

# YES, STEM is for ALL: Diverse Perspectives on Black and Latino STEM Motivation

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and

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According to the literature, there are racial inequities that exist in STEM (science, technology, engineering and mathematics) education and careers. The 2013 U.S. Census Bureau indicates that Blacks and Latinos are underrepresented in STEM, with each group making up less than 7% of the STEM workforce; while Whites are overrepresented, making up 70% of the workforce (Landivar, 2013). In terms of readiness to enter a STEM major and ultimately a career, only 6% of Blacks and 13% of Latinos, compared to 36% of Whites and 53% of Asians, are actually prepared (ACT, 2016). This results from a lack of exposure to STEM in K-12 education, mathematics phobia, students' misperceptions of what science is, lack of real-life application of science, lack of motivation to succeed, and peer pressure that devalues high achievement (Coleman, 2015).

The 2015 U.S. News/Raytheon STEM Index indicates a slow progression in addressing these inequities that are a result of "early bias, discrimination and social expectations". Nationwide, Black and Latino students are least likely to have access to quality STEM instruction and are more likely to experience negative cultural stereotypes and assumptions such as a lack of intellectual ability in math and science (Hutchinson, 2014). This has led to a fixed mindset regarding STEM skills and a diminished sense of confidence in their STEM ability (Bright, 2017). "Racial minorities regularly report encountering negative stereotypes about their (mis-)fit and (in-)ability in STEM..." White individuals are better than racial/ethnic minorities in mathematics, spatial skills and scientific thinking and therefore STEM is better suited for Whites (Byars-Winston, 2013). Basically Black and Latino students are feeling "visibly invisible" in STEM and find a need to combat stereo-

type threat by constantly proving their STEM competence, which is also a source of motivation that will be discussed later in this article (Byars-Winston, 2013).

The National Academy of Sciences suggests that, without the participation of individuals of all racial/ethnic backgrounds, the increasing demand for workers in STEM fields will not be met, potentially compromising the position of the United States as a global leader (2012).

***We don't want to just increase the number of American students in STEM. We want to make sure everybody is involved," former President Barack Obama said during remarks at the fifth annual White House Science Fair. "That means reaching out to boys and girls, men and women of all races and all backgrounds. Science is for all of us. And we want our classrooms and labs and workplaces and media to reflect that (2015).***

The National Association for Gifted Children (NAGC) further suggests that "having an adequate, diverse, and well-trained supply of scientists and engineers depends, in part, on what thousands of high-ability students decide every year to do with their lives" (2009). NAGC believes that supporting gifted and talented students in a STEM talent pipeline will assist U.S. employees in filling "crucial national security, innovative science, and leading technology jobs." Diversifying the STEM fields may also indirectly impact the socioeconomic status of Black and Latino communities with opportunities to increase their earning potential, have more consistent employment, and obtain leadership positions, while enhancing the industry with culturally relevant perspectives and meeting the needs

of the United States in a global economy.

Much of the research regarding this racial STEM divide has examined “how and why certain groups have more or less access, opportunity, and success in the educational trajectories leading to STEM occupations,” but not how to actually address the STEM Racial Divide (Riegler-Crumb & King, 2011). In a preliminary study, “Is STEM for All,” conducted by the Illinois Mathematics and Science Academy (a residential high school for students gifted in math and science), 45 Black and Latino students reported that they are passionate about STEM and despite what the literature has stated, are prepared to enter a STEM major/career (2015). These students had a personal drive to learn, were obligated to their respective communities to break negative stigmas and wanted to solve problems in an effort to advance humanity. In an effort to truly bridge the racial STEM divide by developing an approach to motivate gifted Black and Latino students to enter STEM majors/careers, the study continued with additional perspectives from students and their parents, as well as faculty and staff who work with them. This study takes an intricate look at STEM motivation, as well as the racial STEM divide and how to bridge that racial STEM divide from the collective perspectives of 85 students, 51 parents, and 27 faculty/staff—a total of 163 participants. For the purposes of this study, STEM was defined as follows:

*an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy (National Center on Gifted and Talented, 2013).*

The findings of this study indicate that Yes, STEM truly is for all, more specifically gifted and talented Black and Latino students. Participants were asked why there is a racially-based divide in which Black and Latino students do not major in STEM or enter STEM careers as often as their White and Asian counterparts. The major themes to emerge include lack of STEM vision, lack of quality STEM education, lack of STEM parent support, and negative stigma of Black and Latino students. Regarding lack of STEM vision, the participants overwhelmingly reported that Black and Latino STEM professionals are not visible in the Black and Latino communities, nor is STEM encouraged; and without youth seeing those images or receiving that

push, they are unable to create a vision of themselves entering a STEM field. It was suggested that having Black and Latino STEM professionals serve as mentors to help the students develop a STEM vision can play a significant role in responding to the racial STEM divide. The participants also discussed the lack of quality STEM education, making reference to unqualified/dispassionate STEM educators, inadequate budget for STEM resources, and a STEM curriculum lacking in real-life applicability. To counter this, participants proposed an early STEM intervention, sponsored by the government, in which Black and Latino students are provided opportunities to engage in affordable and accessible quality STEM learning and research. Although study participants reported that most parents are in support of their academic endeavors, they don't necessarily have the knowledge to adequately support STEM endeavors. Many in the study discussed that few Black and Latino parents are engaged in STEM and thus lack knowledge of STEM resources and programs or possess the skill-set to assist with students' STEM homework/projects. A comprehensive STEM Education program to inform parents of Black and Latino students on how to support their children's STEM endeavors and engage in STEM learning was recommended as an intervention. Many of the participants indicated that Black and Latino students confront negative stereotypes of them not valuing education, STEM being too challenging, intellectual inferiority, etc., and as a result of these misperceptions, they are deterred from STEM engagement. Stereotype threat interventions need to be researched and implemented to confront these stereotypical perspectives, and was a proposed solution to the racially-based STEM divide.

In an attempt to gain additional insight on how to potentially bridge the racially-based STEM divide, the participants were asked about the factors that motivate gifted and talented Black and Latino students to engage in STEM education. The premise was that understanding the motivation of Black and Latino students engaged in STEM education can inform STEM curriculum and programs, and ultimately diversify the STEM education to career pipeline. The top five themes to emerge include obligation to Black/Latino community, STEM passion/enjoyment, future success, learning, and solving problems. The participants discussed that gifted and talented Black and Latino students are motivated to engage in STEM due to their obligation to their respective communities to make their ancestors proud, be role models, diversify STEM, and break negative stigmas that suggest they don't value education and are not involved in STEM, as evident in the participant comments below.

### **Students**

*In terms of me being interested in STEM as a Latina, I think it feels good to know that I'm kind of paving the way for someone else, I'm kind of going in there without knowing what to do and I have you guys to help me and it's kind of like the blind leading the blind. But I mean I know I'll get through it and that way I can help the next generation.*

*Not a lot of people in our community are involved in STEM and so it's like, oh it's not just that they aren't involved in it because they don't like it; they aren't given the same opportunities. When people look at people in the African American community, they're like oh they might be an athlete so they'll just get money for school like that or they're black so we automatically assume that all black people get scholarships, which they don't, because they're a minority. So it drives me to like stand out. So people when they look at us, they don't see us at the same level as they would see a white girl who wants to be a scientist like they think oh my gosh the white girl she's driven, but for us it's like oh she's been given a handout to get to where she is. So I feel like I need to work harder that I'm just as good, if not better than Becky.*

### **Parent**

*His intrinsic motivators are most likely his love to solve critical solve problems quickly. In elementary school, his nickname was calculator because he could solve problems faster than someone could insert into a calculator. In addition, he wants to represent Latino doctors in STEM because when he was seven years old, he asked me in the hospital, "Where the Latino doctors are at?" I remember replying that they are Latino doctors but they are very few of them. You can become one when you grow up. After that, he made it his goal to want to become a doctor for his want to represent the Latino Race.*

### **Faculty/Staff**

*It is an interesting question, if I could go a little bit out of the IMSA student. I know a student; he probably is a 3.7 or 3.5 GPA and is interested in math and science. His motivation is basically society always saying that African American males are not capable of. He feels like they are not put to the test, if there is a white student that is in the same class as them that they are not expected to do as well as, and so he feels that he's motivated by hearing that you're not able and he says that I am able and that I am going to succeed. I think that goes for a lot of our youth. I think if they keep hearing, sometimes the more you hear that you can't do something, you know that you*

*can do something. That's the motivation for a lot of our black males right now.*

The second theme to emerge is STEM passion in which participants reported that gifted and talented Black and Latino students are motivated by the mere enjoyment of STEM education, research, and its interconnectedness, as evident in the comments below

### **Student**

*I'm engaged in STEM education because I actually like math and science, from a young age. Even at my old school, I loved my biology class, and I remember writing in my essay and saying that math and science is the basis of everything we know today, like without science we wouldn't have technology, and like math is in everything you see around you, so there's always a demand for math and science, it's not one of those industries that's just gonna run out. So I feel like that's where my interest came from, cause you can see it everywhere.*

### **Parent**

*My son has been passionate about math and science since he was a toddler. He's always been interested in the why and how something works. As a toddler, it wasn't enough for him to build the provided track layouts for his train set, he wanted to create his own and design layouts with hills and curves, understanding conceptually that hills had to be the right height so that the train can go over it and not get stuck and curves couldn't be too steep or else it fell off the track. Not only did he enjoy learning how something worked, he liked to explain it to others, which deepened his understanding even further. His sense of accomplishment and pride has always been visible in his face and demeanor when concepts click.*

### **Faculty/Staff**

*It's just like a passion for anything else; it's something that's embedded in you, and something you seem to have infinity for. I don't think there is a good way to get a handle on where it comes from or how it develops. I think it could possibly be something we saw earlier on. I remember in kindergarten and my science teacher showed us how to spread bubbles and use a straw to blow the bubbles. That was my first encounter with science and I still remember it many years later. It's probably something that they were exposed to as a child that stuck with them. As they develop, they probably noticed an aptitude, ability, and a passion for the science they are pursuing.*

The third theme to emerge that motivates gifted and talented Black and Latino students to engage in STEM is the idea that STEM is a prominent progressive field that will guarantee career and financial stability and in some instance lead to a healthier environment, as indicated in the comments below:

**Student**

*I think my motivation is knowing that if I do stay in STEM, which is something I love doing and love learning about, I can have a stable future. I think all of the professional opportunities are really rewarding in the STEM field and that motivates me.*

**Parent**

*I think that his motivation is because he wants more out of life and our goal with him has always been to be better than us and not like us. We both graduated from college, but we wanted him to go further, so we always motivated him to be the best that he can be and there is no excuse to why he can't do anything. We always taught him honesty, commitment; if starts something he has to finish it and I don't care what it is whether it be school work, sports, volunteer work, you don't start it and say in the middle I'm quitting, there's no quitting.*

**Faculty/Staff**

*People do things for extrinsic and intrinsic reasons, but my area of research is motivation...If they are coming from the inner city of Chicago or a rough area, metro east, or East St. Louis they want to get out of there. Them getting out of there intrinsically motivate them, but also extrinsically motivates them.*

The fourth theme to emerge is learning in which learning in general, but especially STEM learning is a source of STEM motivation in gifted and talented Black and Latino students, as reported in the comments below:

**Students**

*I guess one of my personal motivations, the thing I find the most enjoyment out of is making connections between all the different things I'm learning in school and all the different subjects. I'm just really interested in learning and like I said before I like making connects not just between subjects but also the real world. It's just something that entertains me I guess, it's something that I find really intriguing.*

*I've always wanted to learn more and do more and really challenge myself and see what I'm capable of. So I think with STEM that's a big thing, because there's always something new. Like with biology*

*there's always more detail, it never ends, you get smaller and you get microbes and you get smaller and smaller and smaller and smaller; so there's always more detail to learn and always more to challenge yourself with so I think for me that's a big part of it. And especially with math too, there's always more, you started in algebra and now its calculus and now the next thing multivariable calculus and graph theory or there's all of these different sectors of it and it's the investigation and pushing yourself to see what else you could learn.*

**Parent**

*My perception is that, in my son, I think that he is motivated from within, so he tends to question things, things about life, how things work, why things are the way they are; just that curiosity that really plays a big role I believe in science, engineering and technology because the way I perceive STEM, I perceive STEM to be at the ground level individuals who are engaged in that, like my son they want to find ways to basically improve life and improve the function of life, so that inquisitive nature plays a big role.*

**Faculty/Staff**

*Their intrinsic motivation comes from their confidence, knowing and learning and wanting to learn more, but it is also when they are successful. When they are successful, then they want to do more. Examples of that would be students at IMSA go up against a teacher that they feel that they never could communicate with or that teacher will never listen or help me. Once they realized that the teacher is there for them, and willing to help and guide them. The teacher is there to work with them or sometimes banter with them. Then I believe that is when the tables turn a little bit. Confidence is built, and that they are finding success. It's also that sometimes it is fun. Sometimes I see the students doing different experiments with different peers which look like they are having a lot of fun. I think that's where it comes from. IMSA students study STEM and their intrinsic motivation is also the fact that they know they could do and that it is something else out there. There is something beyond what is in their community. For others, it's there because they want to be better or learn.*



The fifth theme to emerge that motivates gifted and talented Black and Latino students to engage in STEM is to solve problems that advance humanity through methods such as improving the environment, helping the disadvantaged, and discovering phenomena as evident in the following remarks.

### **Students**

*I think my main motivation is really helping others. I really want to learn more about biology, like I want to be a doctor, so I think my main motivation is to be just be able to go out in third world countries and be able to help out a little more. You know that's really been my motivation basically throughout high school because I want to go out there and help people.*

*I think for me since I was little I would look around and I honestly think the world was made so beautiful and I think biology for me is the way to figure out and harness that. For me it's about the problem solving and finding the problems and connecting the dots and everything that I really like, the investigation aspect of it.*

### **Parent**

*I believe my daughter became engaged in STEM after taking biology class during freshmen year. After realizing that biology is a field that continues to make discoveries and advances, she set out to learn more. She wants to provide something more for the world, whether it's being a neurosurgeon and figuring out how to operate on butterfly tumors or whether it's being a microbiologist and discovering the cure for malaria. She loves biology because it's filled with facts and knowledge she can build on. She is motivated because she knows her hard work now will lead to something better in the future.*

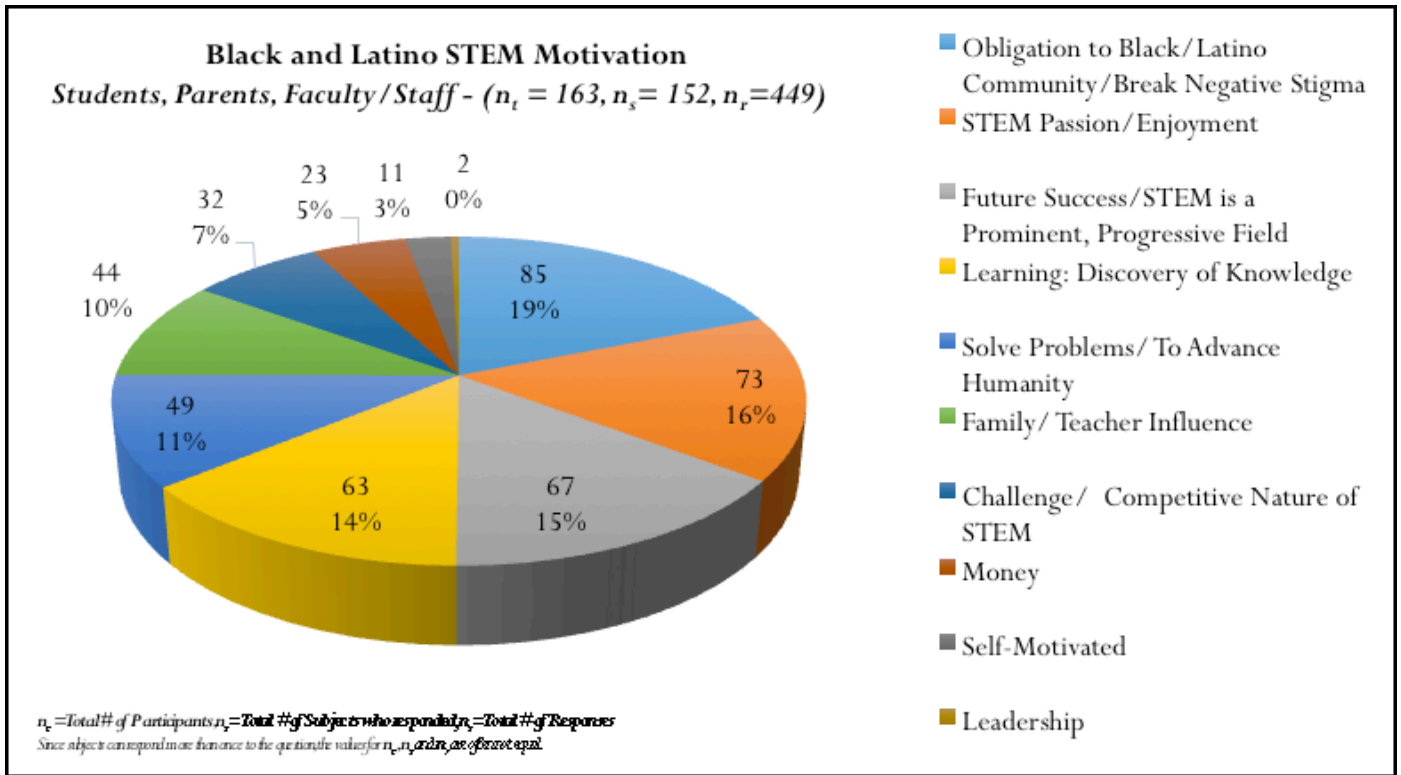
### **Faculty/Staff**

*Courses like MSI [Methods in Scientific Inquiry] do a lot to intrinsically motivate students because they gain experience doing research, see the satisfaction having their research/inquiry questions answered, or design experiments based in things that they are interested about... IMSA provides a lot of unique learning activities in relation to STEM. The sophomores enter IMSA and take the MSI [Methods in Scientific Inquiry] class that allows them to be involved with the process of science. Most students are turned off to science because they spend a lot of time learning about science history and don't get involved in the process of science. Some science classes are heavily focused on content and material. They don't give students the opportunities to come up with an*

*interesting inquiry question, design an experiment or observational study to answer that question, collect data, run analysis, draw conclusion based on information collected, and generating a written paper that summarizes your study or what you found. Going through that process does a lot in intrinsically motivate all students.*

Additional themes to emerge include family/teacher influence, challenge, money, self-motivation, and leadership. The participants discussed the intricate role that family and teachers played in motivating STEM engagement. They further discussed that although STEM can be challenging and at times competitive, it assisted in their motivation to engage in STEM. These participants understood the financial stability that comes along with entering a STEM career which further motivated their engagement in STEM education. Some suggested that Black and Latino students have this innate ability to self-motivate, which is directly connected to their motivation to engage in STEM. Finally, there was discussion about the connection between leadership and STEM motivation. When Black and Latino students' leadership skills are developed within and beyond the STEM classroom, their motivation to engage in STEM is enhanced. What follows is a snapshot of the frequency of responses on the factors that motivate gifted and talented Black and Latino students to engage in STEM education.





Since all study participants were affiliated with IMSA, they were asked the question, “How has IMSA further contributed to motivation of gifted and talented Black and Latino students to engage in STEM?” The participants discussed having enhanced intellectual and social interactions as a result of the culturally and intellectual diversity that makes-up the academy as a STEM motivator. They further discussed the combination of a challenging curriculum and a collaborative support group that contributes to enhanced motivation to engage in STEM education. The residential nature of IMSA contributes to this motivation because there’s immersion in STEM inside and outside the classroom—opportunities to take a wide range of STEM courses, the ability to conduct research, actually solving the world’s problems, and the development of self-realization through independence. Although the majority of participants reported that IMSA positively contributed to their motivation to engage in STEM, there were some who reported that IMSA actually hindered that motivation for some of the following reasons: they realized they were not that good at STEM, discovered other passions, or they lost their enjoyment for STEM. Despite this hindrance, these participants reported utilizing the scientific process in their everyday lives, which further suggests the importance of having a STEM education background. Below is a snapshot of the frequency of responses related to IMSA’s contribution to gifted and talented Black and Latino students’ motivation to engage in STEM education.

This article has presented evidence demonstrating a racial STEM divide in education and careers while demonstrating that despite this divide, gifted and talented Black and Latino students enrolled at the Illinois Mathematics and Science Academy are engaged in STEM education, plan to major in STEM, and ultimately enter STEM careers. They are motivated by an array of factors, from their obligation to their respective communities, to wanting to advance humanity, as well as the discovery of knowledge and STEM learning. Being enrolled at IMSA has further contributed to that development. Although the residential aspect of IMSA cannot be completely replicated, the participants in this study have provided diverse and informed perspectives related to not only motivating more Black and Latino students to engage in STEM education, but also addressing the racially-based STEM divide. This study definitely suggests yes, STEM is for all! Based on the collective responses of 163 diverse perspectives, the following 5-step approach is put forth to motivate Black and Latino students to engage in STEM education and ultimately enter a STEM career:

## 1. Early STEM Exposure

The earlier Black and Latino students are exposed to consistent STEM learning experiences throughout their academic careers, the more likely they are to develop the necessary skills for STEM education. This engagement needs to be nurtured which will ultimately enhance their passion for STEM. In doing so, they will instill a future vision for themselves that involves STEM. This early STEM exposure should incorporate culturally responsive pedagogy so that students view STEM as something that is part of their everyday lives, and not something that is challenging or atypical in the Black and Latino communities. It should also integrate experiences in which students learn about the diversity of careers and the financial gains from entering those respective areas of STEM. Finally, there must be a bilingual parent education component in which parents learn how to support their child in their STEM endeavors, are provided with affordable STEM resources, and expose parents to their own STEM learning.

## 2. IMSA as a Model

There are components of IMSA's approach to teaching and learning that are essential to STEM motivation for Black and Latino students. For one, the Black and Latino students should interact with both culturally and intellectually diverse individuals, allowing the them to learn from each other, hear diverse perspectives, and be collaborative. The curriculum should immerse the students in STEM, introducing them to an array of potential STEM careers. In addition, the teaching

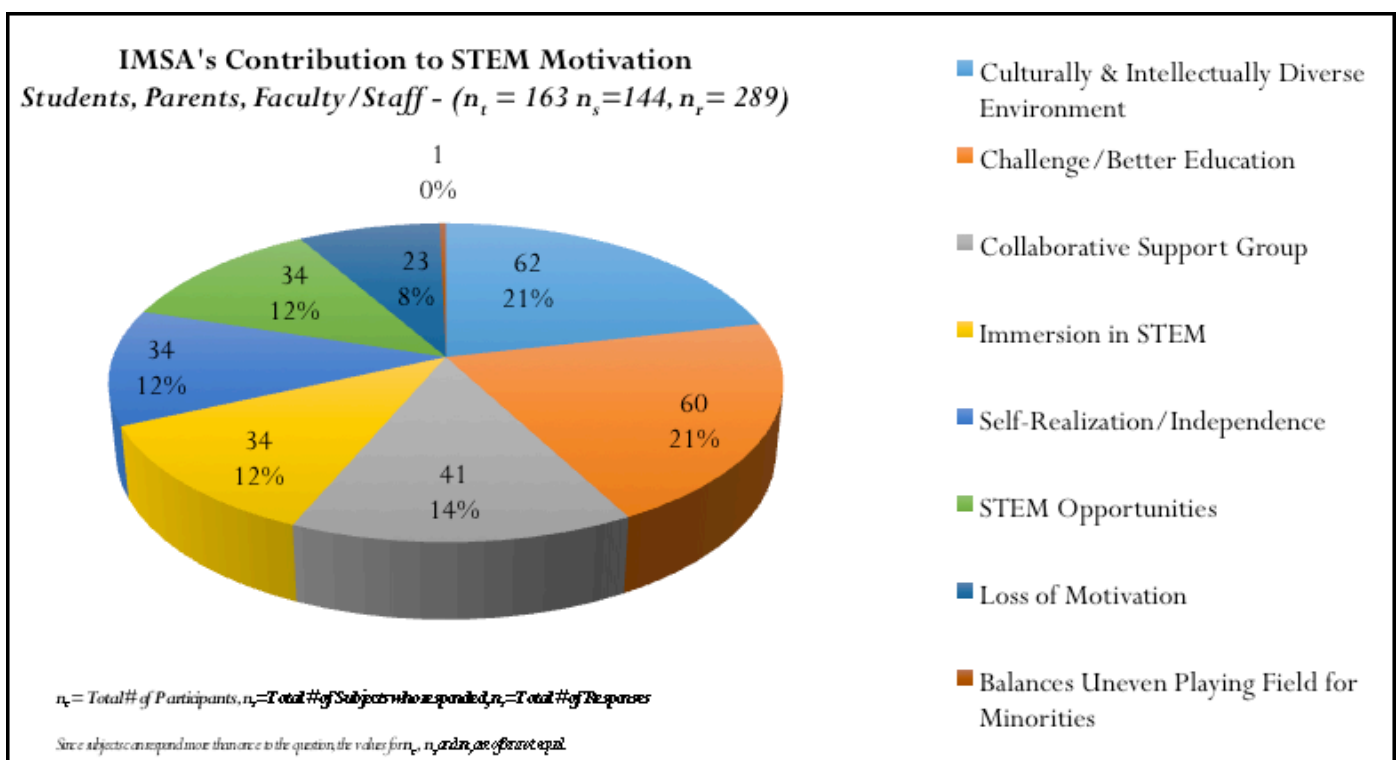
and learning should be exploratory in nature in order to mold the students into inquiry-based thinkers. The activities should include realistic problem-solving elements that promote participant collaboration and support. The students should work with Black and Latino mentors engaged in STEM who help and encourage the students 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 and Latino news and issues. This allows Black and Latino students to understand the issues that impact their respective communities which would nurture their obligation to their culture and the world. A heightened state of awareness would occur, which will help them understand themselves; who they are as students, how they think and learn, and then discover what is important to them. This process not only builds self-confidence and promotes resilience, but also helps create a positive identity as Blacks and Latinos engaged in STEM.

## 4. Personalized Assessment and Evaluation

Black and Latino Students should be regularly assessed from a strengths-based rather than a deficit-based model in order to understand and build upon their strengths; then personalized evaluations should be created to inform the development of their abilities. These evaluations should be discussed with each stu-



dent, focusing on and encouraging a growth mind-set. This will lead to self-realization and the development of a positive self-concept that will help combat negative stereotypes. Furthermore, an aspect of this evaluation should be focused on projects in which students with a diversity of strengths work to solve a problem collaboratively. This process of personalized assessment and evaluation will ultimately lead to the development of both a teacher-to-student and peer-to-peer support system.

## 5. STEM Leadership Development

The STEM areas in which the Black and Latino Students have demonstrated strength need to be complemented with a STEM lesson led by the student that has a problem-solving component. Opportunities to lead STEM research projects that advance humanity should be provided. Leadership opportunities outside of STEM are also important for leadership development and skill application. This will allow them to develop leadership skills needed to be successful STEM leaders in a global world.

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