Teaching Her Future: Reimagining STEM for Girls of Color through Creative Connections

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Abstract

The underrepresentation of women of color in STEM is a critical issue that limits diversity and innovation in these fields. Black, Latina, and other marginalized women face systemic barriers, including societal biases and limited mentorship opportunities. This paper reinforces the importance of eliminating systemic inequities to improve educational outcomes. Addressing these issues is essential for equity and increasing American STEM global leaders. This paper examines the ***STEM G.I.R.L.S.*** *initiative—an acronym for* Giving Inspiration, Resources, and Love 4 STEM, *an innovative educational framework that inspires a* ***mindset shift*** *for educators to see girls of color not only as capable in STEM careers, but also as future STEM leaders. By broadening perspectives, educators become "STEM Champions" who change the current exclusive trajectory. STEM G.I.R.L.S. encourages educators to intentionally direct students of color to STEM opportunities by aligning personal passions and making cultural connections in existing lessons across all subjects and grade levels that both interest and intrigue students, making STEM accessible and relevant. STEM G.I.R.L.S. champions nontraditional fields such as cosmetic chemistry, audio technology, and frequency coding. By connecting girls' unique talents, interests, and cultural experiences to meaningful opportunities, the program helps historically excluded students discover their* ***STEM identity***[1] *and envision themselves as innovators, creators, and leaders. Focus group data shows the viability and importance of initiatives such as STEM G.I.R.L.S. and provides actionable strategies for educators, institutions, and policymakers. The STEM G.I.R.L.S. initiative serves as a model for fostering inclusive, equitable environments where diverse voices drive innovation in STEM fields.*

1. Introduction

In an era of rapid technological and scientific advancement, the underrepresentation of women of color in science, technology, engineering and math (STEM) remains a pressing concern that demands immediate attention. Although Black and Latina women constitute a growing portion of the workforce, they are significantly underrepresented in STEM fields, accounting for only a fraction of professionals in areas like engineering, technology, and scientific research. This disparity is deeply rooted in systemic barriers, including limited access to quality STEM education, societal stereotypes, and a lack of visible role models within these fields. These obstacles hinder individual opportunities and stifle the diversity of thought and innovation required to solve complex global challenges.

Early STEM education for children of color is crucial in creating pathways to success and ensuring equitable access to future leadership roles in science, technology, engineering, and math career fields. By introducing STEM concepts at a young age, children develop critical thinking, problem-solving, and innovation skills that serve as a foundation for their academic and professional journeys. Early STEM exposure not only builds esteem and academic confidence, but it can also help dismantle systemic barriers that have historically excluded marginalized communities. Moreover, early exposure can influence youth to expand and broaden their interest in STEM to see diverse applications in nontraditional fields like audio chemistry, digital media, and cosmetic chemistry, allowing children of color to see diverse applications of STEM in real-world contexts.

This article examines the STEM G.I.R.L.S. initiative (an acronym for Giving Inspiration, Resources, and Love 4 STEM), which aims to redefine STEM education by encouraging educators to integrate nontraditional STEM pathways, such as environmental justice, culinary science, fabric engineering, and arts technology as viable future opportunities. The initiative's mission is to make STEM more accessible and relevant to the lived experiences of young women of color. Grounded in the leadership of Barrett and Stanley [1], STEM

[1] *STEM Identity* refers to an individual's sense of belonging, confidence, and connection to science, technology, engineering, and mathematics (STEM). It reflects how a person sees themselves as capable and valued in STEM fields, shaped by their experiences, interests, cultural background, and exposure to opportunities within these disciplines.

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G.I.R.L.S. emphasizes cultural identity, history, hands-on learning, and dynamic teaching strategies to inspire and empower the next generation. By bridging the gender and racial gaps in STEM, the initiative promotes equity and inclusion and highlights the transformative potential of a diverse STEM workforce.

The STEM G.I.R.L.S. initiative seeks to inspire and empower young girls of color to "find their STEM Identity" by examining their passions and interests through a STEM lens thus exposing them to careers that merge their creativity inherit in their cultural identity with cutting-edge STEM innovation to build an inclusive future in both traditional and non-traditional STEM pathways. By addressing barriers and expanding perceptions of STEM careers, educators and program developers can create pathways that enable girls to thrive.

This article advocates for systemic change in STEM education to create a more equitable and inclusive future by exploring real-world applications, conducting focus groups, and making strategic recommendations.

2. A Critical Mission

Barrett and Stanley [1], both accomplished educators in their respective fields (education and military), have dedicated their careers to improving student outcomes as educators, parents, mentors, and advisors. They are passionate about encouraging those who serve in similar roles to become STEM advocates and join their quest to champion the STEM G.I.R.L.S. initiative at schools throughout the country. Through decades of experience in K-12 and higher education, both have witnessed firsthand the transformative power of effective teaching and mentorship, most powerfully through hands-on, innovative practices. They have also observed the growing challenges in education, from the widening achievement gaps most significantly impacting girls of color to the need for culturally relevant STEM pedagogy, especially in underserved communities.

Both leaders recognize that traditional approaches to education often fail to address the diverse needs of today's learners. They have seen how students who lack access to equitable resources and opportunities are disproportionately affected by systemic barriers. This shared understanding has inspired their mission to create sustainable solutions that meet academic standards and empower students to thrive in an increasingly complex world. Their advocacy emphasizes bridging the gap between research and practice, ensuring educators have tools and strategies that make a real difference in the classroom. Barrett and Stanley [1] are passionate about ensuring that students of color, particularly those from low-income backgrounds, receive the support necessary for success. Their mission goes beyond education; it's about fostering a sense of possibility, equity, and hope for the future.

The impact of their work is already evident, as they've collaborated with educational consortiums, schools, policymakers, and communities to implement evidence-based interventions that drive meaningful change. Barrett and Stanley [1] remain steadfast in their commitment to advocate for the transformation of STEM education, believing every child deserves access to high-quality learning experiences that unlock their full potential. This critical mission reflects not only their professional expertise and personal passion, but also their unwavering dedication to the success of all students.

3. STEM Disparities and Their Implications

Gender and Racial Disparities

STEM fields continue to reflect a stark and persistent imbalance, with men significantly outnumbering women. According to the National Science Foundation [2], women represent just 18% of STEM professionals, and the numbers are even more discouraging for women of color. Racial disparities are similarly concerning; while Asian Americans constitute 39% of minorities in STEM, Black and Hispanic populations represent only 9% and 8%, respectively. This lack of diversity creates environments where unique perspectives are often overlooked, resulting in a narrowed scope of creativity and innovation critical for solving complex global challenges. These disparities are fueled by deeply entrenched systemic barriers, including unequal access to high-quality STEM education, biases in hiring practices, and the pervasive absence of mentorship opportunities for underrepresented groups. Research highlights that young girls from marginalized communities often encounter discouragement or limited encouragement to pursue STEM fields. This lack of representation perpetuates a cycle where aspiring professionals need help to see themselves reflected in these careers, further widening the gap.

Moreover, cultural and socioeconomic factors play a significant role in these disparities. Students from underfunded schools often lack access to advanced STEM courses, modern equipment, or extracurricular STEM programs, limiting their ability to compete on an equal footing. Addressing these disparities is not just a moral imperative but an economic necessity, as diverse teams have been shown to outperform homogeneous ones by fostering innovation and addressing a broader range of challenges. Expanding participation in STEM is essential for building inclusive solutions to the world's most pressing problems.

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4. The Dream Gap

The "Dream Gap" refers to the societal and systemic barriers that discourage girls, particularly those from minority communities, from following their dream of pursuing careers in STEM. These barriers arise from various factors, including pervasive gender biases, inadequate access to STEM education, and limited exposure to diverse role models. The perception that STEM fields lack the need for cultural relevance further exacerbates this gap, as many young girls struggle to connect their identities and experiences with traditional STEM disciplines. Research indicates that by age six, girls are already less likely than boys to associate intelligence with their gender, a belief that can influence their career aspirations later in life [3].

For girls of color, the Dream Gap is compounded by intersectional challenges, including racial stereotypes and underrepresentation. Studies show that only 4% of Black and Latina women are employed in engineering or computing fields, significantly limiting the visibility of role models for younger generations [2].

Programs integrating culturally relevant curricula and representation, such as STEM G.I.R.L.S., have effectively bridged this gap by fostering a sense of belonging and the possibility of STEM success among students. Addressing the Dream Gap is essential not only for equity in STEM but also for harnessing the full potential of diverse talent in shaping a more innovative and inclusive future.

5. The STEM G.I.R.L.S. Approach

Expanding the Definition of STEM

STEM G.I.R.L.S. challenges traditional notions of STEM by incorporating the educational foundation necessary to pursue disciplines such as fashion analytics, sports science, cosmetic dermatology and textile technology. The most significant challenge is ensuring students are exposed to the availability of these opportunities to provide the incentive to learn more. For example, connecting the chemistry of baking with core scientific principles fosters engagement and demonstrates the relevance of STEM in everyday life. This innovative approach underscores that STEM is not confined to laboratories or research facilities; it is deeply interwoven with cultural practices and personal interests.

5.1. Cultivating Girls' STEM Identity

By integrating cultural identity and personal interests, the STEM G.I.R.L.S. initiative helps girls discover and cultivate their STEM identity and seeks to make learning personally meaningful. Community-driven projects such as environmental justice studies or technological solutions for cultural preservation enhance students' sense of both belonging and purpose. Additionally, highlighting the underrecognized contributions of trailblazing women of color role models such as West [4]whose contributions developed the Global Positioning System (GPS) and Dr. Patricia Bath, who invented the Laserphaco Probe which uses lasers to safely dissolve cataracts are examples that will not only instill cultural pride for African American youth in particular but could also serve as incentive to create their own inventions that will be the source of pride within their community and benefit humanity.

6. Innovative Educational Strategies

Technology as a Catalyst

Emerging technologies like artificial intelligence (AI), virtual reality (VR), and coding platforms have transformed the learning landscape. For example, VR simulations in fashion design and tech-based culinary tools enable students to experience STEM interactively. Such tools bridge the gap between abstract theories and real-world applications, making STEM more accessible and engaging.

The authors now share a video of the herculean effort of Yamilee Toussaint, a high school math teacher recognized as a Top 5 CNN Hero of 2024 for utilizing STEM to teach coding to participants in her STEM From Dance school programs and summer camps. Not only were participants learning beautiful steps, but they also learned to code as they programmed lights that adorned their costumes. This is a key example of an exceptional effort that reinforced positive self-concept, intelligence, and capability which was affirmed by the applause of performance attendees. The impact of STEM From Dance will be long-lasting and life changing.

6.1. Highlighting Role Models

Representation matters profoundly in shaping aspirations. Stories of women like Madame C.J. Walker, the first self-made millionaire through her cosmetics line, and Dr. Gladys West, the mathematician behind GPS technology, demonstrate the transformative potential of women of color in STEM. Incorporating such narratives into curricula inspires young learners to envision themselves as future innovators.

6.2. Leveraging History

Role models of color are readily found through a historical review, however, STEM G.I.R.L.S. encourages educators to teach through a different

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lens to emphasize STEM correlations. For example, Dr. Stanley utilizes the contributions of one of America's greatest leaders, Harriet Tubman, in her training. Although Tubman is often readily recognized as one of the most famous conductors of the Underground Railroad, few recognize her STEM connection of utilizing astrology to ensure everyone on her underground "track" arrived safely to freedom. Harriet Tubman is also a prime example that intelligence is not limited to academia. Tubman could not read because it was forbidden at the time for those who were enslaved, she had an impeccable memory and leveraged it to provide intelligence to Union leaders as a Union Spy and Scout. Essentially, she was a one-woman army, but often overlooked, which became the secret to her success.

7. Focus Group Research

Voices from the Future: Insights from HBCU (an acronym for Historically Black Colleges and Universities) Students on Engaging Girls of Color in STEM

Stanley and Barrett [1] expanded their STEM G.I.R.L.S. advocacy presented at the Ireland Conference on Education (2024) and London Conference on Education (2024) by seeking out the experiences of successful students of color currently attending a historically Black college or university. They conducted two focus groups via Zoom to determine what influenced their STEM identities as youth and gather student recommendations regarding effective strategies for engaging girls of color in STEM. The groups were comprised of six college-aged women attending an HBCU who shared their experiences, challenges, and actionable solutions for fostering inclusivity and engagement for youth to encourage them to pursue STEM fields.

7.1. Methodology: Focus Group Design and Participants

Two focus groups were conducted to explore effective strategies for engaging girls of color in STEM with participants, aged 18–22, selected through purposive sampling to reflect diverse experiences in STEM education. The group represented various academic disciplines, from STEM majors to those with limited prior engagement in STEM fields.

7.2. Focus Group Procedure

Each focus group session lasted at least 60 minutes and was facilitated virtually using a semi-structured discussion guide. Questions were designed to explore participants' experiences related to personal STEM education, perceptions of STEM, barriers to engagement, and suggestions for improving STEM education for underrepresented youth. The discussion was recorded, transcribed, and analyzed using thematic analysis to identify recurring patterns and insights.

Participant Profiles

Rachel: A history education major who attended a STEM-focused magnet school but recognized its value later in life. Rachel values science-related activities but emphasizes the need to connect STEM education to cultural identities.

J'Lah: An education major and technology enthusiast who participated in extracurricular STEM activities but initially needed to recognize them as STEM-related. She highlighted the importance of mentorship in fostering engagement.

Camille: An education major expressed frustra-tion with the lack of visible role models and the disconnect between STEM and cultural identities, advocating for culturally relevant curricula.

Alyssa: A third-year business major shared her love for mathematics and how learning key concepts at a young age catapulted her educational success.

Tamia: Tamia shared her pathway to becoming a pre-med major and the programs that piqued her interest in pursuing a medical career.

Grace: a health sciences major, shared the influence of youth programs that allowed her to learn specialized skills such as piloting a plane at the age of 12. These experiences made her believe she could succeed in STEM-related occupations.

8. Results: Focus Group Insights on Engaging Girls of Color in STEM

Early Experiences with STEM

In the first focus group, participants had mixed early experiences with STEM education. While some, like Rachel, attended STEM-focused schools, they only recognized the value of these experiences later in life. Others, such as J'Lah, engaged in STEM-related activities outside traditional subjects but did not identify them as STEM at the time. She enjoyed learning, which is critical for success. Barriers such as a lack of relatable educators and limited resources were common. As one participant shared, a teacher dissuaded her from STEM, noting she "…just kept saying, 'It's gonna be too hard,' and never even tried (to teach her)," which highlights the limiting beliefs and psychological hurdles many girls of color face in school.

The second focus group had extensive exposure

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to STEM throughout their youth, which left a significant impact on their world view. Overall, they saw STEM as fun and enjoyable. They did not have the same STEM barriers others experienced in school.

The two focus groups revealed a spectrum of early experiences with STEM. In the first group, participants often encountered barriers that prevented them from fully engaging with STEM fields. For example, J'Lah became involved in STEM-related activities, such as experimenting with technology at summer camps, but did not initially identify them as STEM experiences. This reinforced the joy seen on the faces who participated in the STEM from Dance programs. If STEM can be perceived as fun, it will become second nature to students. A recurring barrier that was discussed was the lack of innovative educators who actively seek student engagement.

Educator innovation and encouragement made a significant difference for focus group participants. Participants in the second focus group reinforced that positive and consistent exposure to STEM during their formative years. Grace described her experience at the Chappie James Flight Academy in Pensacola, Florida where she learned principles of aviation. At the end of a week of training, field trips and aeronautical simulators, she co-piloted a plane at the age of 12. Ten years later, she still remembered Bernoulli's Principle, a key to understanding how planes generate lift. She had no prior interest in aviation physics. Application and the possibility of co-piloting a plane if she learned the concepts piqued her interest and incentivized her grasp of complex concepts. She noted, "At the academy, we learned about the principles of flight, and I got to fly a plane with a co-pilot. It put STEM in a positive light for me."

These contrasting experiences highlight the importance of early exposure to STEM and hands-on application. Most importantly, it reinforced the need for supportive, engaging environments to foster long-term interest. The perspectives from members of the focus groups provided invaluable insights regarding the impact of early STEM intervention and the potential barriers created by unsupportive environments.

8.1. Representation and Mentorship

Both focus groups discussed the critical role of representation and mentorship in fostering a connection to STEM for girls of color. Participants repeatedly noted the lack of visible role models in STEM fields, particularly for women of color. Camille noted, "I couldn't name a woman in STEM who's a Black woman despite years of school...". She couldn't share what she wasn't taught, which is why inclusive school curricula is critical.

Mentorship was identified as an impactful solution, with Rachel explaining, "Any Black woman in the medical field...opens doors for girls like me." This demonstrates how role models inspire and guide young women in pursuing STEM pathways. Mentorship is a key aspect of Dr. Stanley's training. Allies are necessary to not only light the way for the underrepresented, but to also eliminate the pay gap that remains in place by gender and race according to the 2023 National Science Report.

Mentees will be what they see. Grace shared how her aunt's career as an OB-GYN motivated her to pursue a path in women's health. Although her initial attempt to become a medical doctor proved unsuccessful, she now aspires to open a women's clinic, leveraging the latest STEM technology to address the often-overlooked issue of women's health and provide much needed healthcare. Her goal is to reduce disparity in black maternal mortality. This example reinforces how personal connections to STEM role models can directly influence career aspirations.

8.2. Cultural Relevance in STEM Education

Participants highlighted the disconnect between STEM curricula and cultural identities. Rachel observed, "I don't feel as if much curriculum ever speaks towards the Black community, especially in STEM." Conversely, culturally relevant programs were celebrated. For instance, J'Lah shared a successful example of students 3D-printing nail designs, aligning STEM activities with their interests. Similarly, Barrett emphasized how STEM could be relatable by connecting it to areas that may be of interest to some girls, to include beauty, cosmetics, and fashion: "If you like makeup, you can create formulations for brands like MAC" [5].

Some girls may prefer sports to cosmetics and would be compelled to learn mathematical concepts such as calculating averages and analyzing trends through sports statistics analysis. Although educators are often overburdened and under resourced, knowledge of student interests can lead to identifying strategies to reach best reach and motivate their learning. On a broader scale, utilizing culturally tailored approaches can help bridge the gap and make STEM more accessible and engaging for girls of color.

8.3. Broadening Perceptions of STEM Careers

The focus group identified narrow perceptions of STEM careers as a barrier. As J'Lah noted, "When you say STEM, kids just say 'scientist.'" The discussion emphasized the need for an expanded understanding of STEM careers and opportunities.

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Additionally, participants encouraged the expansion of how STEM careers are presented to students, to include cosmetic science and textile technology as viable pathways of interest. Grace suggested breaking down the components of everyday items, such as makeup or sports gear, to help students recognize the STEM processes behind them. This broader framing helps students connect STEM concepts with their passions and everyday lives.

8.4. Strategies for Designing Inclusive STEM Programs

Participants proposed actionable strategies to make STEM education more inclusive and engaging for girls of color:

Connecting STEM to Daily Life: Programs should relate STEM topics to students' experiences, such as exploring the science behind hair and skin products. "I'd start with our hair, our skin, learning about what products work for us." (Rachel).

Integrating Mentorship: Young, relatable mentors can make STEM careers more tangible. As Tamia suggested, "Bring in young college students to talk about why they love STEM."

Fostering Collaboration and Creativity: Inclusive environments that encourage teamwork and creative problem-solving were highlighted as essential. Camille noted, "Collaborating with others and presenting ideas intentionally can help students connect with STEM".

Culturally Relevant Teaching: Grace and Alyssa pointed out the need for representation at every level, including curricula, educators, and classroom activities. Alyssa explained: "A Black teacher lecturing from a book by a Black author makes learning relatable."

9. Implications for Educators and Policymakers

Educator Training - Teachers often underestimate their potential to inspire students in STEM or the barriers they can create through unintentional racial and gender bias. Practical applications are necessary to make STEM accessible for all. Professional development programs that emphasize cultural competence and creative teaching strategies are essential. Equipping educators with the tools to integrate students' interests into STEM curricula can transform engagement and aspirations to serve in STEM fields.

9.1. Policy Recommendations

Educational leaders and policymakers must prioritize funding for programs that address STEM disparities. Initiatives like STEM G.I.R.L.S. should receive sustained support to scale their impact within schools, particularly in underserved communities. Collaboration with industry partners can also ensure curricula align with evolving workforce needs.

10. Conclusion

The reimagining of STEM for youth of color is both a pedagogical necessity and a moral imperative. By embracing creativity, culture, history, and technology, the STEM G.I.R.L.S. initiative exemplifies how education can become a powerful tool for equity and innovation. Empowering young women of color to see themselves as capable leaders in STEM is not just about closing gaps—it is about building a future where diverse perspectives drive progress and discovery. To ensure the United States maintains its global competitiveness, leaders must recognize that the best and brightest youth must be encouraged to enter the STEM pipeline to ensure that women of color are available for STEM leadership roles. Without proper preparation, experience, and support, women of color will remain underrepresented in STEM fields. Utilizing strategies outlined in the STEM G.I.R.L.S. initiative can potentially close the racial and gender disparity gap by making STEM applicable and available to all.

It was evident that students such as our focus group participants will become future STEM leaders. Hopefully, they will reach back and inspire the next generation, sharing the creativity and resources that influenced their interest in STEM with others. Clearly, they understand the importance of engaging and culturally relevant STEM training either due to their own personal experiences or lack thereof, which serve as yet another reason to serve as visible role models and mentors to inspire and empower girls of color in STEM. Each focus group participant represents hope for the future and reflects the impact that early STEM education can have on post-secondary academic success. Most importantly, early STEM education can expand student career opportunities.

Ultimately, gender and racial inclusion is critical for America to remain a global leader in STEM. Inclusion creates a larger talent pool that is not restricted by racial or gender bias or discrimination. To ensure success, educators are encouraged to foster engagement and help youth envision themselves as STEM leaders by leveraging empowering ideologies such as STEM G.I.R.L.S. in early education to promote a dynamic, diverse future STEM workforce. By investing in culturally relevant and accessible STEM education early,

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educators and advocates can equip children of color with the tools and inspiration needed to pursue impactful careers, transform their communities, and shape the future of innovation.

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