700s *Thomas Fuller*, an American slave and a mathematical genius who could mentally multiply two 9-digit numbers.
- Late 1700s *Benjamin Banneker*, a scientist and mathematician whose almanac has been praised for its accuracy; he constructed the first clock in this country.
- 1872 *Elijah McCoy*, an engineer who held over 48 patents in the field of automatic lubrication. He was a pioneer in the art of steadily supplying oil to machinery in intermittent drops from a cup, doing away with shutting down the machine to lubricate it.
- 1876 *Edward Alexander Bouchet*, a physicist who was the first African American to earn a doctorate from Yale University.
- 1893 *Dr. Daniel Hale Williams*, a scientist who performed the first successful open heart surgery.
- 1896 *Lewis Baxter Moore*, a mathematician and the first African American to earn a Ph.D. in mathematics from University of Pennsylvania.
- Early 1900s *George Washington Carver*, a scientist who advocated innovative agricultural methods and developed hundreds of applications for certain agricultural products, such as the peanut.
Charles Henry Turner, a scientist and the first researcher to prove that insects can hear.
- 1920s *Dudley Weldon Woodard*, a mathematician and the second in the nation to receive a Ph.D. in mathematics who was named one of

the most gifted mathematicians in the nation.

- 1920s–1950s *Elbert Francis Cox*, a mathematician who received his Ph.D. from Cornell University and was head of Howard University's Mathematics Department for 32 years.
- 1930s *Percy L. Julian*, a scientist who brought comfort to sufferers of arthritis. He synthesized cortisone from soya beans at a fraction of the previous cost.
William Waldron Schieffelin Claytor, a mathematician who won the Harrison Scholarship, the most prestigious award offered at the University of Pennsylvania. His dissertation provided a significant advance in the theory of Peanno continua—a branch of point-set topology.
Ernest E. Just, a leading authority of marine biology who pointed out the significance of cytoplasm in the cell. His research supported evidence of the importance of ectoplasm of the egg in the fertilization process.
- 1940s *Charles R. Drew*, a scientist who developed techniques for preserving blood and organized the first Red Cross blood banks in the United States and England. His organized bank saved millions during World War II.
Vivien Thomas, a scientist who had a partnership with a White surgeon, Dr. Alfred Blalock, and was a high school educated hospital janitor who developed a groundbreaking procedure in pediatric heart surgery that is used to correct blue baby syndrome.
J. Ernest Wilkins, a mathematician with a Ph.D. from the University of Chicago who became a professor of applied mathematics and physics at Howard University.
- 1960s *David Blackwell*, a scientist with a Ph.D. from University of Illinois was the first African American elected to the National Academy of Science.
James West, a scientist who developed the foil electret microphone, which became the industry standard.
Robert Coleman, a computer scientist who was the first African American programmer with People's Gas.
- 1970s–present *Clarence (Skip) Ellis*, a computer scientist who was the first African American to hold a Ph.D.

in computer science and helped to develop the icon-based GUI, the basis for Apple's Macintosh and Microsoft Windows' operating systems.

- 1980s *Mark Dean*, a computer scientist who helped to develop a one-giga-hertz computer processor chip and was instrumental in creation of the personal Computer (PC).
Philip Emeagwali, an engineer who won the Institute of Electronics and Electrical Engineers' Gordon Bell Prize. His calculations are currently being used to forecast the weather and predict future global warming.
- 1980s–present *Freeman Hrbowski*, a mathematician and scientist who is currently the President of University of Maryland, Baltimore, received a Ph.D. from University of Illinois in Higher Education Administration/Statistics and was selected as one of the 50 most important Blacks in research science by the National Science Foundation
Ben Carson, a scientist who was the first to perform a separation of craniopagus (Siamese) twins joined at the back of the head and currently is a professor of neurosurgery at the John Hopkins School of Medicine (Baptiste & Boyer, 2000; CSF, 2013; Cullotta, 2013; Imbornoni, 2013; U of Penn, 2013; Williams, 2008).

These Black male scientists and mathematicians made valuable contributions to STEM fields despite adversities. Their accomplishments in STEM refute the perception that the Black males' pursuance of STEM is atypical. It also refutes stereotypical perceptions of mathematicians/scientists as old White men (McGee & Martin, 2011). This information may motivate some Black males to engage in STEM by demonstrating to them that Black males have been successful in STEM.

Methodology

To further understand what motivates Black males to engage in STEM, a study exploring the factors that motivate gifted and talented Black males to engage in science, technology, engineering, and mathematics (STEM) was conducted. The specific problem addressed is the lack of motivation among Black males to engage in STEM. The literature indicates a racially based STEM gap that disproportionately impacts Black males. This gap is evident in STEM majors and careers, where Black males have been underrepresented. Although this gap

exists, however, there are Black males engaged and employed in STEM fields. Thus, the purpose of this study was to examine the factors motivating Black males engaged in STEM. The research question asked, "What factors do gifted and talented Black males identify as motivating them to engage in Science, Technology, Engineering and Mathematics (STEM) at the Illinois Mathematics and Science Academy, a residential academy for gifted/talented students?"

The methodology for the study was qualitative in nature; a phenomenological approach that described the motivational factors of gifted and talented Black males engaged in STEM. This approach was used to acquire multiple perspectives derived from two focus groups with a total of 20 gifted and talented Black males currently enrolled in a STEM high school and 30 minute interviews with 25 gifted and talented Black male alumni of a STEM high school, as well as the literature related to motivation of gifted and talented Black males. It considered human perspective, addressed exploratory questions, and was utilized to "cover contextual conditions because you believe they are relevant . . . and one in which you cannot manipulate the behavior of those involved in the study" (Baxter & Jack, 2008).

Research questions were formulated and used as a foundation to develop the focus group/ interview questions for the study:

1. Why are you engaged in STEM (science, technology, engineering and mathematics) education and whom/ what do you credit for your initiation/interest in STEM education?
2. Describe your motivation to pursue/engage in STEM education...
3. Discuss your intrinsic motivation ("behaviors performed out of interest and enjoyment") as it relates to being a gifted and talented learner engaged in STEM...provide examples in which your motivation to engage in STEM was developed...
4. Discuss your extrinsic motivation ("behaviors carried out to attain contingent outcomes") as it relates to being a gifted and talented learner engaged in STEM... provide examples in which your motivation to engage in STEM was enhanced...
5. How has your enrollment in a gifted, residential high school contributed to your motivation to engage in STEM?
6. The literature suggests that there is a gap in STEM majors/careers since Black males do not major in or enter STEM fields as often as their White and Asian counterparts ...why do you think this gap exists, what makes you different and how would you motivate Black male students to engage in STEM?

These questions assisted in gaining a deeper understanding of the motivational factors that impact gifted and talented Black males engaged in STEM.

The information yielded from these participants was transcribed, utilizing a software transcription program and using a word analysis program along with a qualitative management system. A triangulation analysis was conducted to look for cross-case themes, patterns, and trends. It was further analyzed in relation to the literature.

FINDINGS

Gifted and Talented Black Males' STEM Motivation

This section takes an intricate look at the collective thoughts of 45 gifted and talented Black males engaged in STEM at IMSA. It also looks at the themes within the group and patterns between the groups as well as differences regarding STEM motivation, STEM support, IMSA's contribution to STEM motivation, STEM achievement gap, and the minimization of the STEM achievement gap.

Why STEM

The current Black male students were asked why they were engaged in STEM education. Several themes emerged in response to this question: (a) enjoy STEM, (b) good at STEM, (c) STEM is a progressive field, (d) to solve problems and advance humanity and (e) pursuit of scientific knowledge.

Now, I'm engaged in STEM because I love it so much; it's very entertaining and interesting to me. As far as I've been told and can remember when I was younger my parents would put me in front of the computer and have me doing math problems before I was even in preschool and things like that. So, I had an early interest for STEM and throughout the years it's become bigger and bigger. Because I have a natural affinity for it. I toyed more and more with it, and I help other people with it, and so it's just always been a part of me.

The gifted and talented Black male alumni of the Illinois Mathematics and Science Academy were also asked why they were engaged in STEM. From this question six themes developed: (a) STEM interest, (b) good at STEM, (c) intellectual curiosity, (d) future success, (e) problem-solving aspect of STEM, and (f) STEM is a prominent/progressive field.

Ever since I was young, my father had circuits and electrical components lying around the house. As a curious young mind, I would often gaze upon these circuits and imagine a sort of thriving community populating its surface. The roads connected each minor component to the central hub and other larger components. It looked like a town where all of the

little people were just as significant as the big ones were, a perfect representation of a symbiotic society. I wanted to help people find ways to help others and get connected like a circuit. That vision as a young child matured itself into my drive for STEM.

The dominant patterns that arose between the two groups were the enjoyment of STEM/STEM interests, reported by 18 (40%) participants, and being good at STEM, reported by 11 (24%) participants. Other identified patterns included to be successful, to solve problems in an effort to advance humanity, and that STEM was a prominent/progressive field. The current Black male students stated that their parents encouraged them to pursue scientific knowledge and have intellectual curiosity. When asked about their STEM support network, the common responses included parents, family, teachers, friends, and the school system. The gifted and talented Black male alumni also discussed being members of various organizations, other IMSA alumni, and the church as part of their STEM support system. Below is a table depicting the **frequency of responses** as to why Black males are engaged in STEM:

Table 1: Why are Black Males Engaged in STEM?

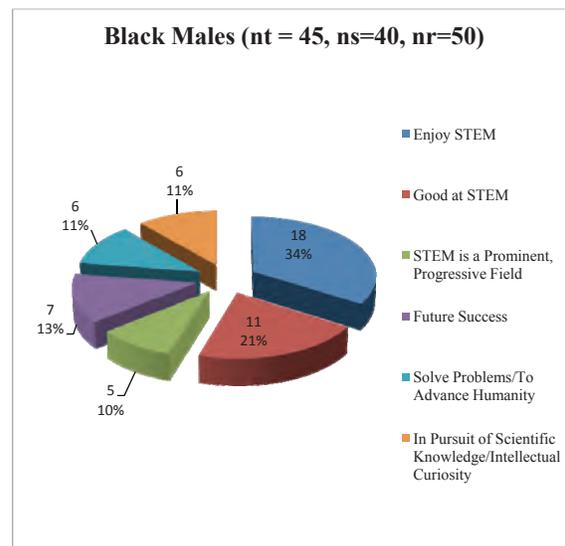


Table 1. Pie charts displaying the relative frequencies of response categories to the question, "Why are Black males engaged in STEM?" Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as n_r, while the actual number of responses given is represented as n_s. Since subjects can choose not to respond or respond more than once to the question, the values for nt, n_s, and n_r are often not equal.

Motivation

The gifted and talented current Black male students were asked to describe their motivation to pursue/engage in STEM education. There were four emergent themes: (a) passion for STEM, (b) money, (c) solve problems/advance humanity, and (d) learning/discovery of knowledge.

I've always had an inner drive to do my best. I try to think deep. I don't know where that comes from; it's just a part of who I am. So academically and no matter what, whether I'm playing sports or volleyball, I just do the best I can; and at the end of the day, I always want to know that I've done the best. So even academically I've talked to my parents about why don't you push me harder. I should have gotten an A in this class; my parents are like, your grades are good. How do you say they are good? I know I could have done better. So I've always been pushing myself, even harder than those people around me and I guess what desires me to push the hardest in STEM is the passion for me. . . .

When the gifted and talented Black male IMSA alumni described their motivation to pursue/engage in STEM the following themes emerged: (a) learning/discovery of knowledge, (b) to advance humanity, (c) future success, (d) passion for STEM, (e) STEM is a progressive field, (6) competitive nature of STEM, and (f) break stigmas of Black males/be a role model.

My motivation was I knew a long time ago that I wanted to do something in medicine. I have two younger brothers who are both autistic, so from an early age I got curious about the human condition, what makes people act the way they do, what is disease. You know just going to the doctor's visit and seeing how they treated my brothers and became intellectually curious about what you need to know to get there, so you know eventually I put two and two together and realized you have to take a path that includes some science, mathematics, and technology even to get to that point, so that's what got me interested. I wanted to do something that intellectually drove me and something I felt I could do that could give back to society. Doctors do a lot of stuff, they teach their patients, they can really do a lot of stuff, they can be leaders, so I think those are my main motivations.

From the responses of 34 out of the 45 gifted and talented Black males who were asked to describe their STEM motivation, three distinct patterns emerged that included learning/discovery of knowledge stated by 11 (32%) respondents, solve problems to advance humanity stated by 11 (32%) respondents, and passion for STEM/STEM enjoyment stated by 10 (29%) respondents. There were several differences. As motivational factors to engage in STEM, the current students discussed money as a major motivator; whereas, the alumni discussed success, the

competitive nature of STEM, and the breaking of stigmas about Black males. Below is a table depicting the **frequency of responses** to the question, describe your motivation to pursue/engage in STEM:

Table 2. The Motivation of Black Males to Engage in STEM

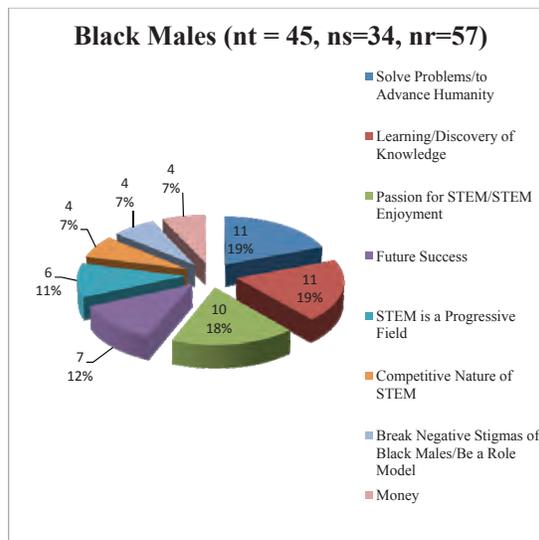


Table 2. Pie charts displaying the relative frequencies of response categories to the question, "Describe your motivation to pursue/engage in STEM?" Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.

Intrinsic Motivation

The gifted and talented Black male students were asked to discuss their intrinsic motivation defined as "behaviors performed out of interest and enjoyment" to engage in STEM (Areepattamannil, Freeman, & Klinger, 2010, p. 234). This question yielded four themes: (a) competitive nature of STEM, (b) solve problems/advance humanity, (c) learning/discovery of knowledge, and (d) obligation to Black community.

My motivation to pursue STEM education is kind of strange. I'm a really competitive person and I want to know everything possible to be known about something and to discover everything by myself; so that's why I have pursued STEM throughout all my years of learning. My parents pushed me from a young age to always to do worksheets, spelling, multiplication tables; and I never realized it, they were molding me and guiding me on this pathway to pursue STEM and because of them I have this interest; and now at IMSA, I see all this new information that I've never been exposed to before,

especially in a biology course. . . . I want to know all of it. . . . I want to keep going and read all I can.

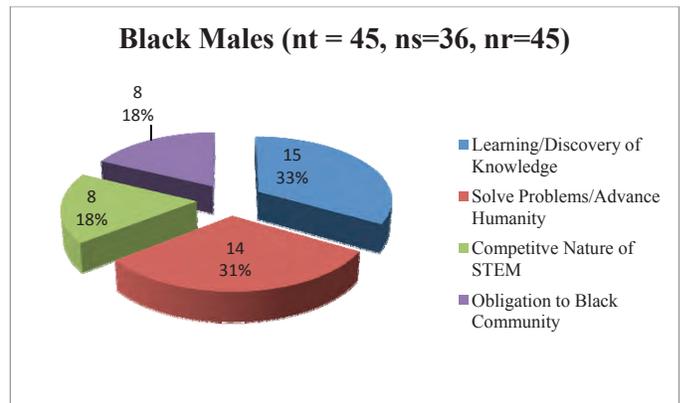
The gifted and talented Black male IMSA alumni were asked about their intrinsic motivation to engage in STEM of which four themes emerged: (a) learning/discovery of knowledge, (b) solve problems/to advance humanity, (c) obligation to the Black community, and (d) competitive nature of STEM.

You know [my brother] for him it was "I'm going to know seven languages." For me it was "I'm going to program in seven languages," and I think they look really different on paper, but I really think they are the same thing. I think you give a kid a seed and you see how it grows, whether or not that's a cucumber or a tomato and so when I think about what's intrinsic to me about STEM, STEM is really the food that you give the seed, right. Once you have told that kid there's something to this whole learning thing, there's something to this whole being something greater than simply a rapper or an athlete, or I think that's the seed and out of that you have to guide the plant, so I think that's really where STEM comes in and so [my brother] used his very different . . . my younger brother used his different and he's in technology as well; even my youngest brother who teaches, I think it's just all really the same seed, watered differently.

There were four patterns that arose from 36 out of 45 respondents: learning/discovery of knowledge reported by 15 (42%) participants, solve problems to advance humanity reported by 14 (39%) participants, obligation to Black community reported by eight (22%) participants, and the competitive nature of STEM reported by eight (22%) participants. There were no differences between the current students and the alumni, but an interesting finding was that the current students, six (55%), reported a competitive nature as their primary intrinsic motivator; whereas, two (8%) members of the alumni reported their competitive nature as the last intrinsic motivational factor. The table above depicts the **frequency of responses** to the question, discuss your intrinsic motivation to engage in STEM:

Table 3. The Intrinsic Motivation of Black Males to Engage in STEM

Table 3. Pie charts displaying the relative frequencies of response categories to the question, "Discuss your intrinsic motivation to engage in STEM?" Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.



Extrinsic Motivation

The gifted and talented Black males students were also asked about extrinsic factors of motivation, defined as "behaviors carried out to attain contingent outcomes" to engage in STEM (Areepattamannil, Freeman, & Klinger, 2010, p. 234). Four themes emerged: (a) future success, (b) STEM Enjoyment/Advance Humanity, (c) money, and (d) obligation to Black community.

My friends, my parents, my family; but not necessarily in a way that you might expect. I know some people complain that their parents push them and say you have to do good, but my parents have always been so supportive and something that motivates me is that I want to make my parents proud. In addition to making them proud, I want to do my best for their sake. . . . So if I work hard I can get into one of these schools, then I won't have to worry about money to pay for college; so money in terms of scholarships for college has been an extrinsic motivator.

The gifted and talented Black male IMSA alumni were asked to discuss their extrinsic motivations to engage in STEM of which seven themes emerged, including (a) break stigmas about African American males, (b) obligation to Black community, (c) future success, (d) STEM enjoyment, (e) STEM exposure, (f) self, and (g) money.

I spoke about being the one Black person and I went to [omitted College], which has a reputation for not being so respectful to African Americans in general, and one of my things is I don't want to come here and take the easy courses. I don't want to come here and take an easy major; I want to go seek to a challenging major. I want to be something different and unique so I think that was a big part of it but I also think society tells young Black men that you will never be successful in science and in technology. It's constantly reinforced everywhere you look and for me I like that thought that I could buck that trend . . . even in my experiences,

I worked for Adobe and taught for a while, you don't see the African American. Like I've never in a technical field worked with anyone that is African American, ever! To date, I think I've only met three or four Black people who program in any capacity and only because of my interest in NSBE, [the National Society of Black Engineers] and even within that, we are the strict minority, so I look at that, it disappoints me in some ways.

Several patterns from 36 out of the 45 respondents developed, with success and to break stigmas about Black males as the most common between the two groups, both reported by 10 (28%) participants. Other patterns that developed were STEM enjoyment, reported by seven (19%) participants, and money, reported by four (11%) participants. Although money developed as a commonality between the current students and alumni, only one gifted and talented Black male alum reported it. In terms of differences, the gifted and talented Black male alumni also discussed obligation to Black community, STEM exposure, and self as factors related to their extrinsic motivation to engage in STEM. A major difference for the current students was they indicated a loss of STEM enjoyment as a factor of extrinsic STEM motivation. Although these two current students no longer enjoyed STEM, they still viewed it as valuable and planned on pursuing a STEM major/career. Below is a table depicting the frequency of responses to the question, discuss your extrinsic motivation to engage in STEM:

Table 4. The Extrinsic Motivation of Black Males to Engage in STEM

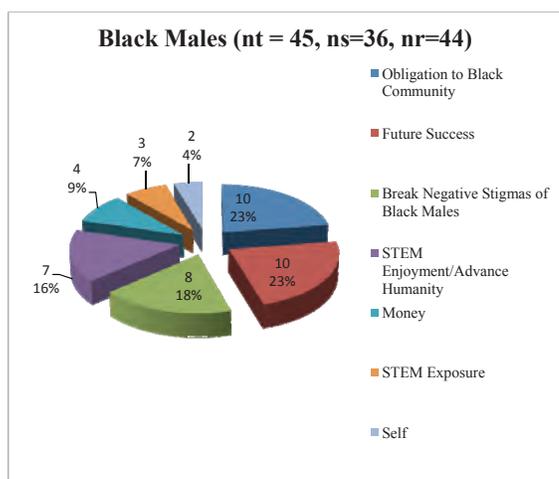


Table 4. Pie charts displaying the relative frequencies of response categories to the question, "Discuss your extrinsic motivation to engage in STEM?" Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.

The Illinois Mathematics and Science Academy's Contribution to STEM Motivation

Besides race, gender and being gifted and talented, the participants also had the Illinois Mathematics and Science Academy (IMSA), a gifted and talented residential high school, in common. The Black male current students were asked why they chose to enroll at IMSA; in which they responded (a) to further STEM knowledge, (b) for a challenge, (c) as college preparation, (d) for the experience, (e) to make connections with people like me, and (f) for quality education. They were also asked how IMSA contributed to their motivation to engage in STEM. The five themes that emerged were (a) immersion in STEM, (b) challenge/better education, (c) diverse environment, (d) self-awareness, and (e) loss of motivation.

At my old school the only place to be challenged in a STEM sense was in the classroom, but here it's like it starts in the classroom and then after that you go back to the dorms and there are other people who challenge you. So right now my roommate is someone in which, where I am in math right now, he was there two or three years ago. So like now he's taking analysis and just having that resource, friends that are like, it's always cool to have someone who is ahead of you in that sense.

The Black male alumni were asked why they chose to enroll at IMSA: responding (a) to receive a challenge, (b) quality education/opportunity to learn, (c) to leave home, (d) to further STEM knowledge, and (e) to make connections with people like me. They were also asked how IMSA contributed to their motivation to engage in STEM. The five themes that emerged were (a) immersion in STEM, (b) diverse environment, (c) challenge/better education, (d) self-awareness, and (e) loss of motivation.

What can I say about IMSA? IMSA was probably the best formative years of my education, I think I was able to do things here at IMSA that I wasn't able to do at another school. I think at IMSA they give you the freedom to kind of be your own thinker. They give you the freedom to really inquire. They don't just point their fingers and say remember this or just give you random facts; they say if you want to learn about it, here's the materials and now you go and figure it out. That's how it was presented to us, so I think they taught us lifelong learning which is important because when you get older, there's not always going to be a teacher, a curriculum, or a syllabus to make you learn what you have to do, especially in medicine. . . . But here the teachers are just as hungry as the

students are, like further your education. And then I remember the Wednesday's were like inquiry days. . . . So I think it's pretty wild that you have a day that you can do your own research, whatever it is, that interests you. No matter the discipline, you have a whole day to four years to carry out your research, present it, and further it in college. They really give you an opportunity to seize where you are.

The primary patterns were to be challenged, reported by 16 (36%) participants, to receive a quality education, reported by 14 (31%) participants, and to further STEM knowledge, reported by 13 (29%) participants. Other patterns that developed were to make connections with like-minded people, to enter a STEM field, college preparation, and to leave home. In terms of differences, the current students also discussed their desire to make a difference, their parents made them, and one student passionately responded, "I love STEM." The gifted and talented Black males were also asked how IMSA contributed to their motivation to engage in STEM, of which 37 participants responded. The majority of the participants agreed that IMSA enhanced their STEM motivation, stated by 32 (86%) participants; whereas, five (14%) reported that IMSA hindered their STEM motivation. One student suggested IMSA both enhanced and hindered their STEM motivation. For the participants who IMSA enhanced their STEM motivation, the current students and alumni identified the same reasons as depicted in the **frequency of responses** table below:

Table 5. IMSA's Contribution to Black Male STEM Motivation

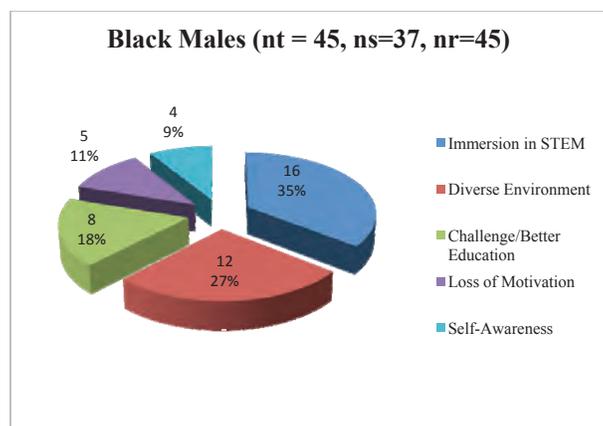


Table 5. Pie charts displaying the relative frequencies of response categories to the question, "How did IMSA contribute to STEM Motivation?" Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.

The participants who stated IMSA hindered their STEM

motivation indicated that they did not like competing with other students in STEM at IMSA; they realized they were not as good at STEM as they initially thought; they did not like the complexity of STEM, and/or they developed other passions at IMSA as factors that decreased STEM motivation.

The STEM Gap

The gifted and talented Black male students were asked their perspectives as to why there was a STEM gap in which Black males did not major in or enter careers as often as their White and Asian counterparts. The themes that emerged were (a) lack of STEM vision for Blacks, (b) lack of STEM parental support, and (c) stigma/misperceptions about Black males.

I guess there is this train that needs to be interrupted, but the reason is a little different. The way that I see it is there might not be as many Blacks in STEM for the same reason you don't see as many women in STEM, which is the fact that there aren't many and I know that sounds like circular reasoning but I know that growing up when STEM is just a field that you don't associate growing up African American. If you don't see African Americans in STEM, if African Americans don't feel it is something they should go into; either that or we aren't given the same opportunities.

The gifted and talented Black male IMSA alumni were asked their perspectives as to why there was a STEM gap in which Black males do not major in or enter careers as often as their White and Asian counterparts. The themes that emerged for why there was a STEM gap included (a) lack of STEM vision for Blacks, (b) lack of STEM exposure, (c) negative stigma of/misperceptions about Black males, and (d) lack of parental support.

That's definitely a difficult question to answer, but I think the most important factor behind this gap lies in access to quality education from a young age. For most middle- to low-income Black students, the hard truth is that it's impossible to be prepared at a high enough level to be able to compete in a rigorous college STEM curriculum. When the best high school that you have access to has 10% of its students at grade level, and an average ACT score of less than 16, schools like this do exist, and they tend to be in Black/Latino neighborhoods. You can hardly be expected to perform at the same level as someone who went to a well-funded high school with outstanding teachers. As long as access to education remains at its current level in low income Black neighborhoods, there's no way we can expect young Black males to suddenly take it on themselves to compete at a high level. There's too much of a disadvantage as it is.

Forty participants addressed reasons for the STEM gap,

developing three patterns that included lack of STEM vision for Black males, reported by 19 (48%) respondents, stigma and misperceptions about Black males, reported by nine (23%) respondents, and lack of parental support, reported by eight (20%) respondents. The alumni (13) respondents also mentioned lack of STEM exposure as a contributor to the Black male STEM gap. Below is a table depicting the **frequency of responses** to the question as to why there is a Black male STEM gap:

Table 6. The Black Male STEM Gap

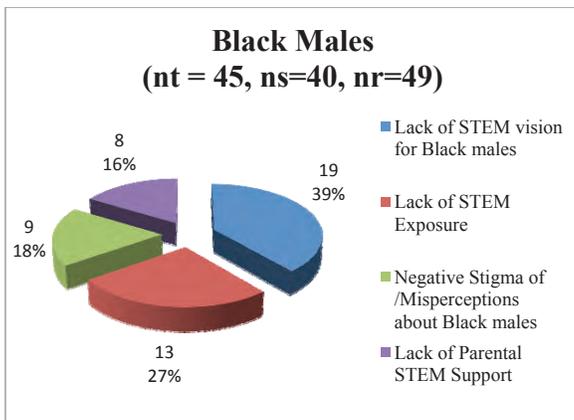
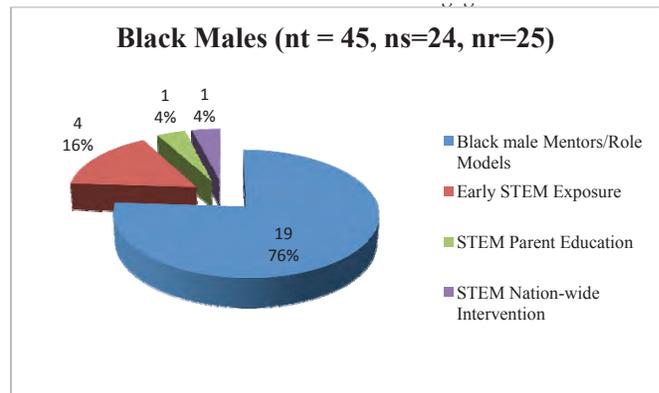


Table 6. Pie charts displaying the relative frequencies of response categories to the question, “Why is there a Black male STEM gap?” Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.

So, what makes these gifted and talented Black males different from those who have not engaged in STEM? In terms of differences, the current students discussed how they had typically been the only Black male in academic classes; whereas, the alumni discussed how they were exposed to STEM early, were good at STEM, and had determination. To minimize the gap, the primary pattern identified was more Black males were involved as role models/mentors reported by 19 (78%) of the 24 respondents. The other pattern that arose was early STEM exposure inside and outside the classroom, reported by four (17%) respondents. In terms of differences, the current students also discussed the need for a nation-wide intervention and parent education as initiatives to address the Black male STEM gap. Above, right, is a table depicting the **frequency of responses** to the question about how best to motivate Black males to engage in STEM:

Table 7. How to Motivate Black male STEM engagement

Table 7. Pie charts displaying the relative frequencies of response categories to the question, “How to motivate Black males to engage in STEM?” Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual



number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.

Conclusion

The research question asked, “What factors do gifted and talented Black males identify as motivating them to engage in Science, Technology, Engineering and Mathematics (STEM) at the Illinois Mathematics and Science Academy, a residential academy for gifted/talented students?” Regarding motivation to engage in STEM, intrinsic motivation to engage in STEM, and extrinsic motivation to engage in STEM, the following are focus group responses from the collective voices of 45 gifted and talented Black males currently attending IMSA and gifted and talented Black male IMSA alumni. Being a current/past student at the Illinois Mathematics and Science Academy was the primary factor that contributed to Black male motivation to engage in STEM, with immersion in STEM, being in a diverse community, the educational challenge, and enhanced self-awareness as valuable aspects of IMSA. The patterns that developed as factors that motivate gifted and talented Black males to engage in STEM included the following:

1. STEM is a progressive field which leads to success, $n = 28$ (62%)
2. Learning/Discovery of knowledge, $n = 25$ (56%)
3. Solve problems/to advance humanity, $n = 21$ (47%)
4. Obligation to Black community/break negative stigmas, $n = 16$ (36%)
5. Passion for STEM/STEM enjoyment, $n = 10$ (22%)
6. Competitive nature of STEM, $n = 8$ (18%)
7. Money, $n = 8$ (18%)

On the following page is a table depicting the frequency of responses to the questions regarding motivation to engage in STEM, intrinsic motivation to engage in STEM, and extrinsic motivation to engage in STEM:

Table 8. STEM Motivation in Gifted and Talented Black Males

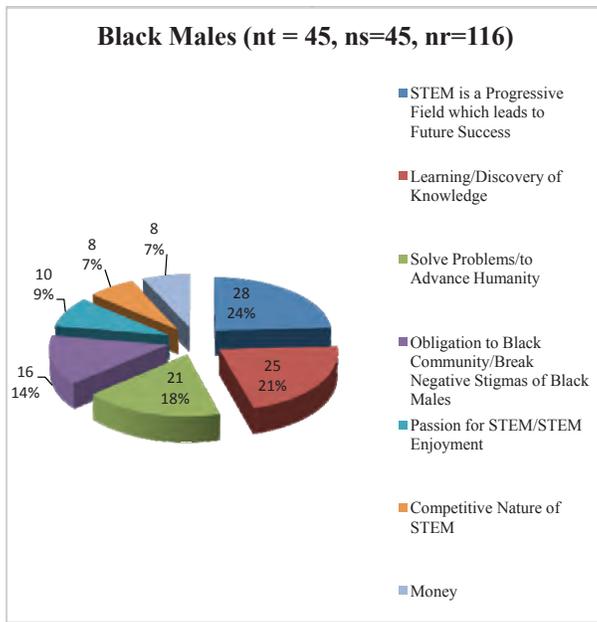


Table 8. Pie charts displaying the relative frequencies of response categories to the question, “What motivated gifted and talented Black males to engage in STEM?” Sample sizes for total number of participants is represented as nt, number of subjects responding to the question are represented as ns, while the actual number of responses given is represented as nr. Since subjects can choose not to respond or respond more than once to the question, the values for nt, ns and nr are often not equal.

The trends that developed as a result of a triangulated analysis between the gifted and talented Black male current students, the gifted and talented Black male alumni and the literature on gifted and talented Black males engaged in STEM are as follows:

1. STEM is a progressive field which leads to success
2. Learning/Discovery of knowledge
3. Passion for STEM/STEM enjoyment
4. Obligation to Black community/break negative stigmas
5. Competitive nature of STEM

The factors motivating gifted and talented Black males that were new contributions to the literature on Black male STEM motivation are as follows:

1. Solve problems/to advance humanity
2. Money

This study also provided a gifted and talented Black male perspective about the literature’s suggestion that there is a Black male STEM gap and ways to minimize that gap. Table 9 shows a comprehensive, collective snapshot of gifted and talented Black males perspectives of the STEM achievement gap, reasons why they engaged in STEM, their STEM motivational factors, and how attending a gifted, residential contributed to their motivation and opinions about motivating Black males to engage in STEM (n = 45):

Table 9: Black Male Perspective: Gifted and Talented Black Male Motivation (n = 45)

Why a Black Male STEM Gap	Why engaged in STEM	Gifted and Talented Black Male STEM Motivation	IMSA's Contribution to STEM motivation	How to Motivate Black males to engage in STEM
Lack of STEM vision for Black males, n = 19	Enjoy STEM/STEM interest, n = 18	IMSA, n = 32	Enhances Motivation, n = 32 -Immersion in STEM -Diverse Environment -Challenge, better education -Self-awareness, independence	More Black Males involved/Black mentors, role models, n = 19
Negative Stigma of and isperception about Black males, n = 9	Good at STEM, n = 11	STEM is a progressive field which leads to Success, n = 28		Early STEM exposure: Inside/outside of the classroom, n = 4
Lack of parental support, n = 8	Success, n = 7	Learning/ discovery of knowledge, n = 25		
	Problem-solving aspect of STEM/To advance humanity n = 6	Solve problems/ to advance humanity, n = 21		
	STEM is a prominent, progressive field, n = 5	Obligation to Black community/ break to negative stigmas about African American males, n = 16	Hinders Motivation, n = 5 -Realization that I'm not that good at STEM - Competing with other students in STEM - Development of other passions -Complexity of STEM	
		Passion for STEM/STEM Enjoyment, n = 10		
		Competitive Nature of STEM, n = 8		
		Money, n = 8		

Implications for Educators

Based on the findings of this study, an exploration of the factors motivating gifted and talented Black males to engage in STEM, several implications for professional practice are posed. Below is a 5-step model for educators on motivating Black males to engage in STEM education leading to STEM careers:

1. Early STEM Exposure

The earlier Black males are exposed to STEM learning experiences and are supported throughout their primary academic years, the more they will develop the necessary skills and eventually nurture their passion for STEM. In doing so, they will instill a future vision for themselves that involves STEM by raising the awareness of it.

2. The Illinois Mathematics and Science Academy as a Model

There are components about IMSA's approach to teaching and learning that are essential to STEM motivation for Black male students. For one, the participants should not only be culturally but also intellectually diverse, allowing

the students to learn from each other due to a variety of perspectives while in a collaborative group. The curriculum should immerse the students in STEM, introducing them to all areas of STEM. In addition, the teaching and learning should be exploratory in nature in order to mold the students into inquiry-based thinkers. The activities should include realistic problem-solving elements that promote participant collaboration and support. The students should work with Black male mentors engaged in STEM that help and encourage them to solve problems and advance humanity; further enhancing the STEM vision.

3. Historical and Current News/Issues Discussion

In addition to using the STEM immersion technique during these learning experiences, the curriculum should also include historical and current Black news and issues. This helps Black male students to understand societal perspectives and nurtures their obligation to their community and the world. The state of awareness of themselves and those around them will grow which could encourage them to develop as students. Recognizing this, could increase their ability to understand themselves: who they are as a student, how they think and learn, and then discovering what is important to them. This process not only builds self-confidence but promotes resilience.

4. Personalized Assessment and Evaluation

Black male students should be regularly assessed to understand their strengths and weaknesses; then personalized evaluations should be created to emphasize their strengths and address their weaknesses. This demonstrates to them the importance of collaboration by showing how a diversity of strengths and weaknesses can assist in solving problems. In terms of competition, showing success in certain areas will ultimately help build self-confidence and enhance the students' awareness of areas that need improvement. This enhances their determination to do better among the Black male students. Furthermore, it establishes a support system for the student with the teacher who will intimately know what each specific student needs to progress.

5. Leadership Opportunities

The STEM areas in which the Black male students have demonstrated strength need to be complemented with an activity he can lead that has a problem-solving component to it. Then the student should be provided with leadership opportunities, outside of STEM, and encouraged to be versatile. This will inspire them to develop leadership skills needed to be successful STEM leaders in a global world.

Recommendations

The findings in this study demonstrated the various factors that motivate gifted and talented Black males to engage in

STEM. However, these findings did not completely address the problem of there being a lack of Black males in STEM majors and careers. Thus, there need to be more studies that not only examine this problem, but also look at other underrepresented cultural groups in STEM fields. Not only that, there is a gap in literature in which the authentic male voice is rarely evident. Thus, more studies that include Black males as participants as it relates to various educational endeavors need to occur. ♦

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