Available online at www.worldscientificnews.com

World Scientific News

An International Scientific Journal

WSN 203 (2025) 387-399 EISSN 2392-2192

Promoting Equity in STEM Education: Strategies for Supporting Underrepresented Students in High School Science Programs

Olanrewaju Awoyemi[1], Fadeke Adeola Atobatele[2], Chioma Angela Okonkwo[3]

[1]Launchforth Group of Schools, Matogun, Lagos, Nigeria

lanre.awoyemi@gmail.com

[2]Department of Educational Leadership and Policy Studies, University of Texas at Arlington, USA

Faa0719@mavs.uta.edu

[3]Community Secondary School, Umunnachi, Nigeria

chiomaagbagu@gmail.com

Corresponding Author: lanre.awoyemi@gmail.com

ABSTRACT

This paper explores strategies for promoting equity and inclusion in STEM education, specifically focusing on supporting underrepresented students in high school science programs. It examines these students' systemic barriers, including socioeconomic challenges, lack of access to resources, and implicit bias, which hinder their participation and success in STEM fields. The paper highlights key strategies such as mentorship programs, scholarship initiatives, and community engagement as essential tools for providing academic and motivational support. Additionally, it emphasizes the importance of fostering an inclusive STEM curriculum and learning environment through culturally responsive teaching practices, diversifying the curriculum, and building supportive classroom cultures.

(Received 10 February 2025; Accepted 20 March 2025; Date of Publication 17 May 2025)

The paper concludes with actionable recommendations for policymakers, educators, and community leaders to implement sustainable solutions that support underrepresented students, enhance STEM participation, and promote long-term success in science education.

***Keywords**:* STEM education, underrepresented students, mentorship programs, equity in education, inclusive curriculum.

1. INTRODUCTION

STEM education, which encompasses the fields of science, technology, engineering, and mathematics, plays a crucial role in preparing students for the evolving job market and equipping them with the skills necessary for innovation and problem-solving (Tytler, 2020). As the global economy increasingly relies on technology and scientific advancements, proficiency in STEM disciplines has become a key factor in shaping future career opportunities and driving economic growth. High school students who excel in STEM subjects are more likely to pursue higher education in these fields and secure high-demand jobs in healthcare, information technology, and engineering industries. Consequently, STEM education serves as a powerful tool for social mobility, enabling individuals to secure stable, well-paying jobs and contribute meaningfully to society (Eisenhart & Weis, 2022).

However, despite the recognized importance of STEM education, a significant equity gap persists, particularly for underrepresented students. These students, often from minority racial or ethnic backgrounds, low-income families, or rural communities, face multiple barriers that hinder their full participation in STEM programs (Whitcomb & Singh, 2021). Gender disparities also play a role, with girls often being underrepresented in science and engineering fields due to societal biases and the lack of female role models in these areas. The lack of access to high-quality STEM education and resources further compounds the problem, leaving underrepresented students at a disadvantage when it comes to developing the skills necessary for success in these fields (Dare, Keratithamkul, Hiwatig, & Li, 2021).

The equity gap in STEM education is not only an issue of fairness but also one of lost potential. When students from diverse backgrounds are excluded from STEM opportunities, society as a whole misses out on the innovative ideas and perspectives that these individuals could contribute to the field (Russo-Tait, 2022). Moreover, the workforce of the future requires a diverse talent pool to tackle the complex, global challenges we face, such as climate change, public health crises, and technological advancements. Therefore, promoting equity in STEM education is not just a moral imperative but also an economic and social necessity (Martin & Fisher-Ari, 2021).

This paper aims to explore strategies that can promote inclusion and support for underrepresented students in high school science programs, which are critical in shaping students' interest and ability in STEM. The focus will be on three main approaches: mentorship, scholarships, and community engagement. These strategies are particularly effective in addressing the systemic challenges that underrepresented students face and can help create a more equitable learning environment where all students, regardless of background, have the opportunity to succeed in STEM disciplines. Through this analysis, the paper aims to highlight actionable solutions for educators, policymakers, and communities to close the equity gap in STEM education and empower the next generation of diverse STEM professionals.

2. LITERATURE REVBARRIERS TO EQUITY IN STEM EDUCATION

Equity in STEM (Science, Technology, Engineering, and Mathematics) education remains a significant challenge, particularly for students from underrepresented groups such as racial and ethnic minorities, economically disadvantaged families, and female students. Despite efforts to increase diversity and inclusion in STEM fields, systemic barriers continue to hinder the participation and success of these students, especially at the high school level. These barriers are rooted in a range of social, economic, and educational factors that affect the students' ability to access quality STEM education and pursue related careers.

2.1. Socioeconomic Challenges

Socioeconomic challenges represent one of the most pervasive barriers to equitable STEM education. Many underrepresented students come from low-income families, which often translates to limited access to quality educational resources. Schools in economically disadvantaged areas may lack the funding necessary to offer advanced STEM courses, modern laboratories, or extracurricular programs that nurture students' interest in science and technology. This resource disparity puts underrepresented students at a significant disadvantage compared to their peers in more affluent areas who have greater exposure to hands-on learning experiences and advanced coursework (Jones & Burrell, 2022).

Furthermore, students from low-income backgrounds often face additional pressures outside of school, such as needing part-time jobs to support their families or unable to afford supplemental tutoring and STEM-related activities. These financial constraints can limit their ability to engage fully in schoolwork or explore extracurricular STEM opportunities, thereby diminishing their long-term interest and performance in STEM subjects. As a result, many talented students from underprivileged backgrounds miss out on opportunities to develop their potential in STEM fields, perpetuating the cycle of inequity (Sarma & Bagiati, 2021).

2.2. Lack of Resources

The lack of resources in underfunded schools exacerbates the equity gap in STEM education. Schools with limited budgets often struggle to provide the necessary tools and technologies that are essential for teaching STEM effectively. For example, science labs may lack updated equipment, making it difficult for students to engage in experiments that foster critical thinking and problem-solving skills. Similarly, schools with insufficient funding may not have access to up-to-date technology, which is increasingly crucial for teaching subjects like computer science and engineering (Allegretto, García, & Weiss, 2022).

In addition to material resources, many schools in low-income areas also face a shortage of qualified STEM teachers. The shortage of well-trained teachers who can effectively teach advanced STEM topics further limits students' learning opportunities. In many cases, underqualified or overburdened teachers are assigned to teach STEM subjects, resulting in inadequate instruction that does not meet the rigorous demands of the STEM curriculum. Without access to knowledgeable teachers and the appropriate learning tools, students from underrepresented backgrounds are often left without the foundation needed to excel in STEM education (Cruz, 2021).

2.3. Implicit Bias in STEM Classrooms

Implicit bias in the classroom is another major barrier to equity in STEM education. Implicit biases, or the unconscious attitudes and stereotypes teachers and administrators hold, can influence how students are treated and assessed in STEM subjects.

Research shows that teachers may have lower expectations for students from minority or low-income backgrounds, which can result in these students receiving less encouragement and support to pursue challenging STEM courses (Beachum & Gullo, 2020).

Implicit bias can also affect the way teachers perceive students' abilities in STEM, particularly for female students and students of color. For instance, female students may be discouraged from pursuing advanced mathematics or science courses due to stereotypes that suggest girls are less capable in these areas. Similarly, students of color may be overlooked for advanced STEM programs or may face harsher disciplinary actions that detract from their academic progress. These biases, whether intentional or not, can have a lasting impact on students' self-confidence and interest in STEM, ultimately contributing to their underrepresentation in these fields (O'Leary et al., 2020).

2.4. Access to Advanced STEM Courses

Access to advanced STEM courses, such as Advanced Placement (AP) classes or International Baccalaureate (IB) programs, is critical in determining students' future success in STEM fields. However, many underrepresented students, particularly those in underfunded schools, do not have the same access to these advanced courses as their peers in more affluent areas. This lack of access can significantly limit students' ability to gain the knowledge and skills necessary to succeed in college-level STEM programs and competitive STEM careers (Conger, Kennedy, Long, & McGhee, 2021).

High school science programs that offer advanced courses typically require significant financial and educational resources, such as well-equipped laboratories, experienced teachers, and the availability of specialized courses. These resources are scarce or nonexistent in many schools serving underrepresented students (Xu, Solanki, & Fink, 2021). As a result, students are left with fewer opportunities to challenge themselves academically, explore their interests in STEM, or build a strong foundation for higher education in these fields. Without access to advanced coursework, underrepresented students are at a clear disadvantage when applying to colleges and pursuing STEM-related degrees, perpetuating the equity gap in STEM education (Breeden, 2021).

2.5. Gender Disparities in STEM

Gender disparities also play a significant role in limiting equity in STEM education. Despite progress in recent years, women, particularly in high school science programs, continue to be underrepresented in advanced STEM courses, such as physics, computer science, and engineering. These disparities are often reinforced by societal stereotypes that suggest STEM fields are more suitable for men, discouraging young women from pursuing STEM studies (Kuchynka, Eaton, & Rivera, 2022).

Moreover, the lack of female role models in STEM fields exacerbates the issue, as girls may not see themselves represented in STEM careers (González-Pérez, Mateos de Cabo, & Sáinz, 2020). This absence of representation can discourage female students from pursuing STEM subjects, leading to a self-reinforcing cycle of underrepresentation. In high school science programs, gender bias can manifest in various ways, from the lack of encouragement for girls to take challenging STEM courses to subtle biases in classroom interactions that favor boys. These experiences can cause female students to feel less confident in their abilities and ultimately steer them away from pursuing careers in STEM fields (Guenaga, Eguíluz, Garaizar, & Mimenza, 2022).

2.6. Lack of Role Models and Mentors

Lastly, the lack of role models and mentors for underrepresented students is a significant barrier to equity in STEM education. For many students from minority or economically disadvantaged backgrounds, the absence of teachers, professionals, or community members who share their background and have succeeded in STEM fields can make it difficult for them to envision a future in STEM. Role models and mentors play a crucial role in inspiring students, providing guidance, and offering support as they navigate their educational and career paths (Nkrumah & Scott, 2022).

Many underrepresented students may feel isolated or discouraged from pursuing STEM fields without access to mentors who can provide advice and encouragement. Mentorship programs that connect students with professionals who have overcome similar barriers can significantly impact students' confidence and interest in STEM. However, the scarcity of such programs, particularly in schools serving underrepresented students, further limits their opportunities to succeed in STEM education (Arif et al., 2021).

3. STRATEGIES FOR SUPPORTING UNDERREPRESENTED STUDENTS

Promoting equity in STEM education requires the implementation of strategic initiatives designed to support underrepresented students. These students, often from marginalized racial or ethnic groups, low-income families, or under-resourced schools, face numerous barriers that limit their access to quality STEM learning opportunities. To address these barriers and foster inclusion, targeted strategies such as mentorship programs, scholarship initiatives, and community engagement can play a pivotal role in ensuring these students receive the necessary support to succeed in STEM disciplines. Educators, policymakers, and community leaders can help bridge the equity gap and create a more diverse and inclusive STEM workforce by implementing these strategies.

3.1. Mentorship Programs

One of the most effective ways to support underrepresented students in STEM is through mentorship programs. Mentors serve as valuable guides, providing academic support, career advice, and emotional encouragement to students who may otherwise feel isolated or overwhelmed by the challenges of STEM education. For students from underrepresented backgrounds, mentors can offer insights into navigating academic systems, overcoming barriers, and building the confidence necessary to pursue challenging STEM careers (Kezar, Hallett, Perez, & Kitchen, 2024).

Mentorship programs are particularly important for students who may not have access to role models in their immediate environment (Stephens & Dearani, 2021). Many students from low-income or minority backgrounds lack the social networks that provide exposure to professionals in STEM fields. Without mentors, these students may struggle to envision themselves in STEM careers or understand the pathways available. By connecting students with mentors—whether they are teachers, college students, or professionals working in STEM industries—schools can help students gain the knowledge and confidence they need to succeed (Hansen, Palakal, & White, 2024).

In addition to providing academic and career guidance, mentors can also play a critical role in helping students develop resilience and perseverance. STEM subjects, particularly at advanced levels, are often challenging, and many students may face moments of self-doubt or frustration. Mentors can offer encouragement during these difficult times, helping students stay motivated and focused on their long-term goals.

This emotional support is especially important for underrepresented students who may not have access to other forms of academic or social support. By fostering a sense of belonging and self-efficacy, mentorship programs can help students overcome the challenges they face in STEM education and build the confidence needed to pursue STEM careers (Tram, Nwankwo, Khan, & Sabado, 2023).

3.2. Scholarship Initiatives

Financial barriers are a significant obstacle for many underrepresented students seeking to pursue STEM education. These students often come from low-income families and may lack the resources to pay for advanced coursework, tutoring, or extracurricular STEM programs. Additionally, the cost of higher education, particularly in STEM fields, can be prohibitive for students from economically disadvantaged backgrounds. Scholarship initiatives targeting underrepresented STEM students can help alleviate these financial barriers and provide greater access to educational opportunities (Peña, Ruedas-Gracia, Cohen, Tran, & Stratton, 2022).

Scholarships for STEM students can take many forms, from covering the cost of high school programs, such as summer science camps or AP courses, to providing financial aid for college or university tuition. These scholarships reduce the financial burden on students and their families and signal to students that their potential is recognized and valued. For many underrepresented students, receiving a scholarship can be a transformative experience, boosting their confidence and encouraging them to pursue their interests in STEM (Kitchen, Chen, Sonnert, & Sadler, 2022).

Moreover, scholarships can help to level the playing field by ensuring that talented students are not excluded from STEM opportunities simply because of their financial situation. Without financial support, many underrepresented students may be forced to forego opportunities that could help them develop their skills and prepare for STEM careers. By providing targeted scholarships, educators and policymakers can help to break down financial barriers and create a more equitable STEM education system (Heise, Hall, Ivie, Meyer, & Clapp, 2020).

Beyond traditional scholarships, many programs also offer stipends for internships, research projects, and other experiential learning opportunities in STEM fields. These opportunities are critical for helping students apply their academic knowledge in real-world settings and gain valuable work experience (Morley & Jamil, 2021). Underrepresented students, who may not have the same access to internships or research opportunities as their more privileged peers, can benefit from these scholarships, which can provide a much-needed gateway to professional development in STEM fields. By funding these experiences, scholarship programs support students' academic success and help them build the practical skills and professional networks needed for long-term career success (Bradford, Beier, & Oswald, 2021).

3.3. Community Engagement

Community engagement is another crucial strategy for promoting equity in STEM education. For underrepresented students, a supportive community can make a significant difference in their ability to succeed in STEM. Community engagement can take many forms, including after-school programs, partnerships with local organizations, and parental involvement, all of which can contribute to creating a more inclusive and supportive environment for students (Varty, 2022).

After-school programs focused on STEM are particularly valuable for students who may not have access to advanced coursework or extracurricular activities during the school day. These programs provide additional opportunities for hands-on learning, allowing students to explore their interests in STEM fields in a more informal and engaging setting.

For underrepresented students, after-school programs can be a critical source of support, offering access to resources such as tutoring, mentorship, and hands-on projects that may not be available in their regular school curriculum. By participating in these programs, students can build their skills, gain confidence, and develop a deeper interest in STEM subjects (Habig & Gupta, 2021).

Partnerships between schools and local organizations, such as universities, businesses, or non-profit groups, can also enhance STEM education for underrepresented students. These partnerships can provide access to resources, such as guest speakers, field trips, internships, or STEM competitions, that would otherwise be unavailable to students in under-resourced schools. For example, a local technology company might partner with a high school to provide students with internships or job-shadowing opportunities, giving them firsthand experience in STEM careers. Similarly, a nearby university might offer summer programs or weekend workshops in coding, robotics, or environmental science, allowing students to engage in hands-on learning experiences outside of the traditional classroom setting (Nation & Hansen, 2021).

Parental involvement is another critical aspect of community engagement. Parents play a key role in shaping their children's attitudes toward education and career aspirations. However, many parents of underrepresented students may not be familiar with the pathways to success in STEM fields or may not have had the opportunity to pursue STEM education themselves. Schools and community organizations can help bridge this gap by offering workshops or information sessions for parents, educating them about the importance of STEM education and how they can support their children's interests. By fostering parental involvement, schools can create a stronger support network for students and encourage them to confidently pursue STEM education (Kitchen et al., 2022).

4. FOSTERING AN INCLUSIVE STEM CURRICULUM AND LEARNING ENVIRONMENT

4.1. Culturally Responsive Teaching Practices

Culturally responsive teaching is essential for creating an inclusive and welcoming environment for diverse students in STEM education. Many underrepresented students, particularly those from racial and ethnic minority backgrounds, often feel alienated or disconnected from the STEM subjects they are learning. This disconnect can stem from a curriculum that fails to reflect their cultural experiences or from teaching practices that do not consider their unique learning needs. Culturally responsive teaching aims to bridge this gap by recognizing students' cultural backgrounds and integrating those perspectives into the learning process (Hernandez, 2022).

One of the key components of culturally responsive teaching is understanding students' cultural values, traditions, and experiences and using that knowledge to shape instructional practices. For instance, teachers can incorporate examples and case studies relevant to students' cultural contexts, making STEM subjects more relatable and engaging. This approach makes learning more meaningful for students and helps to counteract the implicit messages that STEM is a field primarily for certain racial or socioeconomic groups. When students see their own cultures and experiences reflected in the curriculum, they are more likely to feel that they belong in STEM and that their perspectives are valued (Berlian & Huda, 2022).

Moreover, culturally responsive teaching emphasizes the importance of building strong relationships between teachers and students. Trust and rapport with teachers are crucial for academic success for many underrepresented students, particularly those from communities that have historically been marginalized in educational systems (Lau & Shea, 2024).

Teachers who take the time to understand their students' backgrounds and who demonstrate genuine care and concern for their well-being can create a more supportive and inclusive classroom environment. This, in turn, can encourage students to engage more fully in STEM learning and to see themselves as capable of succeeding in these fields (Hutchison & McAlister-Shields, 2020).

4.2. Diversifying STEM Curricula

Diversifying the STEM curriculum to include contributions from underrepresented groups is another vital strategy for fostering inclusion in STEM education. The traditional STEM curriculum has often focused disproportionately on the achievements of a narrow group of scientists and innovators, typically white males from Western countries. This lack of representation can send the implicit message that STEM fields are not welcoming or accessible to students from other backgrounds. To address this issue, educators must take intentional steps to diversify the curriculum, ensuring that it reflects the contributions of scientists, engineers, and mathematicians from a wide range of cultural, racial, and gender backgrounds (Russo-Tait, 2022).

By highlighting the achievements of underrepresented groups in STEM, educators can challenge stereotypes and broaden students' understanding of who can succeed in these fields. For example, lessons can include the work of trailblazing African American, Latinx, Indigenous, and female scientists, mathematicians, and engineers. This provides role models for students from similar backgrounds and fosters a greater appreciation of the diverse contributions to STEM fields. When students see individuals who look like them or share similar experiences excelling in STEM, they are more likely to believe they can achieve success in these disciplines (Posselt, 2020).

Furthermore, diversifying the curriculum should extend beyond simply adding diverse names to a list of contributors. It should involve examining the ways in which STEM knowledge has been constructed and used, often in ways that have marginalized or excluded certain communities. Educators can help students understand how power dynamics have shaped scientific inquiry and innovation by encouraging critical thinking about the history and development of STEM fields. This approach deepens students' understanding of STEM subjects and fosters a more inclusive and equitable learning environment (Takeuchi, Sengupta, Shanahan, Adams, & Hachem, 2020).

4.3. Building a Supportive Classroom Culture

A supportive classroom culture is essential for ensuring that all students feel included and valued in STEM education. One of the biggest challenges to fostering such a culture is addressing implicit bias, which can negatively affect the participation and performance of underrepresented students. Implicit bias refers to the unconscious attitudes and stereotypes that individuals may hold about certain groups of people, which can influence their behavior and decision-making. In the context of STEM education, implicit bias can manifest in various ways, such as teachers having lower expectations for students from certain racial or ethnic backgrounds, or students being less likely to be called on in class or selected for leadership roles in group projects (Lorenz, 2021).

To address implicit bias, educators must first be aware of its existence and its potential impact on students. Professional development and training on implicit bias can help teachers recognize and challenge their own biases, ensuring that they create a classroom environment where all students have equal opportunities to participate and succeed.

Additionally, schools can implement practices that promote equity, such as using diverse examples in lessons, ensuring equitable access to advanced coursework, and encouraging collaboration among students from different backgrounds (La Salle, Wang, Wu, & Rocha Neves, 2020).

Encouraging participation from all students is another critical aspect of building a supportive classroom culture. Teachers can use a variety of strategies to ensure that all students feel comfortable speaking up, asking questions, and sharing their ideas. For example, teachers can use inclusive language, create a collaborative and non-competitive atmosphere, and explicitly encourage participation from students who may be hesitant to contribute due to fear of making mistakes or feeling out of place. By fostering a classroom culture that values diversity of thought and encourages open dialogue, educators can help all students feel confident and engaged in STEM learning (Ayeni, Chisom, Al Hamad, Osawaru, & Adewusi, 2024).

Moreover, classroom culture should promote resilience and a growth mindset, particularly in STEM subjects, which can often be challenging. Teachers can help students develop a positive attitude toward learning by emphasizing the importance of persistence, curiosity, and problem-solving. This focus on growth and resilience is especially important for underrepresented students, who may face additional challenges due to systemic barriers. By creating a classroom environment that celebrates effort and improvement, rather than simply rewarding those who achieve the highest scores, teachers can help all students develop the confidence and skills needed to succeed in STEM (Al Hamad, Adewusi, Unachukwu, Osawaru, & Chisom, 2024; Atobatele, Kpodo, & Eke, 2024).

5. CONCLUSION

Promoting equity in STEM education is critical for ensuring that all students, regardless of their background, have the opportunity to succeed and contribute to the fields of science, technology, engineering, and mathematics. This paper has outlined key strategies for supporting underrepresented students in high school science programs, emphasizing the importance of mentorship programs, scholarship initiatives, community engagement, culturally responsive teaching practices, and diversifying STEM curricula. By implementing these strategies, educators and policymakers can create a more inclusive and supportive environment that encourages student participation.

Mentorship programs play a crucial role in providing guidance, academic support, and motivation to underrepresented students. By connecting students with role models who can share their experiences and offer practical advice, mentorship helps to build confidence and foster a sense of belonging in STEM fields. Scholarship initiatives are equally important, as they alleviate financial barriers and make STEM opportunities more accessible to students from low-income backgrounds. Through after-school programs and partnerships with local organizations, community engagement provides additional support and resources, encouraging students to explore and pursue their interests in STEM.

Culturally responsive teaching practices are essential for creating a welcoming environment for diverse students. Educators can make STEM subjects more relatable and engaging by incorporating students' cultural backgrounds into the curriculum and teaching methods. Diversifying STEM curricula to include contributions from underrepresented groups challenges stereotypes and broadens students' understanding of who can succeed in these fields. Building a supportive classroom culture that addresses implicit bias and encourages participation from all students is also critical for fostering an inclusive learning environment.

Policymakers should prioritize funding for mentorship programs and scholarship initiatives aimed at underrepresented students in STEM. They should also support professional development for educators on culturally responsive teaching practices and implicit bias training. Additionally, policies should encourage the development and implementation of diversified STEM curricula that reflect the contributions of scientists from various backgrounds.

Educators should actively seek out and implement culturally responsive teaching practices in their classrooms. They should work to diversify their curricula and highlight the achievements of underrepresented groups in STEM. Building strong relationships with students and creating a supportive classroom culture that values diversity and encourages participation from all students are also essential steps educators can take. Community leaders should foster partnerships between schools and local organizations to provide additional resources and support for underrepresented students. They should promote community engagement initiatives that encourage students to explore STEM subjects outside the classroom. By working together, community leaders, educators, and policymakers can create a more equitable and inclusive STEM education system that supports the success of all students.

References

[1] Al Hamad, N. M., Adewusi, O. E., Unachukwu, C. C., Osawaru, B., & Chisom, O. N. (2024). Counselling as a tool for overcoming barriers in stem education among underrepresented groups. *Engineering Science & Technology Journal, 5*(1), 65-82.

[2] Allegretto, S., García, E., & Weiss, E. (2022). Public Education Funding in the US Needs an Overhaul: How a Larger Federal Role Would Boost Equity and Shield Children from Disinvestment during Downturns. *Economic Policy Institute.*

[3] Arif, S., Massey, M. D. B., Klinard, N., Charbonneau, J., Jabre, L., Martins, A. B., . . . Nanglu, K. (2021). Ten simple rules for supporting historically underrepresented students in science. In (Vol. 17, pp. e1009313): Public Library of Science San Francisco, CA USA.

[4] Atobatele, F. A., Kpodo, P. C., & Eke, I. O. (2024). Strategies for enhancing international student retention: A critical literature review. *Open Access Research Journal of Science and Technology, 10*(2), 035-045.

[5] Ayeni, O. O., Chisom, O. N., Al Hamad, N. M., Osawaru, B., & Adewusi, O. E. (2024). Enhancing STEM education through emotional intelligence and counseling techniques. *World Journal of Advanced Research and Reviews, 21*(2), 903-916.

[6] Beachum, F. D., & Gullo, G. L. (2020). School leadership: Implicit bias and social justice. *Handbook on promoting social justice in education*, 429-454.

[7] Berlian, Z., & Huda, M. (2022). Reflecting culturally responsive and communicative teaching (CRCT) through partnership commitment. *Education Sciences, 12*(5), 295.

[8] Bradford, B. C., Beier, M. E., & Oswald, F. L. (2021). A meta-analysis of university STEM summer bridge program effectiveness. *CBE—Life Sciences Education, 20*(2), ar21.

[9] Breeden, T. (2021). *Invited but excluded: Examining the underrepresentation of African American women and girls in STEM-based fields of education, and how historically Black colleges and universities are bridging the equity gap.* University of Illinois at Urbana-Champaign,

[10] Conger, D., Kennedy, A. I., Long, M. C., & McGhee, R. (2021). The effect of Advanced Placement science on students' skills, confidence, and stress. *Journal of Human Resources, 56*(1), 93-124.

[11] Cruz, C. (2021). From digital disparity to educational excellence: closing the opportunity and achievement gaps for low-income, Black and Latinx students. *Harv. Latinx L. Rev., 24*, 33.

[12] Dare, E. A., Keratithamkul, K., Hiwatig, B. M., & Li, F. (2021). Beyond content: The role of STEM disciplines, real-world problems, 21st century skills, and STEM careers within science teachers' conceptions of integrated STEM education. *Education Sciences, 11*(11), 737.

[13] Eisenhart, M. A., & Weis, L. (2022). *STEM education reform in urban high schools: Opportunities, constraints, culture, and outcomes*: Harvard Education Press.

[14] González-Pérez, S., Mateos de Cabo, R., & Sáinz, M. (2020). Girls in STEM: Is it a female role-model thing? *Frontiers in Psychology, 11*, 564148.

[15] Guenaga, M., Eguíluz, A., Garaizar, P., & Mimenza, A. (2022). The impact of female role models leading a group mentoring program to promote STEM vocations among young girls. *Sustainability, 14*(3), 1420.

[16] Habig, B., & Gupta, P. (2021). Authentic STEM research, practices of science, and interest development in an informal science education program. *International Journal of STEM Education, 8*, 1-18.

[17] Hansen, M. J., Palakal, M. J., & White, L. J. (2024). The importance of STEM sense of belonging and academic hope in enhancing persistence for low-income, underrepresented STEM students. *Journal for STEM Education Research, 7*(2), 155-180.

[18] Heise, N., Hall, H. A., Ivie, K. R., Meyer, C. A., & Clapp, T. R. (2020). Engaging high school students in a university-led summer anatomy camp to promote STEM majors and careers. *Journal of STEM Outreach, 3*(1), 1-7.

[19] Hernandez, A. (2022). Closing the achievement gap in the classroom through culturally relevant pedagogy. *Journal of Education and Learning, 11*(2), 1-21.

[20] Hutchison, L., & McAlister-Shields, L. (2020). Culturally responsive teaching: Its application in higher education environments. *Education Sciences, 10*(5), 124.

[21] Jones, T. R., & Burrell, S. (2022). Present in class yet absent in science: The individual and societal impact of inequitable science instruction and challenge to improve science instruction. *Science Education, 106*(5), 1032-1053.

[22] Kezar, A., Hallett, R. E., Perez, R. J., & Kitchen, J. A. (2024). Scaling success for low-income, first-generation in college, and/or racially minoritized students through a culture of ecological validation. *Journal of Diversity in Higher Education, 17*(2), 229.

[23] Kitchen, J. A., Chen, C., Sonnert, G., & Sadler, P. (2022). The impact of participating in college-run STEM clubs and programs on students' STEM career aspirations. *Teachers College Record, 124*(2), 117-142.

[24] Kuchynka, S. L., Eaton, A., & Rivera, L. M. (2022). Understanding and addressing gender-based inequities in STEM: Research synthesis and recommendations for US K-12 education. *Social Issues and Policy Review, 16*(1), 252-288.

[25] La Salle, T. P., Wang, C., Wu, C., & Rocha Neves, J. (2020). Racial mismatch among minoritized students and white teachers: Implications and recommendations for moving forward. *Journal of Educational and Psychological Consultation, 30*(3), 314-343.

[26] Lau, W. S., & Shea, M. (2024). Empowering English learners in the classroom through culturally responsive social-emotional teaching practices. *Journal of Multilingual and Multicultural Development, 45*(7), 2880-2897.

[27] Lorenz, G. (2021). Subtle discrimination: do stereotypes among teachers trigger bias in their expectations and widen ethnic achievement gaps? *Social Psychology of Education, 24*(2), 537-571.

[28] Martin, A. E., & Fisher-Ari, T. R. (2021). "If We Don't Have Diversity, There's No Future to See": High-school students' perceptions of race and gender representation in STEM. *Science Education, 105*(6), 1076-1099.

[29] Morley, D. A., & Jamil, M. G. (2021). Introduction: Real world learning—recalibrating the higher education response towards application to lifelong learning and diverse career paths. *Applied Pedagogies for Higher Education: Real World Learning and Innovation Across the Curriculum*, 1-17.

[30] Nation, J. M., & Hansen, A. K. (2021). Perspectives on community STEM: learning from partnerships between scientists, researchers, and youth. *Integrative and Comparative Biology, 61*(3), 1055-1065.

[31] Nkrumah, T., & Scott, K. A. (2022). Mentoring in STEM higher education: a synthesis of the literature to (re) present the excluded women of color. *International Journal of STEM Education, 9*(1), 50.

[32] O'Leary, E. S., Shapiro, C., Toma, S., Sayson, H. W., Levis-Fitzgerald, M., Johnson, T., & Sork, V. L. (2020). Creating inclusive classrooms by engaging STEM faculty in culturally responsive teaching workshops. *International Journal of STEM Education, 7*, 1-15.

[33] Peña, C., Ruedas-Gracia, N., Cohen, J. R., Tran, N., & Stratton, M. B. (2022). Ten simple rules for successfully supporting first-generation/low-income (FLI) students in STEM. In (Vol. 18, pp. e1010499): Public Library of Science San Francisco, CA USA.

[34] Posselt, J. R. (2020). *Equity in science: Representation, culture, and the dynamics of change in graduate education.* Stanford University Press.

[35] Russo-Tait, T. (2022). Color-blind or racially conscious? How college science faculty make sense of racial/ethnic underrepresentation in STEM. *Journal of Research in Science Teaching, 59*(10), 1822-1852.

[36] Sarma, S., & Bagiati, A. (2021). *Current innovation in STEM education and equity needs for the future.* Paper presented at the Symposium on Imagining the Future of Undergraduate STEM education, convened by the National Academy of Sciences, Engineering, and Medicine. Available at https://www. nationalacademies. org/event/10-21-2020/imagining-the-future-of-undergraduate-stem-education-symposium Accessed.

[37] Stephens, E. H., & Dearani, J. A. (2021). On becoming a master surgeon: role models, mentorship, coaching, and apprenticeship. *The Annals of Thoracic Surgery, 111*(6), 1746-1753.

[38] Takeuchi, M. A., Sengupta, P., Shanahan, M.-C., Adams, J. D., & Hachem, M. (2020). Transdisciplinarity in STEM education: A critical review. *Studies in Science Education, 56*(2), 213-253.

[39] Tram, J. M., Nwankwo, N., Khan, A. N., & Sabado, J. A. (2023). Impact of faculty mentoring on ethnic and racial minority student program satisfaction. *Scholarship of Teaching and Learning in Psychology, 9*(1), 50.

[40] Tytler, R. (2020). STEM education for the twenty-first century. *Integrated approaches to STEM education: An international perspective*, 21-43.

[41] Varty, A. K. (2022). Promoting achievement for community college STEM students through equity-minded practices. *CBE—Life Sciences Education, 21*(2), ar25.

[42] Whitcomb, K. M., & Singh, C. (2021). Underrepresented minority students receive lower grades and have higher rates of attrition across STEM disciplines: A sign of inequity? *International Journal of Science Education, 43*(7), 1054-1089.

[43] Xu, D., Solanki, S., & Fink, J. (2021). College acceleration for all? Mapping racial gaps in Advanced Placement and dual enrollment participation. *American Educational Research Journal, 58*(5), 954-992.