

IS STEM FOR ALL? Perspectives of Black and Latino Students on STEM Motivation

By Adrienne Coleman and Kayla Ingram

Is Science, Technology, Engineering, and Mathematics (STEM) truly for all? According to the literature, it is rare to find gifted and talented Black and Latino Students who are engaged in STEM (C. G. Wright, 2011; LSA, 2005; Scott, 2010; Speight & Weatherspoon, 2009). They are virtually invisible in these majors and careers. While Caucasians and Asians view STEM careers as a world of opportunities, Blacks and Latinos see them as challenging and inaccessible (The Center on Education and Work, 2008). This results from a lack of exposure to STEM in K - 12 education, mathematics phobias, 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 (Flores, 2007; PEW, 2005; Scott, 2010; QEMN, 2010). Black and Latino students tend to pursue familiar areas, such as the arts or athletics where they are sure they can excel because their role models have excelled in those areas already (Schlesinger, 2005).

When Black and Latino students from the Illinois Mathematics and Science Academy (IMSA), a residential high school for students gifted in mathematics and science, were asked *why a STEM gap exists*, they stated that many Black and Latino students lack a STEM vision for themselves and have not been exposed to these fields. This is a result of being in under-resourced schools, being stereotyped, and being more exposed to non-STEM areas; as evident in their comments below:

Black Male: So before I came here, I came from a selective enrollment school in Chicago so one of the better schools in Chicago and predominately Black and students were motivated. Their parents were motivating them to be great and do great things in life; but the big thing in that school was the arts. Students were getting \$20,000 scholarships to the Art Institute of Chicago, that's the direction we were going. And I think that's what's popular in our culture, the arts and humanities, because that's what we have as a Black community; that is part of what we give back and that's part of how we continue to thrive. I don't think it has to do anything with motivation; it's about what we have and who we are as a people.

Black Female: I feel like our education system isn't leveled like it should be. A lot of what you get in school is based on your zip code. Unfortunately a lot of black and Latino students are in schools that don't provide them with enough resources or they don't have the budget or they are just living in not the best environments. Going along with us being minorities, it also hinders how many of us are in these fields. I feel like if kids were exposed to everything as their Caucasian and Asian peers then, you would see an increase

in STEM. Because a lot of kids love science because there are no boundaries to it, you know. You can blow up something and you can just be yourself. So that is why I feel like, it's not that many of us in STEM field.

Latino Male: I think one of the big things, definitely, I think we also touched on is the environment in which these Hispanics and African American students live in. There are resources in the communities that Hispanics and African Americans that aren't necessarily affluent or rather more poor. I think that definitely contributes to it just because they can't pursue STEM because it's just not a possibility. And if it is, it's not easily accessible. And another thing is historically, I feel like African Americans and Hispanics have been affiliated with things that aren't academic, like gang affiliations and different stereotypes of that variety which makes it easy to go along with the stereotypes because I'm not expected to do anything else. So that's definitely one thing that I think is a big contributor because historically they aren't expected to do anything.

Latino Female: So I think the common thing throughout what we are going to be discussing is in terms of information and how knowledgeable the student is in terms of if you're Latina you are given, since you were young, a stereotype based off of which race you were. I feel like that's a really big thing because studies have shown that kind of changes your sense of motivation, your priorities, so say they, "Oh Hispanics don't do that well in STEM education," well if you're badgered with that stereotype, that start to feel like "Oh well what if they are right," what if you don't really feel comfortable in this situation because people keep on putting you down. So I feel like a very big component and especially in this institution, it's kind of the knowledge and de-establishing the hype of stereotypes.

Although this STEM gap exists, Black and Latino students currently enrolled at IMSA, suggest STEM is for all. They are motivated to engage in STEM, and they plan on majoring in STEM as well as entering STEM careers. These 45 students were asked "What factors do gifted and talented Black and Latino students 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 trends that all students agreed upon include: **personal drive to learn, obligation to Black and Latino community in an effort to break negative stigmas about Black**

and Latino students, and solve problems to advance humanity.

Consistent with the literature on motivation, these trends demonstrate that these students are motivated to engage in STEM because they feel obligated to give back to their community and ancestry that provide them with the opportunities they have with hopes of contradicting negative stereotypes and breaking stigmas about their race/ethnicity. Their motivation also originates from their personal drive to learn more of the subjects they are interested in and this curiosity inspires them to solve real-world issues in order to advance humanity. The factor that is new and contributes to literature is Black and Latino students' motivation stems from their aspiration to solve problems in order to advance humanity.

For these students, their motivation is simply about the acquisition of knowledge; learning and discovery of new information impelled them to engage in STEM. They discussed their desire to want to know everything and how there is so much information to know as evident in some of their comments:

Black Male: It's not so much motivational, but I do want to find out as much as I can. But I fell into STEM education; there's something unique about it that is not really relevant or apparent in any other aspects of learning. There's this knowledge that no matter how much you know, you will never know all of it; so being part of STEM education drives me to know. . . . It's inspiring to know that I'll be finding new things possibly, but there is always more to know.

Black Female: I have developed a passion for biology specifically and for the medical field and microbiology both. So what my motivation at this point is just getting through whatever else will get me to a place where I can really pursue that passion and develop it and eventually, I've always had that childish dream of "I want to save the world with learning" so just kind of see what the abilities I've been given what I can do to help out with them so just being able to pursue that passion and being able to see where I can take it.

Latino Male: I think that STEM still has the most unknown attached to it. We know a lot of basic math, we know a lot of basic scientific concepts but it's always evolving. And I think with a lot of other fields we kind of hit our peak or at least it's not as evident when you make a change. With reading and writing and things like that, that's kind of set in stone. You're going to learn new techniques as you grow older but if you look at the past fifty years even a hundred years some of the basic strategies with that stuff, it hasn't changed. But STEM has evolved so dramatically and it has the potential to evolve so dramatically and . . . it is fundamental in just about everything we're doing because it's so unknown. You know if you're going into STEM you're going to find some area of importance, you're going to find some way to apply it to your life because there's

so much that is available to you. Whereas other fields are kind of closed off.

Latino Female: I think something that has helped me throughout my entire education, ever since I was a little girl. I think what has helped me is that I am very energetic. As in I can't sit still. Whenever I do not do anything I feel like I am worth nothing. I feel like I always have to be doing things, I would say I am antsy. That has driven me to be involved in activities and when it comes to school, learning. I can't just sit there and waste time so essentially what I do is get the most I can with the time that I do have do not like to be bored I like to do things and school I like to learn things and seek more out of it so very curious along with antsy. So that has helped me when I am in school to make sure I am focused and I am doing worthy of my time and do things right and I am learning the subjects that I should be learning and then the curiosity has driven me further more as a high schooler now to make sure that I have understand what I need to understand and learning what I need to learn, that has helped me.

Besides a personal desire to learn, the Black and Latino students also are motivated to engage in STEM by their obligation to the Black and Latino community to break negative stigmas. These students believed that their ancestors and parents worked hard to ensure they received a good education; thus it became their responsibility to be successful. They also believed that negative stereotypes exist in society that suggest they don't value education. Thus, the students' motivation to engage in STEM lay in proving society wrong and breaking those negative stigmas as the following comments show:

Black Male: I feel like a big external motivator is to break negative stigmas about the African American male population; to put myself out there in a position in which I know other young African Americans who are younger than me can see what I'm doing and know that they can do it as well. And not only African Americans but other cultures as well; especially Caucasians so they know African Americans are just as good as they are, and I feel like for me to be successful I need to be in a position where I can represent my population.

Black Female: It's more of an obligation and not necessarily to anyone around me, but to my ancestry. As I have gone through my education and gotten older, the struggle of African Americans in America has grown more and more important to me as a person; and I feel like the opportunities that I'm offered no matter how good or bad they are, they are education. The more that I am offered these opportunities and I know I need to do well because the people before me did not have these opportunities, and they paved the way to make sure I did have these opportunities.

So when I do get the chance to learn something new, I take it as chance to take advantage and appreciate what other people have done for me. When I get out into the world I know that what I'm doing was someone else's dream. I know that the work that I am doing and the knowledge that I have is because someone worked for me.

Latino Male: A big thing for me is I want to be able to give back to my community and give back to the people who gave to me. Specifically, my parents, I want to be able to support them when they can no longer support themselves because they're old or whatever. I want to be able to give my children, not only the same but better opportunities. And I want to be someone who, not only kids but anyone can look up to, I guess going back to the role model thing. Not only do I strive to be like my role models but I want to be a role model, one day. I want to be somebody that people can look up to so they can say, "I could do that."

Latino Female: I say that my drive would be the, like whenever I was in middle school my mom would be like "si se puede" which is "yes you can" "yes I can" stuff like that and that's always been in my head since that time because she would be like "oh, look at how hard your dad worked for all five of you even me" even her, because my mom has like carpal tunnel so she can't really work right now in the moment. She has I believe seven years without working and my dad has been working ever since they both got married. I feel like I can do anything I set my mind to. And my dad says the same thing, "si se puede" "you can do that, you can see how hard I've worked" and like him telling me that he doesn't care as much as like how hard he works or how much his back hurts, cause he has back issues stuff, if his back goes out or anything or that sort of stuff, he doesn't care for it, because he says that he knows we will take care of him, that what I like. To have them rest and know that we did well. They worked so hard to get us to get to the right path, to get us like, more out there to have that opportunity as they did growing up.

This obligation to the Black and Latino communities, especially family, has been a significant factor of motivation for these students to engage in STEM.

An additional factor of motivation that has not been evident in professional literature is to solve problems in order to advance humanity. The students want to accomplish this by addressing the vital questions of this world. The interesting aspect of this factor is that it is consistent with the mission of the Illinois Mathematics and Science Academy: "The mission of IMSA, the world's leading teaching and learning laboratory for imagination and inquiry, is to ignite and nurture creative, ethical, scientific minds that advance the human condition, through a system distinguished by profound

questions, collaborative relationships, personalized experiential learning, global networking, generative use of technology and pioneering outreach." This suggests that not only are the students interested in real life problem-solving, but also that IMSA's mission has contributed to STEM development and motivation in Black and Latino students:

Black Male: During my junior year I worked in a lab at the University of Illinois, Chicago, doing research on prostate cancer. I was surprised to learn that Black men had the highest prostate diagnostic rates. Throughout my experience I focused my work on molecular and cellular biology. I was reading articles and running statistical analysis to find out why Blacks are at such a disadvantage of prostate cancer. That motivated me throughout the summer and the next year I did more research and overall my lab manager, the professor, and all others that worked with me guided me towards STEM. That and my parents pushing me towards hard science motivated me to try to accomplish something that would benefit a large amount of people.

Black Female: Seeing other people, not being able to help in this whole health care thing, I think that's the outside factor that really pushes me to go into medicine. I don't have an idea of what I want to do to help them right now but I know I want to do something. So that, women especially would be able to get good health care, while they are pregnant and they know the right person is taking care of their babies.

Latino Male: I think that STEM education is kind of, not necessarily the content, but the way you have to learn when you study like science, math, technology and all that good stuff the way you learn the connections you make, sets you up to solve problems which is what you're eventually going to have to do. That's the goal, that's what you do when you're older, you solve problems. Regardless of what those problems may be that's what you're doing, you're solving problems. Studying STEM sets you up to solve those problems. It teaches you how to solve those problems. It teaches you how to think about things at a lot of different angles. That's why studying STEM it prepares me with what I want to do with my life even if what I want to do doesn't have to with STEM.

Latino Female: I think what motivates and what keeps me going, especially when I get down is my willingness to help other people and make a difference. That is the one reason I wanted to become a doctor is because I wanted to help people so it keeps me going if I understand the material and I can just accomplish at least one thing then I can help others do it too and I can make a difference by know that other people can do it just as well or

even better than me. What keeps me motivated is the fact that I can help people examples will be not only in the working but also in the service trips that IMSA has even the small trips like shoveling snow you can save some from falling on the ice and dying. Something as simple as that is keeps me going knowing that I made a difference somehow. That keeps me motivated to get better grades so that I can become a doctor so that I can help people and that what I love doing and I know that's what I want to do for the rest of my life.

STEM is definitely for all! Even though some of the literature suggests that many Black and Latino students are not motivated to engage in STEM; students at IMSA have disproven those findings. So educators, if you want to motivate Black and Latino students to engage in STEM, follow the 5-Step program below:

1. Early STEM Exposure

- a. The earlier Black and Latino students are exposed to STEM learning experiences and are consistent throughout their academic careers, 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 awareness for it.

1. IMSA as a Model

- a. There are components about IMSA's approach to teaching and learning that are essential to STEM motivation for Black and Latino 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. 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 them to solve problems and advance humanity, further enhancing the STEM vision.

2. Historical and Current News/Issues Discussion

- a. 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 societal perspectives which would nurture their obligation to their community and the world. Awareness of themselves and those around them will grow which could entice their desire to develop as students. Recognizing this could increase their ability to understand themselves: who they are students, how they think and learn, and what is important to them. This process not only builds self-confidence but promotes resilience.

3. Personalized Assessment and Evaluation

- a. Black and Latino Students should be regularly assessed to understand their strengths and weaknesses; then personalized evaluations should be created to emphasize their strengths and inform the development of strategies to 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 some success in certain areas will ultimately help build self-confidence and enhance the students' awareness of areas that need improvement. This enhances the will to do better amongst the Black and Latino students. Furthermore, it establishes a support system for the student with the teacher because the teacher will intimately know what each specific student needs to progress.

4. Leadership Opportunities

- a. The STEM areas in which Black and Latino students have demonstrated strengths need to be complemented with problem-solving activities where they can

lead. Then the students should be provided with leadership opportunities outside of STEM and encouraged to be versatile. This will allow them to develop leadership skills needed to be successful STEM leaders in a global world.

The following tables show a comprehensive perspective of gifted and talented Black and Latino students currently attending IMSA, thoughts of why a STEM gap existed, why they engaged in STEM, what their STEM motivation was, and how they would motivate other Black and Latino students to engage in STEM:

*Table 1
Gifted and Talented Black Male Motivation (n = 20)*

Why a Black/Latino STEM Gap	Why STEM for Gifted and Talented Black and Latino Students	Gifted and Talented Black/Latino Student STEM Motivation	IMSA's Contribution to STEM motivation	Motivate Black/Latino Students to Engage in STEM
Lack of STEM vision, <i>n = 6 (30%)</i>	Enjoy STEM, <i>n = 5 (25%)</i>		<i>Enhances Motivation,</i> <i>n = 11(55%)</i>	More Black Males as Mentors & Role Models <i>n = 5 (25%)</i>
Lack of parental support <i>n = 6 (30%)</i>	Good at STEM, <i>n = 4 (20%)</i>	Learning: Discovery of knowledge, <i>n = 10 (50%)</i>	-Immersion in STEM -Challenge -Diverse Environment -Self-awareness	Early STEM exposure, <i>n = 1 (5%)</i>
Negative stigma of/misperception about Black males, <i>n = 3 (15%)</i>	STEM is a prominent, progressive field, <i>n = 3 (15%)</i>	Solve problems/to advance humanity, <i>n = 9 (45%)</i>		Nationwide STEM intervention for Black males, <i>n = 1 (5%)</i>
	Solve problems/to advance humanity <i>n = 2 (10%)</i>	Money, <i>n = 7 (35%)</i>	<i>Hinders Motivation,</i> <i>n = 2 (10%)</i>	Educate parents, <i>n = 1 (5%)</i>
	Pursuit of scientific knowledge <i>n = 1 (5%)</i>	STEM is a progressive field that leads to future success, <i>n = 6 (30%)</i>	-Loss of STEM enjoyment -Realization of not being good in STEM -Competing with other students in STEM	
		Competitive nature of STEM, <i>n = 6 (30%)</i>		
		STEM Passion/Enjoyment, <i>n = 5 (25%)</i>		
		Obligation to Black community/break to negative stigmas about Black males, <i>n = 4 (20%)</i>		

Table 2
Gifted and Talented Black Female Motivation (n = 11)

Why a Black/Latino STEM Gap	Why STEM for Gifted and Talented Black and Latino Students	Gifted and Talented Black/Latino Student STEM Motivation	IMSA's Contribution to STEM motivation	Motivate Black/Latino Students to Engage in STEM
Negative Stigma of/Misperception about Black and Latino students <i>n = 4 (44%)</i>	Enjoy STEM, <i>n = 6 (60%)</i>	IMSA, <i>n = 11(100%)</i>	<i>Enhances Motivation,</i> <i>n = 11 (100%)</i>	Early STEM Exposure <i>n = 3 (60%)</i>
Lack of STEM vision for themselves, exposure to STEM, <i>n = 3 (33%)</i>	Future success <i>n = 2 (20%)</i>	Future Success <i>n = 8 (73%)</i>	–Immersion in STEM –Challenge –Diverse Environment –Self-awareness	Improve Curriculum by making it more fun and relatable <i>n = 1 (20%)</i> Improve racism in school system <i>n = 1 (20%)</i>
Lack of parent support, <i>n = 3 (33%)</i>	Solve Problems/To Advance Humanity <i>n = 1 (10%)</i>	Solve Problems/To Advance Humanity <i>n = 7 (64%)</i>		Educate them on future STEM benefits <i>n = 1 (20%)</i>
Unaware of future STEM/benefits <i>n = 3 (33%)</i>	Parents Support <i>n = 1 (10%)</i>	Personal Drive to learn and be successful <i>n = 6 (55%)</i>	<i>Hinders Motivation,</i> <i>n = 0</i>	
There is no gap <i>n = 1 (11%)</i>		Obligation to Black Community/Break to Negative Stigmas about Black students <i>n = 7 (46%)</i> Money <i>n = 2 (18%)</i> STEM Passion/Enjoyment <i>n = 2 (18%)</i> Contentment <i>n = 2 (18%)</i> Good At It, <i>n = 1 (9%)</i> Challenge <i>n = 1 (9%)</i> Instilled Values <i>n = 1 (9%)</i>		

Table 3
Gifted and Talented Latino Male Motivation (n = 5)

Why a Black/Latino STEM Gap	Why STEM for Gifted and Talented Black and Latino Students	Gifted and Talented Black/Latino Student STEM Motivation	IMSA's Contribution to STEM motivation	Motivate Black/Latino Students to Engage in STEM
Negative Environment / lack of community support, focus is on supporting family not education n = 3 (60%)		IMSA, n = 5 (100%)		
Lack of parental support n = 6 (30%)		Obligation to Latino Community/Break Negative Stigmas about Latinos n = 4 (80%)		
Negative stigma of/misperception about Latino Students n = 2 (40%)			Enhances Motivation, n = 5(100%)	
Parents are flexible giving child freedom to decide future n = 1 (20%)		Seeks Parental / Familial Approval, Parental / Familial Support n = 3 (60%)		
Lack of STEM vision for themselves, exposure to STEM n = 1 (20%)				Organizational Support / public program to help families n = 2 (40%)
	Solve Problems/To Advance Humanity n = 3 (60%)	Solve Problems/To Advance Humanity n = 2 (40%)	-Immersion in STEM -Challenge -Diverse Environment - Balance the "uneven playing field" for minorities	More Black and Latino Professionals as Mentors & Role Models n = 1 (20%)
	STEM is a Prominent, Progressive Field, Fundamental for everything n = 3 (60%)	Want to be like role models / wants to be a role model n = 2 (40%)		Early STEM Exposure n = 1 (20%)
	Future success n = 2 (40%)	Personal Drive to learn and be successful n = 2 (40%)		STEM Encouragement n = 1 (20%)
	STEM Application to real-world occurrences n = 1 (20%)			Demonstrate STEM is necessary n = 1 (20%)
		Competitive Nature of STEM n = 1 (20%)		

REFERENCES

Center of Education and Work. (2008). *Increasing STEM retention for underrepresented students: Factors that matter*. Retrieved from www.cew.wisc.edu.

Flores, A. (2007). Examining disparities in mathematics education: Achievement gap or opportunity gap. *The High School Journal*, 91(1), 29 – 42.

Pew Hispanic Center (2005). *Hispanics: A people in motion*. Retrieved from <http://www.pewhispanic.org/files/reports/40.pdf>.

Latino STEM Alliance (2005). *The Challenge*. Retrieved from <http://www.latinostem.org/about-us/lsa-overview>

Quality Education for Minorities Network (2010). *Spring 2010 workshop on the recruitment and retention of African American male students in science, technology, engineering*

and mathematics (STEM). Retrieved from [http://www.qem.org/African%20American%20Males%20Report\[5\].pdf](http://www.qem.org/African%20American%20Males%20Report[5].pdf)

Schlesinger, R. (2005). Better myself: Motivation of African Americans to participate in correctional education. *Journal of Correctional Education*, 56 (3), 228 - 252. Retrieved from <http://www.jstor.org/stable/23282589>.

Scott, A. (2010). Dissecting the data: The STEM education opportunity gap in California. Retrieved from http://www.lpfi.org/sites/default/files/dissecting_the_data_-_stem_ed_opportunity_gap_lpfi_report.pdf.

Speight, S. L., & Witherspoon, K. M. (2009). An exploration of African Americans' interests and self-efficacy beliefs in traditional and nontraditional careers. *Journal of Black Studies*, 39 (6), 888 - 904. Retrieved from <http://www.jstor.org/stable/40282605>.

Wright, C. G. (2011). Seeing as sound travels everywhere: African American boys learning to see transmission through the analysis of invented representations. *Journal of African American Males in Education*, 2(1), 81-97.

Adrienne Coleman possesses a Doctorate in Educational Leadership from Argosy University and a Master of Science Degree in Health, Physical Education and Recreation with an emphasis in Health Education as well as a Master of Science in Educational Administration and Foundation with an emphasis in College Student Personnel Administration both from Illinois State University. Currently, she is employed at the Illinois Mathematics and Science Academy (IMSA), a three year residential high school for gifted students, as the Multicultural Education Specialist. She previously worked at Rutgers University as a Program Development Specialist and at Illinois State University

as a Health Educator. Adrienne has served as an AmeriCorps member and has been part of the United States delegation team to assist Moldova (Eastern Europe) in addressing issues of human trafficking and inadequate health education. Her areas of interest include public health, social justice/diversity education and higher/gifted education. She hopes to continue providing educational and enrichment opportunities, specifically math and science related for youth from underrepresented populations.

Kayla Ingram, Student Inquiry and Research Student

Kayla Seymone Ingram is an alumnus of Illinois Math and Science Academy that graduated in May of 2014. During her senior year, she completed an on-campus Scientific Inquiry Research project on the motivational factors of gifted and talented Black and Latino students engaged in Science, Technology, Engineering and Mathematics with the intention of complementing her advisor, Dr. Adrienne Coleman's, dissertation, An Exploration of the Factors that Motivate Gifted and Talented Black Males to Engage in STEM. Her hope is that more Black and Latino students in future generations will participate in STEM education and excel in the careers. Currently attending Hampton University in Hampton, Virginia, she is studying biology and psychology to pursue her career of being a forensic neurologist.

The Illinois Mathematics and Science Academy

1500 Sullivan Road – Aurora, IL – 60506

630-907-5079

630-907-5062, fax

acoleman@imsa.edu

