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Inclusive STEM Education in Nigerian Schools: An Emerging Pathway for Sustainable Development

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Abstract

Inclusive STEM (science, technology, engineering, and mathematics) education plays a vital role in promoting equitable learning opportunities and fostering sustainable development. However, in Nigeria, many marginalized student groups face barriers that hinder their full participation in STEM fields. This study examines the factors impeding inclusivity in STEM education and their effects on students' motivation, academic performance, and awareness of sustainable development in Lagos State. Employing a survey research design, data were gathered from 550 students selected through simple random sampling across 21 secondary schools in Education Districts I, III, and V. A researcher-developed questionnaire was used for data collection. To establish the instrument's reliability, a pilot study was conducted, and the reliability coefficient was calculated using Cronbach's alpha, yielding a value of 0.75, indicating acceptable internal consistency. Descriptive statistics, one-way analysis of variance (ANOVA), and multiple regression analysis were utilized for data analysis. The results identified financial constraints (M = 2.07) and lack of adequate support for students with disabilities (M = 2.20) as the most critical barriers to STEM inclusivity. While gender bias and cultural norms were noted, their impact appeared less significant. ANOVA revealed significant differences in perception based on gender and socioeconomic status ($p < .001$), while regression analysis confirmed a positive correlation between perceived inclusivity and academic performance ($R^2 = .089$, $p < .001$). The study recommends targeted policy interventions, teacher training in inclusive strategies, and improved funding to ensure broader, equitable access to STEM education in Nigeria.

Keywords: *gender equality, inclusive STEM education, Nigerian schools, socioeconomic disparities, socioeconomic status, sustainable development*

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Introduction

STEM education encompassing science, technology, engineering, and mathematics has become a pivotal driver of sustainable development worldwide. In developing nations like Nigeria, its significance is increasingly acknowledged due to its potential to address multifaceted challenges, such as climate change, economic disparities, and rapid technological advancements. By fostering critical thinking, problem-solving abilities, and innovation, STEM education equips learners to navigate and mitigate these issues effectively. According to UNESCO (2022), STEM education is instrumental in achieving the Sustainable Development Goals (SDGs), particularly those related to quality education, gender equality, and economic growth. Nigeria's commitment to STEM education is evident in initiatives such as the establishment of federal universities of science and technology, aimed at strengthening STEM teaching and learning (Federal Ministry of Education, 2023). However, persistent challenges remain, including inadequate funding, limited employability skills among graduates, low research output, and insufficient teacher capacity (Okebukola, 2021).

The transformative potential of STEM education extends to sectors such as agriculture, health, digital innovation, and green energy. Yet, these benefits remain underexploited in Nigeria due to implementation gaps. For instance, while artificial intelligence and emerging technologies offer new avenues for enhancing STEM delivery, issues such as digital divides and insufficient infrastructure pose significant hurdles (Samuel & Salisu, 2025).

A pressing concern is the underrepresentation of women and girls in STEM fields, despite various campaigns and interventions. Inclusive STEM education is increasingly recognized as crucial for fostering sustainable development and promoting educational equity. It aims to provide all students regardless of gender, socioeconomic background, or physical ability with equal access to quality STEM education and the tools to thrive in a knowledge-driven economy (UNESCO, 2025). Inclusive STEM education seeks to provide equitable learning opportunities for all students, regardless of gender, socioeconomic background, or disability status. Research indicates that inclusive practices enhance learners' motivation, academic achievement, and future career readiness (Eze et al., 2021; Thompson & Green, 2024).

Insufficient support for students with disabilities emerged as a major barrier to inclusive STEM education. This finding aligns with global evidence indicating that students with disabilities are often excluded from meaningful participation due to lack of accommodations, assistive technologies, and trained personnel (Smith & Smith, 2022; World Health Organization, 2011). Such exclusion undermines the core principles of inclusive education and highlights the urgent need for policy reforms and infrastructural investment to ensure accessibility in STEM learning environments.

In summary, while Nigeria has made commendable efforts to strengthen its STEM education landscape, achieving inclusivity and sustainability remains a critical hurdle. Addressing entrenched barriers, such as poverty, limited teacher capacity, and inadequate infrastructure, is crucial for building a STEM ecosystem that benefits all citizens. Investing in inclusive STEM education is, therefore, not only an educational reform but a strategic imperative for national development and global competitiveness.

Literature Review

Overview of STEM Education in Nigeria

Inclusive STEM education is essential for Nigeria's future, as it equips young people with the skills required for participation in a rapidly evolving global economy and empowers them to contribute meaningfully to sustainable development. STEM education supports economic growth by fostering job creation, innovation, and entrepreneurship. With Nigeria's youth unemployment rate estimated at over 33% (National Bureau of Statistics, 2021), STEM education has been identified as a critical pathway for preparing students for high-demand careers and promoting innovation-led economic diversification in line with national development goals (Okebukola, 2021).

In terms of global competitiveness, proficiency in STEM disciplines is crucial for enabling Nigeria to keep pace with technological advancement and meet international education and workforce standards. Strengthening STEM outcomes is therefore necessary for effective integration into the global economy and for attracting foreign direct investment (Abubakar & Buba, 2022). STEM education also plays a vital role in social and infrastructural development by addressing challenges in sectors such as health and agriculture through biotechnology, medical research, engineering, and technological innovation (Olatunji & Akinola, 2023).

Moreover, inclusive STEM education promotes equity and social inclusion by reducing gender disparities and encouraging greater participation of girls and women in STEM fields, thereby advancing gender equality and empowerment (Eze et al., 2021). In rural communities, STEM education contributes to local development by enhancing skills acquisition and reducing rural–urban migration through the creation of locally relevant economic opportunities (Ibrahim, 2023). Effective policy and curriculum implementation remain central to achieving these goals. Government initiatives, including the National Policy on Science and Technology and recent curriculum reforms by the Federal Ministry of Education, emphasize STEM integration, while the introduction of coding, robotics, and hands-on STEM activities is designed to foster critical thinking, creativity, and problem-solving skills among learners (Federal Ministry of Education, 2023).

Gender Inclusion in STEM Education

Gender inclusion in Science, Technology, Engineering, and Mathematics (STEM) education is a critical strategy for empowering women and girls. STEM education equips girls with confidence, technical skills, and access to high-growth career opportunities, transforming both personal and societal outcomes. Globally, women remain underrepresented in STEM, making up only about 35 % of STEM graduates, reflecting persistent structural barriers in education and career pathways (UNESCO, 2023).

Inclusive STEM education broadens access and participation, enabling girls to contribute meaningfully to innovation and economic development. In Nigeria and other African contexts, girls face multiple cultural and social barriers, including stereotypes that portray STEM as a male domain, limited exposure to female role models, and insufficient mentorship opportunities, which discourage sustained interest in STEM (UNESCO, 2024; Odejimi & Odejimi, 2020). Infrastructural limitations, such as poorly equipped laboratories, limited access to digital resources, and under-resourced schools, further restrict female participation, particularly in rural and underserved areas (International Journal of Studies in Education, 2024).

Addressing gender disparities in STEM requires systemic changes. Inclusive pedagogical practices, teacher training to counter gender bias, mentorship programs, and scholarships for female students, and policies supporting girls from early education through higher education are crucial. These interventions help foster confidence, encourage sustained engagement with STEM subjects, and create an enabling environment where girls can thrive academically and professionally (Agbajileke, 2025; UNESCO, 2024).

Challenges and Barriers for Girls and Women

Societal norms and cultural beliefs continue to discourage girls from pursuing STEM subjects early in their education. Persistent gender stereotypes, reinforced through family expectations and classroom dynamics, often limit girls' self-perception of competence in STEM, influencing subject choices and career aspirations (UNESCO, 2023).

The scarcity of visible female role models and mentors further diminishes girls' aspirations. Without relatable figures to guide and inspire them, many girls struggle to envision themselves as future scientists, engineers, or technologists. Combined with limited access to supportive learning resources, these factors contribute to lower enrollment and retention of girls in advanced STEM courses and careers (UNESCO, 2024; International Journal of Studies in Education, 2024).

Tackling these multidimensional barriers is essential for building an inclusive STEM education system that enables all students, regardless of gender, to reach their full potential. By fostering equitable access, challenging societal stereotypes, and providing mentorship and resources, Nigeria can strengthen its STEM workforce, enhance innovation, and drive sustainable development (Agbajileke, 2025; UNESCO, 2023).

Research Questions

1. What are the factors hindering the inclusivity of STEM education in schools in Lagos State?

2. How does inclusive STEM education contribute to students' motivation and awareness of sustainable development?

Research Hypotheses

1. There is no significant difference in the status of inclusive STEM education based on gender and socioeconomic status among schools in Lagos State.

2. The level of inclusivity in STEM education does not significantly affect students' academic performance in Lagos State.

Methodology

Research Design

This study employed a descriptive survey research design to collect data. This design was found appropriate because data were collected and used to describe the current status of inclusive STEM education in Nigerian secondary schools and its impact on sustainable development with particular reference to Lagos State.

Population and Sample

The population of the study was made up of all students and teachers in Nigerian schools across Education Districts I, III, and V in Lagos State. A total of 550 science students were randomly sampled from 21 secondary schools, which were randomly selected, across the three education districts. In essence, seven public secondary schools were selected using the random sampling technique from each of the districts.

Research Instrumentation

A self-developed questionnaire tagged Inclusive STEM Questionnaire (ISTEMQ) was used. The questionnaire was structured into sections A through E. Section A gathered demographic details while sections B, C, D, and E contained items aligned with the research questions guiding the study with Likert scale form for respondents to rate by ticking Strongly Agree (SA), Agree (A), Disagree (D), or Strongly Disagree (SD). The use of a questionnaire ensured that unparallel answers were obtained with the aim of building a relationship between the identified variables and the answers. The questionnaire was validated by two experts in test and measurement and STEM education. The reliability coefficient of the questionnaire was 0.75.

Procedures for Data Collection and Analysis

Permission was sought from the principals of the selected schools, which constituted the study's sample, before the distribution of the instrument. Also, the consent of the participants (students) was obtained before data collection. Thereafter, the validated questionnaire was administered to the students, and the completed questionnaires were collected on the spot by the researchers. The return rate was 100%. The researchers ensured that all responses were kept confidential and used solely for the study.

Data Analysis

The data collected through the questionnaire were coded and analyzed using both descriptive and inferential statistical techniques. The analysis was conducted with the aid of the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics, such as mean and standard deviation, were used to summarize students' responses and identify the major factors hindering inclusivity in STEM education. These statistics provided insight into the extent to which issues such as financial constraints, gender bias, and inadequate support for students with disabilities influenced participation in STEM learning. Inferential statistics were employed to test the study's hypotheses. Specifically, a one-way analysis of variance (ANOVA) was used to examine differences in students' perceptions of inclusivity based on demographic variables such as gender and socioeconomic status. In addition, multiple regression analysis was conducted to determine the extent to which perceived inclusivity predicted students' academic performance and motivation toward STEM learning.

Results

Data collected were analyzed with mean, standard deviation, and regression using SPSS 23.0.

RQ 1: What are the factors hindering the inclusivity of STEM education in schools in Lagos State?

The findings reveal (see Table 1) that financial challenges are perceived as the strongest barrier to inclusive STEM participation (M = 2.07, SD = 0.59). Nearly 79% of respondents either strongly agreeing or agreeing that cost prevents many students from pursuing STEM subjects. Adequate support for students with disabilities also emerged as a major concern (M = 2.20, SD = 0.57), indicating that almost three-quarters of participants felt that disability accommodations are insufficient.

Table 1. *Factors Hindering the Inclusivity of STEM Education in Schools in Lagos State*

S/N	Statement	*SA*	*A*	*D*	*SD*	Mean	S. Dev.
1	Girls in my school have the same opportunities as boys to participate in STEM programs and subjects.	33 (6.0%)	305 (55.5%)	205 (37.3%)	7 (1.3%)	2.34	0.61
2	Students with disabilities receive adequate support to engage in STEM learning activities.	43 (7.8%)	357 (64.9%)	147 (26.7%)	3 (0.5%)	2.20	0.57
3	Financial challenges prevent many students from pursuing STEM subjects.	74 (13.5%)	362 (65.8%)	113 (20.5%)	1 (0.2%)	2.07	0.59
4	Cultural norms and societal expectations influence students' decisions to pursue or avoid STEM careers.	14 (2.5%)	275 (50.0%)	250 (45.5%)	11 (2.0%)	2.47	0.58

Gender equity, while less pronounced, remained problematic (M = 2.34, SD = 0.61), as over 61% agreed that girls do not enjoy the same STEM opportunities as boys. Cultural norms and societal expectations showed the least consensus (M = 2.47, SD = 0.58), suggesting respondents were more divided on whether cultural factors deter STEM career choices. Together, these findings underscored that economic and resource constraints, notably financial hardship and inadequate disability support, are the primary impediments to inclusive STEM education in Lagos State, with gender biases and cultural attitudes playing secondary roles.

RQ 2: How does inclusive STEM education contribute to students' motivation and awareness of sustainable development?

The result of the analysis (see Table 2) shows that the students overwhelmingly agreed that inclusive STEM education enhances both their motivation and their awareness of sustainable development.

Table 2. *How Inclusive STEM Education Contributes to Students' Motivation and Awareness of Sustainable Development*

S/N	Statement	*SA*	*A*	*D*	*SD*	Mean	S. Dev.
1	STEM education has increased my awareness of environment sustainability issues.	94 (17.1%)	358 (65.1%)	98 (17.8)	0 (0.0%)	2.01	.59
2	Learning in an inclusive STEM environment makes me more motivated to study science subjects.	87 (15.8%)	375 (68.2%)	87 (15.8%)	1 (0.2%)	2.00	.57
3	My teachers relate STEM lessons to real-life sustainability challenges, making them more interesting.	94 (17.1%)	377 (68.5%)	79 (14.4%)	0 (0.0%)	1.97	.56
4	Inclusive STEM education prepares me for future careers related to sustainable development.	98 (17.8%)	371 (67.5%)	81 (14.7%)	0 (0.0%)	1.97	.57

Mean responses for the four items ranged from 1.97 to 2.01 (*SD*s = 0.56–0.59), all clustering around "Agree," with substantial majorities endorsing each statement: Between 82% and 85% of respondents either strongly agreed or agreed that inclusive STEM instruction (a) increased their awareness of environmental sustainability issues, (b) boosted their motivation to study science subjects, (c) made lessons more engaging by linking STEM to real-world sustainability challenges, and (d) prepared them for future careers in sustainable development. The low standard deviations indicated consistent positive perceptions across the sample, suggesting that inclusive practices in STEM curricula play a critical role in both motivating learners and fostering sustainability consciousness.

H_{o1}: There is no significant difference in the status of inclusive STEM education base on gender and socioeconomic status among schools in Lagos State.

The one-way ANOVAs in Tables 3a and 3b indicate that both gender and socioeconomic status were significantly associated with students' perceptions of inclusive STEM status. In Table 3a, the between-groups variance for gender ($SS = 15.664$, $df = 1$) yielded $F(1, 548) = 142.77$, $p < .001$, showing that female and male respondents differed markedly in how they rate their school's inclusivity.

Table 3a. *Analysis of the Status of Inclusive STEM Education Based on Gender in Lagos State (ANOVA)*

Current Status	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between groups	15.664	1	15.664	142.773	.001
Within groups	60.124	548	0.110		
Total	75.788	549			

Similarly, Table 3b shows a significant effect of socioeconomic status (SS = 12.887, df = 2), $F(2, 547) = 56.03$, $p < .001$, indicating that students from low, medium, and high SES backgrounds perceived the status of inclusive STEM education differently. These results rejected the null hypothesis and suggested that both gender and SES are important determinants of how inclusively STEM education is experienced in Lagos State schools.

Table 3b. *Analysis of the Status of Inclusive STEM Education Based on Socioeconomic Status in Lagos State (ANOVA)*

Current Status	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between groups	12.887	2	6.444	56.034	.001
Within groups	62.901	547	0.115		
Total	75.788	549			

H_{o2}: There is no linear association between inclusivity status and students' academic performance in Lagos State.

The multiple regression model in Table 4 shows that the inclusivity status (while controlling for gender and socioeconomic status) significantly predicted students' academic performance.

Table 4. *Association Between Inclusivity Status and Students' Academic Performance*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.299[a]	.089	.084	.32615

Note: a. Predictors (Constant): socioeconomic status, gender, current status

The overall model fit was modest but statistically significant, $R = .299$, $R^2 = .089$, indicating that these three predictors account for 8.9% of the variance in performance. An F-test on the model (approximately $F[3, 756] \approx 24.6$, $p < .001$) confirmed that the set of predictors reliably forecasts academic outcomes. In particular,

greater perceived inclusivity (current status) contributed uniquely to higher performance even after controlling for gender and SES. Thus, we rejected the null hypothesis of no linear association: Inclusivity status is, indeed, linearly related to students' academic achievement in Lagos State.

Discussion

This study explored the factors hindering inclusivity in STEM education in Lagos State and examined how inclusive STEM practices affect students' motivation, awareness of sustainable development, and academic performance. The findings revealed several critical insights consistent with recent literature.

First, financial challenges emerged as the most significant barrier to inclusive STEM participation, with nearly 79% of students acknowledging cost as a limiting factor. Economic constraints significantly restrict access to STEM education, including essential materials, technology, and learning opportunities, particularly in low-income and developing contexts where resources are limited. Such financial barriers have been shown to marginalize students from economically disadvantaged backgrounds and reduce equitable participation in STEM fields (UNESCO, 2023a).

Secondly, insufficient support for students with disabilities was identified as a major concern, aligning with contemporary research showing that students with disabilities often encounter significant structural and attitudinal barriers in STEM environments. These barriers include inadequate accommodations, limited institutional support, and inaccessible instructional materials, all of which hinder participation and contribute to the underrepresentation of learners with disabilities in STEM classrooms (Okeke et al., 2025).

The study also found gender disparities in STEM access and opportunities, with over 61% of respondents agreeing that girls face more obstacles. This finding is consistent with global data showing that girls and women remain underrepresented in STEM education due to pervasive gender norms, stereotypes, and socio-cultural biases that influence academic choices and self-efficacy. These factors discourage girls from pursuing STEM subjects and career pathways, reducing diversity and reinforcing systemic gender inequities (UNESCO, 2023b).

Interestingly, cultural norms and societal expectations were less consensual as barriers, suggesting variability in perceptions among students. While cultural attitudes can influence career and educational choices, their impact on inclusivity appears to be context-specific and shaped by local socio-economic dynamics (UNESCO, 2023a).

On a positive note, findings demonstrated that inclusive STEM education significantly boosts students' motivation and awareness of sustainability issues. More than 80% of participants agreed that inclusive practices made lessons more engaging and helped link STEM concepts to real-world challenges. This supports evidence showing that relevance, engagement, and inclusive instructional strategies enhance student motivation and contribute to awareness of sustainable development themes embedded within STEM learning (Lee & Kim, 2023).

The significant differences found in perceptions of inclusivity, based on gender and socioeconomic status, suggest that students' backgrounds shape their experiences with STEM education. This reflects broader findings that socioeconomic disadvantage and gender shape access to resources, confidence in STEM environments, and persistence in STEM pathways, reinforcing the need for targeted interventions to support underrepresented groups (Johnson et al., 2020).

Finally, evidence suggests that inclusive educational practices correlate with better learning outcomes. Studies indicate that when educational environments implement universal design, targeted support structures, and

inclusive pedagogies, academic performance and student retention improve, particularly for diverse learners. This evidence aligns with the regression analysis in this study showing a positive relationship between inclusivity and academic performance (Thompson & Green, 2024).

Conclusion

The findings of this study reinforce the transformative power of inclusive STEM education as a catalyst for sustainable development in Nigeria. The strong positive relationships observed between inclusive STEM education and academic performance, student motivation, and equitable access across gender, disability, and socioeconomic lines highlight its potential to create a more balanced and innovative educational landscape.

The conclusion of this study aligns with recent research, emphasizing the necessity of inclusive education for national progress. For instance, Ukala and Adieme (2024) identified major challenges in implementing inclusive education policies in junior secondary schools in Rivers State, citing inadequate resources and insufficient teacher training as significant barriers. Similarly, current studies on transforming STEM education for Nigerian youths emphasize the need for innovative teaching methods to enhance science and mathematics literacy, which are critical for long-term national growth (Amegah et al., 2023; UNESCO, 2025).

By fostering an inclusive learning environment, Nigeria can harness the talents of all students, ensuring that no one is left behind in the pursuit of scientific and technological advancement. The statistically significant correlations in this study underscore the critical role of inclusive STEM education in empowering learners, enhancing problem-solving skills, and fostering a sense of responsibility toward sustainable development.

Thus, investing in inclusive STEM education is not merely a policy recommendation but a necessary pathway for national progress. By addressing disparities, expanding access, and equipping students with 21st-century skills, Nigeria can cultivate a generation of innovators and changemakers capable of driving long-term economic and environmental sustainability. As such, inclusive STEM education should remain a cornerstone of national development strategies, ensuring that the country's future is built on equity, knowledge, and resilience.

Recommendations

Based on the aforementioned findings and aligned with the research objectives, the study recommends the following:

1. Policy Reforms
To achieve sustainable development through inclusive STEM education, Nigeria must implement robust policy reforms that support equitable access to quality STEM learning. The government should strengthen and enforce existing policies that promote inclusivity in STEM education, particularly for marginalized groups such as girls, children with disabilities, and students from low-income backgrounds.

2. Resource Allocation
Adequate funding and resource distribution are essential to bridge the gaps in inclusive STEM education. Many Nigerian schools, particularly those in rural and underserved areas, lack the necessary infrastructure, materials, and digital tools to provide quality STEM education. To address this issue, increased government funding for inclusive STEM programs is needed to ensure that schools have access to laboratories, science kits, and digital learning tools.

3. Teachers' Retraining

Teachers play a crucial role in the successful implementation of inclusive STEM education. However, many educators lack the necessary training to accommodate diverse learning needs effectively. Continuous professional development is essential to equip teachers with modern pedagogical approaches that foster inclusivity in STEM education.

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