

The Voice of One to the Voices of Many: The Story of a Black Girl in STEM

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Abstract

In this article, I take the reader along on my journey as a professional Black woman from Queens, New York, who chose a career in science, technology, engineering, and mathematics (STEM) and education. In this paper, I identify many parallels in the experiences of four students engaged in STEM, through the lens of culturally responsive and sustaining education. I then discuss how these four teenage girls' individual experiences and thoughts converged, due to their participation in a STEM-based summer program. In this narrative, readers will discover how curiosity about STEM, along with sufficient education, determination, and support, can impact the lives of girls, their families, and communities. It also shines a light on the polarization experienced by Black girls and women in education. In the paper, I also reflect on and advise how girls and young professionals can utilize tools and influential people to embrace cultural differences, establish multiple measures of success, and focus on individual ability in order to sustain the stamina and rigor needed to pursue a career in STEM and education.

Keywords: Black and Brown girls, STEM, mentorship

Introduction

The journey of a Black or Brown girl in science, technology, engineering, and math (STEM) is a significant experience, but a story not often told or widely shared. Through storytelling and authentic conversations, we can find support, commonalities, and the energy to extend our early curiosity to achieve a meaningful career in STEM. At the time of writing this article, I was the senior manager of Youth Leadership and Alumni Programs at the Intrepid Sea, Air & Space Museum. In this paper, I explore three components of the culturally responsive and sustaining (CR-S) approach to education as they relate to my own journey, and to the experiences of four alumni of Greater Opportunities Advancing Leadership and Science (GOALS) for Girls, a STEM-based summer program that I co-founded at the museum. As outlined by the New York City (NYC) Department of Education (2021) and the New York State Department of Education, the three components of CR-S are (a) to build strong connections with students and strive to understand their lives, backgrounds, and identities (Howard, 2001); (b) to create emotionally safe spaces and foster trust among students, nurture their identities, and give them a sense of ownership and belonging (King & Pringle, 2019; Ong et al., 2018; Smith, 2016; Solórzano & Yosso, 2002); and (c) to encourage students to interrogate and leverage their personal experiences, while learning from historically marginalized voices to challenge inequitable systems of power and privilege as agents of positive change (Basu & Barton, 2007; Young et al., 2019).

Through separate conversations with Goongoon, Treazure, Madison, and Amrita, four alumni of different summer cohorts of the GOALS for Girls Summer Intensive (GGSI) program conducted virtually in 2020, I align my experience with theirs and identify shared patterns. GOALS for Girls, now in its 13th year, is currently supported by the Motorola Solutions Foundation, ConEdison, the Institute of Museum and Library Services, Craig Newmark Philanthropies, and the NYC Department of Cultural Affairs. The program's mission is to promote awareness of STEM opportunities for middle and high school girls in NYC and nurture their leadership and social skills, offer paid school-year-long internship-mentorship opportunities for program alumni, and host free, inclusive youth and family events throughout the year in STEM and youth development with cultural institutions and industry leaders.



CHARLOTTE ARZOUIAN, 5TH GRADE

At the time I conducted the interviews in 2020, the four alumni ranged in age from 14 to 22; they included high school students and a recent college graduate. Each was on a journey toward achieving various milestones and levels of success in high school, college, and career. Madison was a 14-year-old ninth grader attending Brooklyn High School of the Arts and a recent graduate of the first-ever virtual GGSI, which was held in 2020 due to COVID-19 restrictions. Treazure was a 17-year-old 12th grader at Midwood High School at Brooklyn College and was part of the 2018 summer cohort. Goongoon was also a 17-year-old 12th grader and part of the 2018 summer cohort; she attended Bronx Science High School. Amrita was a 22-year-old graduate of Boston University who was part of the 2012 summer cohort; at the time of writing, she was employed as a paralegal.

STEM: Role Model and Mentor

As is true of many Black and Brown girls, my name enabled my entry into different groups and cliques at school and determined whether I was an outcast or “one of us.” My name is hard; I struggled with it as a child. It was so alien, so different, so “Muslim.” My name is Shihadah Muslimah Saleem, and I am a young Black woman who is excited about marine science. Although not yet heralded as the luxury beachfront community it is today, Far Rockaway in Queens was my childhood playground.

My three siblings and I had many adventures along the shore, under the boardwalks, and in conquering the vast ocean swells. Sitting on the shell-encrusted shore, watching the horseshoe crabs as those ancient organisms slowly made their way out of the surf, I had so many questions. I wanted to know about the formation of waves, the specks of black in the sand, and the mysterious animals that dwelled just below the surface. “What are these things?” And even though my family

couldn't answer my questions, I found that PBS programs such as the NOVA series could. I was enamored with all that I learned about our planet on those programs—I was hooked! But, I didn't see myself in those TV episodes; I didn't see any Black or Brown female marine scientists, engineers, or biologists on the shows. I only saw Jacques Cousteau and other white men showcasing their work and the excitement of their various underwater discoveries.

Representation and authentic role models, coupled with intentional dialogue and mutual conversations between student and teacher, mentee and mentor, or young professional and seasoned professional can activate the practice of CR-S by both or all parties involved. Representation in STEM is key to encouraging the next generation of girls and young women to pursue and maintain a STEM career. Young et al. (2020) discuss the need for practical role models and STEM mentors from various and often interconnected fields of STEM (professional engineers, astrophysicists, engineers, chemists, marine scientists and more) who can speak with students about their STEM journey, offering authentic insights on college and career readiness.

Having compelling and diverse role models and mentors who share their STEM journeys can have a positive impact on the trajectories and STEM identities of Black and Brown girls (Kim et al., 2018). The first component of CR-S, building strong connections with students, when paired with intentional mentorship and out-of-school staff relationships, such as informal educators from cultural institutions or after-school programs, can enrich the dialogue in understanding backgrounds and identities for all involved. Intentional collaborative combinations of teachers, informal educators, practitioners, and mentors can provide a space where students can openly share their authentic selves, learn together, and reflect on their experiences with supportive adults. These opportunities may lead to more bonding and relationship-building (Yong et al., 2020) that can help sustain retention in higher education and a STEM career. Students, especially Black and Brown girls, must find commonalities, hear about individual journeys, and witness the celebration and support of women in STEM. During moments of recognition in the classrooms, at after-school clubs, in the media, and in their communities, female students can freely aspire to a career in STEM without fear of ridicule or bias. In recent years, steps have been taken to provide young women with more opportunities to achieve and sustain a STEM career: the creation of all-girls STEM programs, clubs, and mentorship events has moved the needle forward in the number of women majoring in and sustaining careers in various STEM fields. However, much more can be done to highlight the diversity of women in engineering, computer science, technology, and more. Although few studies have been conducted on how social media can be used to gain recognition for marginalized people of color in the STEM fields, it is important to note that, in the last two or three years, social media have provided a great platform for culturally diverse professionals, organizations, nonprofits, and higher education to showcase their talents and research.

What do Black and Brown girls see and experience today? Is it a shared generational experience of aspiring to academic greatness, only to see whiteness exalted? It remains the case that most traditional school systems solely perpetuate the celebration of white scientists, engineers, and mathematicians. Only during Black History Month do students briefly learn about the usual suspects of Black Americans' contributions to STEM. When this pattern is repeated year after year, it stunts the recognition marginalized students need to be inspired by the achievements of Black and Brown people in the sciences (Korbey, 2018). In my conversation with 17-year-old Goongoon, she reflected on her need for such inspiration in order to develop the perseverance and resilience to pursue and maintain a career in the sciences:

It's a lot about seeing your face when you look at the TV or read about an article. It's about having a background of confidence, in my opinion, that pushes you to actually pursue that career. We live in a day where, like my generation especially, we have some women to look up to. However, our inspiration could be a lot more diverse . . . It just comes down to having a lot of examples. So you feel motivated or represented enough to actually take that step to become like the people you look up to.

Teachers and educators are missing a great opportunity for students to discover and develop deeper connections with living role models and trailblazers in STEM. If applied through dynamic

curricula that support female Black and Brown students' identities in STEM, the second and third components of the CR-S approach can help them develop a better sense of self-efficacy and societal involvement (Gershenson & Papageorge, 2018; Woodson, 2015).

Treasure, also 17 years old, expressed to me that STEM is her passion. She applied to GGSI because it sounded like a great opportunity: "I had always wanted to go into a STEM field. I felt this opportunity was going to be the perfect bridge from going into middle school, [then] into high school . . . [and then] transitioning from a high school [STEM] career to an actual career." Various studies demonstrate the importance of nurturing middle and high school students' curiosity about STEM before they enter higher education. The act of nurturing their interests consistently from elementary to high school provides various opportunities for self-expression and exploration. It allows students to develop perseverance, rigor, and 21st-century "soft skills," such as critical thinking and problem-solving, creativity and innovation, and communication and collaboration (Larson & Miller, 2011). Informal learning environments and afterschool programs can help to bridge gaps between building and sustaining their curiosity and formal academic mastery in STEM skillsets. These non-school opportunities can offer students a respite from high-stakes academic pressure and negative adolescent group dynamics that can inhibit their success and achievement (Christensen et al., 2015; Xie & Reider, 2014).

A Safer-Braver Space for Growth

As the co-founder (2009-2022) of the GOALS for Girls program which includes summer and after-school programs and enrichment, I help guide students' development of the whole self. The whole self is inclusive of one's socio-emotional well-being and development, academic skill building and the active acquisition of knowledge, and the continued growth and utilization of 21st-century skills. Humans are such complex and diverse beings, with immense talents, experiences, and ideas. Each summer, through the intentional combination of academic studies and outdoor physical activities and workshops, the summer staff and museum educators create safer-braver spaces that enable a group of 50 female students and staff members to build a sense of trust and belonging and to thrive. I push these Black and Brown city girls out of their comfort zones and encourage them to participate in stereotypically "white people" activities, such as hiking, kayaking, rock climbing, sailing, and acting. I then compliment and reinforce these bonding and developmental experiences with academic STEM content. This combination of activities helps the girls understand the importance of fostering team-building, persistence, conflict-resolution, and communication skills with diverse people who also have varied skillsets and knowledge. The girls are developing a personal and professional network, a group of like-minded people to help support, inform, and balance their journey and attain career goals. These characteristics and connections are needed for STEM professionals to work together to develop and execute innovative solutions. We continually invite students to share their lived experiences and validate their uneasy feelings as they try kayaking for the first time (trying not to get their hair wet—girl, I know!) or read aloud from a scientific journal despite not being "good" readers. We also address their misconceptions about their ability to get into a "good" college or university.

The second component of CR-S, creating emotionally safe spaces and fostering trust among students, is paramount to student development. Along with pursuing restorative practices that promote positive relationships between students and educators (Schott Foundation for Public Education, 2014), students, teachers, and informal educators can engage in fostering cultural awareness, caring, and respect. For example, Goongoon learned about GGSI through an alumna, who encouraged her to participate. Goongoon said, "I felt like I needed a space to fully explore the different possibilities that were out there, that [the program] might be a really good space for me to have that exploration." All-girl STEM programs that integrate socio-emotional learning can provide participants with a safer-braver space to learn and explore without fear of judgment, exclusion, or the negative bias that impedes learning and trust (Baker, 2013; Kerr et al., 2012; Lane & Id-Deen, 2020). Giving female students time to explore and discover what they like and dislike about the various STEM careers expands their self-efficacy and power of choice. Informal learning environments also foster their development of a STEM identity and

can strengthen their belief in their personal and academic abilities, and explore the intersection of STEM and career pathways through inquiry-based activities, peer-to-peer conversations, and opportunities to speak with experts in the field (Marra & Bogue, 2006). Guided discussions encourage students to share and reflect on their personal experiences of stereotyping and other misconceptions in STEM. Misconceptions may include working in a boring lab all day, exclusion of creativity and/or the arts, and often working alone or writing research papers all day. The use and development of intentional and open conversations using growth mindsets and individual goal-setting strategies with students also refocus their attention on their own personal development and achievement.

Informal learning environments, such as after-school and summer programs, can pinpoint individual needs and give students the tools they need to become proponents of their own development. In a study called I AM STEM, King and Pringle (2019) dissect the informal STEM experiences of Black girls who were summer participants of the I AM STEM Camp in 2015, drawing from the girls' reflective journaling and narrative inquiries (Corbin & Strauss, 2014). Successful STEM programs, in contrast to those that are lackluster, boring, and confusing, focus on providing innovative tools and resources and fostering discussions of relevant and relatable STEM content, with the aim of nurturing student-centered learning and growth (Basu & Barton, 2007; King & Pringle, 2019). Informal and out-of-school programs that offer hands-on, inquiry-based activities and workshops, field trips, and discussions can provide Black and Brown girls with a much-needed environment in which they can thrive, pursue their interests, and readily understand the real-world application of a career in STEM. Having relatable role models and mentors can significantly affect the decisions girls make about pursuing studies or a career in STEM. During GGSI's mentor mornings, female students have the opportunity to speak with ethnically, culturally, academically, and occupationally diverse women in the fields of aviation and space science, marine and earth science, and technology and engineering. From undergraduate to graduate students, formal to informal educators, and entry-level to expert professionals in the STEM fields, GOALS girls are able to hear about the STEM journeys of a wide spectrum of women. Creating a space for authentic conversation in the summer program gives the students the validity and connection they need to seriously consider a career in STEM.

Every Friday of GGSI offers a professional day of mentor mornings led by the summer staff. It provides GOALS girls with the opportunity to learn and practice their professional career readiness skills with each other and to participate in informal group conversations with invited women from the STEM fields noted above. The mentor mornings are especially important, as they offer the invited female mentors a chance to share their authentic experiences in the field or in the process of pursuing a STEM career. Through effective storytelling, visuals, and informal questions/answers, the mentors reflect on their first memorable experiences with science, technology, engineering, and math with either family, school, a program, or a role model. The students listen to the personal stories of women pilots, environmental scientists, astrophysicists, technologists, sound engineers, and more. We celebrate the journeys of these female mentors and the important roles they play in helping to shape the next generation of women in STEM.

During this process, 14-year-old Madison came to understand the importance of having influential and relatable female mentors. She remembers how a female mentor in aviation science spoke about the injustices in her workspace and broke everything down and how she overcame it. But that's the one thing I definitely remember. She talked to us about how it made her feel: "I just felt like she really opened up and was vulnerable at that moment. Vulnerability is power. So just to see how young we [summer students] are and how comfortable she felt expressing herself and what she went through in her work department felt really special and felt close."

Providing mentors who share their lived experiences emphasizes the third approach in CR-S. Having opportunities to speak with mentors and role models in STEM occupations gives prospective STEM students unique and thoughtful perspectives on the realities of attaining a career in the sciences. Mentorship provides a collective conversation and a foundation of support for developing and managing a professional career (Stroege et al., 2017). Having diverse and effective female mentors helps girls define, navigate, and develop important skills in leadership

roles that will lead them toward a career in the STEM fields. The mutual mentor-mentee relationship allows for deeper dialogue and practice in analyzing strengths and weaknesses, setting personal and professional goals, and building confidence, self-esteem, and skills. The recognition and scaffolding of these leadership skills are transferable in maintaining academic and professional rigor, expressing confidence in STEM research findings and participating in professional meetings, and readily employing collaborative approaches to finding innovative solutions to a problem or need.

Goongoon explained how she came to realize, through her own experiences, that she can be a mentor to future generations of girls interested in STEM: “In the future, I myself want to be that much more for the future generation of Bengali [girls to be] scientists or engineers, female engineers.” “Paying it forward” offers Black and Brown girls with a passion for STEM an opportunity to encourage younger students and to create peer-to-peer connections that broaden access to and understanding of the field. There is a growing movement of Black and Brown women in STEM careers who are yearning and willing to give back to their community. As they reflect on and sometimes still cope with harsh and toxic personal and professional environments characterized by bias, racism, and discrimination, their grit and perseverance enable them to welcome and cultivate new and fresh talents, which are so greatly needed in the U.S. STEM sectors (Archer et al., 2013).

From Research to Education

In 2007, after completing my master’s degree in marine geomorphology at the University of South Florida College of Marine Science, I moved back to New York City, NYC, where skyscrapers, trains, buses, and people (so many people) swarm the streets and eclipse the limited green spaces, was a far cry from the warm waters of the Gulf of Mexico, where spotting dolphins, stingrays, sea stars, and seagrasses was a normal occurrence. I went from collecting data on marine research cruises to a job as a museum educator at the Intrepid Sea, Air & Space Museum, which was housed aboard an aircraft carrier. But, the two environments weren’t as different as you might think. Even in a community as diverse as NYC, I was one of the very few Black educators in the department. By applying the research and communication skills I developed as a graduate student to learn about the Intrepid, I soon became a well-rounded museum educator who comfortably presented the history of the ship and its technological feats to thousands of students and teachers.

In 2008, a great opportunity came my way—a grant from the Motorola Solutions Foundation. The grant enabled me to stretch and challenge my skillsets in STEM and education and to form partnerships with nationally acclaimed all-girl schools in NYC. As I entered the classrooms of these eighth-grade students, I took a deep breath and smiled. I had an Intrepid-centric STEM lesson loaded on my laptop and my wheelie cart was stuffed with worksheets, models, and artifacts. I needed to show the students, who were predominantly Black and Brown girls, that I was capable, knowledgeable, and an ally who would help them to do and be their very best.

Once a safer-braver space had been created, it was critical for me to nurture the girls and to offer them a sense of ownership and recognition of their prior STEM knowledge and celebration of new STEM content. The sense of belonging within a facilitated program and in supportive groups that intentionally honor their diversity supports program impact and retention. The GOALS curriculum allows for the collective evolution of the students’ educational and social journeys within the program, thereby strengthening their connections to the STEM content, program staff, invited guests, and each other (Richards et al., 2004). Therefore, I welcomed their colloquialisms, their freedom of expression, their curiosity and misconceptions, and even their resistance to an academic or social challenge, but above all, I welcomed the comfort they showed in their behavior toward me. I invited them to bring their culture into every lesson and, importantly, I didn’t sugar coat, “dumb down,” or evade the histories of racism and sexism so tightly intertwined with STEM.

In the classes, we co-created a community of learning that highlighted the girls’ involvement in the process. During my workshops, there was no apprehension about a test or quiz, so the pace

and ease of exploration and development were satisfying for both the students and the teachers. The practices of community-building and student-centered learning are among the many ways of creating a sustainable and cohesive environment where all students can grow, build confidence, and gain acceptance. Therefore, one of my primary objectives for the first summer STEM program was to have girls define their own measures of success and achievement, which I did using open-ended questions, trial and error, and by providing a safer-braver space in which the girls could fail—and then try again.

Through the lens of measuring the value of success and power combined with the systemic erasure of the historic achievements of marginalized people, the third component of CR-S also supports a student's perception of the "whiteness" of success and a fear of failure. This often inhibits their ability to engage with and expand their interests and skillsets. This occurs to such an extent that students begin to question their own perceptions of their culturally ridiculed "Blackness" and "Brownness." Having been historically and commonly stereotyped as lazy, unmotivated, stupid, cognitively incapable, or lacking academic stamina/perseverance (Welch & Sigelman, 2011) often stifles Black and Brown girls' ability to try new things and to embrace the process regardless of the desired outcomes.

The measure and attainment of success are important to a person's academic and professional journeys, especially for Black and Brown girls. Amrita, who is 22 years old, explained how she defines her own measure of success as she navigates within society: "Success means being comfortable with your situation, being at peace with your past and the mistakes you've made, and being hopeful about the future." González-Pérez et al. (González-Pérez, De Cabo, & Sàinz, 2020) emphasize Eccles' expectancy-value theory (Eccles, 2005; Eccles et al., 1983), which suggests that, if students perceive and/or expect success and give it high value, they will be more likely to take a particular course of action. This involves, for example, taking challenging academic courses, applying for and completing a rigorous internship, and sacrificing leisurely activities for more education or professional development when pursuing a chosen career or role. Therefore, as Amrita becomes more comfortable with her knowledge and workforce skills, she will be able to cope more easily with her mistakes or failures. She will no longer see a mistake as a permanent roadblock to her success or a reflection of her ability, and she will not let it interfere with her goals. Enabling Black and Brown girls to redefine success and failure helps to broaden their lens on their cultural identity and self-evaluation, thereby lessening the need to uphold the societal superiority of "white" success (Kruger & Aviv, 2012). Educators who employ the third CR-S component with intentionality, thoughtful planning, authentic reflection, and actionable outcomes will enable girls to think critically about and confidently address their development and abilities, which are too often confined by systemic oppression through power and privilege. Once recognized and addressed, students can more readily become agents of change for themselves and their communities.

Black and Brown girls everywhere are capable, interested, and excited about STEM. They excel in traditional classroom settings and often surpass academic expectations, but too often their need for additional support falls short. Madison, the youngest of the girls I interviewed, described the importance of Black and Brown women being represented in STEM careers and the need for programs like GOALS for Girls, which couples socio-emotional development with learning STEM content to provide a holistic experience. Young et al. (2019), for example, explain the need for culturally relevant out-of-school opportunities that support girls' engagement with real-world opportunities (such as internships, increasing awareness of STEM relevance that matters directly to them or the community, or participation in clubs, design challenges, and events), connections with the community, and parental and peer involvement. Maintaining strong connections within communities and with families, addressing the challenges and obstacles of pursuing an interest in STEM, and being encouraged to master STEM subjects all provide Black and Brown girls with a wealth of support and choice.

The Voices Carry On

I am the product of my household, community, education, and occupation. I understand and embrace the full extent of my identity, both personal and cultural, and the fact that it can shift and expand over time through my experiences (Sue, 2001). Over many years of self-reflection, observation, research, conversations, and presentations, I have brought my whole self to the table and have pushed the narrative of Black and Brown people in everything I do. If I may borrow words from Treasure, “My mindset is, if there isn’t already someone doing it, I might as well be the first one.” Formal and informal education that responds to the cultural and societal pressures Black and Brown students endure can help increase their persistence and confidence as they continue on their STEM journey (Morton, 2020).

I continue on this journey with and for girls who are interested in science, technology, engineering, and math. I share my story of a shy child with big curiosity and the determination to follow through with my love of geology and marine science. I share the thoughts of Amrita, Treasure, Goongoon, and Madison because this kind of validation of Black and Brown girls needs to be at the forefront of how cultural institutions, higher education, and STEM companies can increase and sustain trust, value cultural diversity, celebrate and promote success, and support academic and occupational growth. If we do not share such conversations with Black and Brown girls, and our own journeys, the utilization and effectiveness of the CR-S approach will fall short.

The CR-S approach helps to sustain a cultural shift in recognizing and addressing the bias and systematic barriers that inhibit the academic success and development of Black and Brown girls. Informed by my lived experiences and the programming I have provided for Black and Brown girls interested in STEM careers, I call for increased and more robust opportunities for these girls to excel that will energize their interest in and passion for science, technology, engineering, and math.

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