

Research Article

Gender differences in STEM engagement: Evidence from female participation in Mathematics, Physics and Chemistry in public secondary schools in Nigeria

H. Muhammad^{a*}, M. Umar^b, A. T. Aliyu^c F. E. Adamu^b & N. A. Y. Musa^d

^aDepartment of Mathematics, Federal University of Education, Kontagora, Nigeria.

^bDepartment of Physics, Federal University of Education, Kontagora, Nigeria.

^cDepartment of Chemistry, Federal University of Education, Kontagora, Nigeria.

^dGovernment Day Secondary School Gabukka, Gombe State, Nigeria.

Abstract

The field of STEM (Science, Technology, Engineering, and Mathematics) education plays a critical role in the development of our nation, but there are still disparities between males and females, particularly in the enrollment of females in main science subjects at the secondary school level. The present study investigated gender parity in participation (enrollment, attendance and engagement) in Mathematics, Chemistry and Physics in public secondary schools in Gombe and Bauchi, Nigeria especially the girls. A descriptive survey design was used for the study with 107 STEM teachers selected using purposive sampling. Data collection was done using a structured questionnaire which is validated by experts. The perceptual items had a reliability statistic of Cronbach's alpha of 0.82. Descriptive statistics were used to analyze the data. The findings revealed that participation of females in Mathematics (40-49%) and Chemistry (40-49%) was moderate while in Physics (below 30%) was low as perceived by teachers. Teachers identified some factors which affect participation such as, interest and motivation, beliefs about STEM, availability of laboratory, parental support, peer influence, stereotypes in society, cultural attitudes, and the presence of role models. The findings highlight the importance of intentional, sustained actions by policy-makers, schools, communities and other stakeholders to enhance females' participation in STEM fields. Challenging stereotypes and encouraging participation of females in STEM disciplines are recommended through public enlightenment activities that are shared via PTAs, community groups, and community meetings.

Keywords: Gender differences, STEM Education, Female participation, Mathematics, Physics, Chemistry

1. Introduction

Science, Technology, Engineering and Mathematics (STEM) education is still one of the most paramount areas of growth, technological advancements and social development. A transformation in today's world. Many countries today depend on a scientifically educated and technically skilled workforce which is the hallmark of the knowledge economy, digitalization, automation and artificial intelligence. Any developed or developing government and international body will always highlight the importance of STEM education for innovation, productivity, being competitive and sustainable in a globalized world. While there are many, People who see the need for STEM education, there are still challenges worldwide to ensure that there is equal participation particularly by gender.

The issue of "gender gap" in STEM education remains an international problem and is still quite complex. Although females have made considerable progress in improving access to basic education and their school enrolment rates, there are variations by subject. UNESCO (2023; 2026).

(Stoet & Geary, 2018) have consistently shown that the participation of females in STEM subjects is significantly less in more specific and career-oriented subjects, at both secondary and post-secondary levels. The global phenomenon indicates that differences in the participation of men and women in STEM fields are not a result of inherent differences in academic abilities, but rather of differences in sociocultural, institutional and psychological factors that influence participation prior to their appearance in academic performance.

In concept, participation in STEM is now considered a multidimensional construct rather than just the number of students in STEM. From the perspective of modern educational research, participation is represented by the presence in the classroom, active engagement in learning activities, the availability of learning materials, involvement in doing activities, and interest in continuing subjects. (Ilyas et al., 2022)_note that participation is the first and most sensitive indicator of inequality in STEM pathways; that is, when students drop out of participation at this point, they are

*Corresponding author: H. Muhammad,

Email address: profmaths781@fcek.edu.ng (H. Muhammad)

ORCID: <https://orcid.org/0009000700951489>

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more likely to fall behind in their STEM performances, to lower their retention in STEM, and ultimately to be excluded from STEM careers. This framing emphasizes the importance of thinking about patterns of (female) participation in the context of the everyday classroom situation.

The Organisation for Economic Co-operation and Development OECD (2024) defines gender gaps in STEM as a process, which can be mapped to the early stages of the learning path that students take in the education system. OECD analyses show that males and females are subject to gender stereotypes about their intelligence and problem-solving abilities, and the roles they can play in the workplace, from an early age. Such expectations are reinforced in subtle ways in families, in the classroom, and in curriculum and media representations. These early experiences influence females' self-concept, self-efficacy in school and interest in the subject matter and eventually drive them to take a path that differs from the STEM path even if they end up with similar outcomes as boys.

Such models as the Social Cognitive Theory give useful information about processes involved, which can be modeled. As part of this, self-efficacy beliefs, observational learning and social reinforcement are key to participation. If females are consistently exposed to a world where STEM is male-dominated, a world where few females succeed in STEM careers, or a world where STEM teachers have a negative perception of females' ability to be successful in STEM, then females' confidence in their ability to be successful in STEM, even if they have high STEM skill levels, diminishes. This explanation is substantiated by the Expectancy-Value Theory that attributes the selection of a subject to learners self-efficacy and values they have for a subject and the effort they think is required to learn that subject. As long as STEM is seen as not socially valuable, challenging, and not feminine, females are less likely to participate in STEM. Theoretically, these dynamics are reflected in regular empirical patterns, all over the world. (Smith & Evans, 2024; Stoet & Geary, 2018) found that in the vast majority of OECD and partner countries, females' interest in STEM-related occupations is lower than males and females are under-represented in high level studies of Mathematics, Physics and Engineering in school. The gender gap widens at the secondary level of education: UNESCO (2025) states that in countries where gender balance is achieved at primary level, the gender gap increases with academic specialisations at secondary level due to the structural and cultural barriers to participation. The participation in STEM is particularly low in sub-Saharan Africa for women and girls.

According to the World Bank (2023), multiple challenges were addressed simultaneously by females in the region including shortage of school resources, teacher shortage, poverty, early marriage, and entrenched gender norms. Because of these factors, girls are restricted in their access to STEM learning opportunities, and to the notion that STEM is inappropriate or unreachable. Most importantly, as the World Bank points out, these constraints are far greater for secondary school students because of the importance of subject choice in secondary school and because of the importance of building confidence and support from institutions to enter into secondary school.

Nigeria has been an example of a lot of these dynamics in the region. Nigeria as the most populous country on the African continent attaches great significance to the importance and practice of STEM education because it is the stepping stone towards the development, industrialization and relevance of the country. The theme of STEM is always emphasized in national policy documents as an essential economic diversification, technological innovation and youth employment (Chisom et al., 2024) But despite these pledges, there are still gender gaps in the STEM learning experiences, especially at the secondary level of education where students start to specialize in subjects like Mathematics, Chemistry and Physics. Overall the situation in secondary education as described in the national education statistics has slightly worsened over the past decade, but steadily improved over the years. There are ongoing gaps in subject level participation, however. The results obtained from WAEC and NECO have shown that participation of male and female students in science subjects such as Mathematics and Chemistry has been steadily rising but that of male students in physics is low (WAEC, 2025; NECO, 2024). while female participation in physics remains even lower (Kibona, 2023). This disparity is often exacerbated by deep-rooted socio-cultural norms that associate scientific and logical reasoning with masculinity, alongside teacher biases that unconsciously provide more attention and encouragement to boys in STEM subjects (Bulala & Ntumi, 2025). The patterns reflect the global trends and accentuated by the specific socio-cultural and institutional context in Nigeria.

The issue of gender in Nigeria is set in the social construction of gender roles in participation of STEM. In popular discourses about culture, scientific thinking, technical skills and abstract thinking are typically associated with men, while caring for others or socially oriented work are associated with women. In this sense, the telling of an account like that helps to shape young girls' academic selves, which in turn affects their sense of self and the expectations of others, as Bie ,(2024) explain. These beliefs become ingrained in children through the attitudes of their parents, the interactions they have with peers and the social norms within their community, which create less supportive environments for girls to persist in STEM fields. At the school level institutional factors further mediate participation. Excessive enrolments in public secondary schools, lack of instructional materials, laboratory facilities and equipment, are some of the challenges faced by many schools in Nigeria. Studies show that girls' confidence is lower and stereotype threat more likely to impact girls, making these limitations more harmful for girls. Okeke and Ramaila, (2024) reveal that frequent practice activities in science education have significant impact on the interest and self-confidence of the learners but when the practice activities are not used regularly and are not adequately resourced for the female learners, the science interest of the learners is reduced.

As a fundamental subject of the STEM disciplines, mathematics also plays a role.

As a gateway to the advanced scientific learning. There is growing awareness in international literature of the significant reduction in gender achievement gaps in Mathematics but persistence and participation gaps continue to exist, especially in advanced mathematics levels. In many

countries, (Chandralekha et al., 2025) reports that girls' performance is equal to boys' performance in Mathematics, but they are far less likely to follow pathways of study that involve Mathematics due to lack of confidence and expectations of society. Similarly, in Nigeria, attitudinal aspect of teacher and parental support, atmosphere of the classroom (Okpe et al., 2022), were also identified as the factors affecting participation of the girls in Mathematics.

Chemistry has its own unique participation challenges with the need for long term commitment to experimental and laboratory-based learning activities. Research from around the world shows that experiential activities are important to promoting a scientific identity and interest, especially among groups that are underrepresented in science. With less access to laboratories, students are less able to relate theory to practice which diminishes engagement in under-resourced contexts. The results of the current study in Nigeria agree with the study conducted by the Nigerian researcher which found out that the factors affecting the participation of girls in Chemistry include practical facilities while the absence of these facilities affects the participation and self-confidence of girls in Chemistry (Rogers & Fraser, 2022)

Physics is still the most male dominated STEM subject in the world. According to (Msafiri et al., 2024), Physics is one of the subjects where school female dropouts are mainly due to the involvement of it with male identity, abstract thinking and technical occupations. According to (Radulović et al., 2022) in most countries of the world the drop in interest in Physics is more than other sciences among girls. This is the typical situation in Nigeria. According to Afamefuna (2023), the enrolment of secondary school girls in Physics in Gombe and Bauchi is still low because of cultural stereotype, non-availability of Physics role model and exposure to Physics related career.

Provides a strategic setting for an understanding of these patterns of participation, in Gombe and Bauchi. Which are part of Nigeria's administrative state and embodies national diversity and systemic educational issues. The conditions in which the public secondary schools of some part of the Gombe and Bauchi are situated is uneven because they have different infrastructures, quality of teachers and availability of school resources. The variability has made them an important focus to develop and document granular evidence of gender differences at the classroom level beyond national averages to reflect the ways in which gender issues are embedded in routine classroom practice.

While there has been a lot of academic research and interest in the gender issue in STEM education in Nigeria, there are salient gaps. The prevailing literature tends to focus on achievement outcomes and exam performance and neglect participation as a separate, important aspect of inequality. UNESCO (2021) warns that use of achievement data only provides a snapshot of disengagement and masking the process of disengagement, making it less effective to inform policy interventions. Moreover, there are few studies that emphasize the point of view of the teacher, when teachers are especially positioned to observe engagement in the classroom.

Participation is influenced by elements of teacher behaviors, feedback and interactions/expectations in the classroom. Their perceptions provide valuable insight into

the lives of girls in STEM subjects on the day-to-day. The experiences studied are particularly suitable to descriptive survey methods, based on practitioner observations, as noted by Harnischfeger and Stahl, (2025) Patterns of teachers' estimates of participation may be identified through research and then inform targeted interventions specific to their context.

The conceptual basis of the present study is the ecological framework that takes into consideration interrelationships among individual, instructional, and sociocultural factors, as well as their influences and contributions to gender disparities in participation in STEM. Girls' engagement is influenced at individual level by interest, motivation and self-beliefs. Participation is influenced at the classroom level by pedagogy as well as peer relations and hands-on activities. On the societal level, the norms of the cultural environment, the expectations of parents and the labour market signal those subject choices that are gendered. These layers are interactively explored with each other to create context-specific participation patterns for subjects.

The study examines the three core subjects of the STEM disciplines, Mathematics, Chemistry and Physics in Senior Secondary School Two (SS2) based on the various curriculum structures, both nationally and internationally. Year 2 is an important year in which decisions are starting to be made in subjects and this will have an influence on the future. Thus, it is essential to understanding what is going on in terms of participation in this phase, before the action taken to do something about gender gaps becomes more permanent gendered exclusion.

STEM education plays a crucial role in national development, industrialization, and innovation. However, there is a persistent gender gap, especially in core subjects like Mathematics, Chemistry, and Physics, particularly at the senior secondary level in Nigeria. While there has been an overall increase in female enrollment in secondary education, gender disparities in classroom participation and engagement are still prevalent. This issue is often overlooked because national statistics generally focus on enrollment figures without delving into subject-specific participation.

Girls are notably underrepresented in key STEM subjects, and this gap begins at an early stage, well before academic results or career outcomes become visible. Most current studies focus on enrollment rates and achievement data, which provide limited insight into the complex dynamics of classroom engagement. Classroom participation is influenced by various contextual factors that are often not captured in these broad statistics.

Teachers, who observe student engagement on a daily basis, are a valuable resource that is not fully utilized in understanding the reasons behind girls' lower participation in STEM. The situation is especially pronounced in Gombe and Bauchi, where uneven resource distribution and varying sociocultural influences further complicate the issue. Moreover, the lack of detailed, classroom-level data on girls' participation in STEM subjects in schools in regions like Gombe and Bauchi underscores the need for targeted interventions to address gender inequality in STEM education.

The following objectives were examined in this study

- (i) To examine teachers' estimates of girls' participation

in SS2 Mathematics, Chemistry, and Physics in public secondary schools in Gombe and Bauchi, focusing on the percentage of girls involved in each subject based on teachers' observations and classroom engagement.

- (ii) To investigate the strategies and actions taken by public secondary schools in Gombe and Bauchi to improve girls' participation in Mathematics, Chemistry, and Physics, including curriculum interventions, teaching methodologies, and resource allocation.
- (iii) To identify and analyze the factors that teachers perceive as influencing girls' participation in Mathematics, Chemistry, and Physics in public secondary schools in Gombe and Bauchi, with a focus on institutional, sociocultural, and pedagogical factors.

The following research questions served as the guide to the study:

- (i) What are teachers' perceptions of percentage of girls that participate in SS2 Mathematics, Chemistry and physics in Gombe and Bauchi.
- (ii) What efforts are public secondary schools in Gombe and Bauchi making to encourage female participation, Mathematics, Physics, and chemistry?
- (iii) What do teachers perceive as the factors that affect the participation of girls in Mathematics, Chemistry and Physics in public secondary school in Gombe and Bauchi.

2. Methodology

The study has a descriptive survey design because it is appropriate for the nature of the study and the focus will be on perceptions and experiences of STEM teachers with respect to girls' participation in Mathematics, Chemistry and Physics in public secondary schools in Gombe and Bauchi, Nigeria. Descriptive survey designs enable data to be collected in a systematic way from a sample of respondents to describe their characteristics, beliefs, or opinions without influencing their behavior (Creswell & Creswell, 2018).

The descriptive survey design was selected to provide teachers with an in-depth look at girls' firsthand estimates of participation and their perceptions of the factors affecting girls' participation in STEM subjects. This design is suitable because it allows this study to obtain reliable data on the situation of participation of female students in STEM at classroom level.

2.1. Population and Sampling

The population of this study is 321 STEM teachers (Mathematics, Chemistry and Physics) of Senior Secondary Class Two (SS2) students in public secondary schools in Gombe and Bauchi. Secondary Education Board records (2025) indicate that there are about 68 public secondary schools in the Gombe and Bauchi region with 2 to 6 teachers each in STEM subjects.

A purposive sampling technique was used for selecting 107 teachers as the sample. This method was selected for the study because it involved teachers who are directly engaged

in teaching SS2 students and who are familiar with female classroom participation. Purposive sampling technique is recommended by Etikan, Musa, and Alkassim (2016) as it increases the accuracy and credibility of data because the sample consists of participants with relevant information for the study.

A total of 107 teachers were retained after data cleaning. This sample was considered adequate for generating meaningful conclusions about classroom participation dynamics in the study area.

2.2. Instrument

The data were collected by applying a structured questionnaire which was prepared to find out teachers' perceptions about the participation of girls in Mathematics, Chemistry and Physics. The questionnaire had three sections:

Section A: Demographic information for teachers such as gender, years of experience and subject taught.

Section B: Teachers' perceptions of girls' participation in SS2 Mathematics, Chemistry and Physics (in percentage terms, e.g., less than 30%, 30-39%, 40-49%, 50% and above).

Section C: Likert scale items measuring teachers' perceptions of various factors influencing girls' participation in STEM subjects, such as interest and motivation, beliefs about STEM, availability of laboratories, peer influence, and cultural attitudes.

Face validity of the questionnaire was ensured by having experts in science education and educational measurement validate the questionnaire. Further, the reliability of the instrument was determined using Cronbach's alpha which gave the coefficient of 0.70, signifying an acceptable level of internal consistency. Participants were efficient in providing data, and the structure of the questionnaire made it possible to compare all the answers.

2.3. Data Collection Procedure

The data collection process was divided into two parts. The first phase was the physical distribution of the questionnaires to the selected teachers in the various schools. The second phase, questionnaires were also made available by digital means (email and WhatsApp) to cater for the busy schedules and locations of teachers. This approach worked well to boost response and inclusion of teachers with different levels of availability. The purpose of the study was explained to the teachers and they were told they had the option of participating or not. Their responses were ensured to be kept confidential and their names were not written down to preserve anonymity.

The questionnaires were pilot tested on a small sample of teachers from outside the study area to find out the ambiguities in the items and make the necessary refinements. To ensure data quality, the data was filtered for incomplete or inconsistent responses.

2.4. Data Analysis

Data obtained from the questionnaires were subjected to descriptive statistics such as frequencies, percentages, mean and standard deviation. These measures enabled an understanding of the distribution of teachers' estimates of girls' participation and the perceived reasons for participation. Specifically:

The teachers' estimate of the participation of girls in SS2

Mathematics, Chemistry and Physics were summarized using frequencies and percentages.

The Likert scale items were used to determine means and standard deviations to measure the perceived influence of different factors on girls' participation.

The findings were analysed with regard to the three research questions of the study:

Descriptive statistics gave a detailed picture of the data, patterns and trends in girls participation in all three subjects were identified. The data analysis results were presented and

discussed with other existing literature and theory in order to come to conclusions and provide recommendations on how to promote gender equity in STEM education.

3. Results

3.1. Research Question 1

What do teachers think of the percentage of girls that participate in SS2 Mathematics, Chemistry, and Physics?

Table 1. Teachers' Estimates of Girls' Participation in SS2 Mathematics, Chemistry, and Physics.

Subject	Less than 30%	30-39%	40-49%	50%and above
Mathematics	13.7%	28.4%	43.5%	12.7%
Chemistry	13.4%	31.7%	48.9%	10.8%
Physics	55.4%	30.6%	11.0%	0%

Table 1 presents the teachers' estimates regarding the level of girls' participation in Mathematics, Chemistry, and Physics in SS2 (Senior Secondary School 2) based on their observations. The data shows that girls' participation in Mathematics and Chemistry is moderate, with a significant portion of teachers (43.5% for Mathematics and 48.9% for Chemistry) estimating participation between 40-49%. However, the participation in Physics is notably lower, with over half (58.4%) of teachers estimating that less than 30% of girls participate in Physics classes. These estimates

reflect the general trends in the classroom and indicate a lower female engagement in Physics compared to Mathematics and Chemistry. (Note- this table would be better if there was a comparison with percentage for boys' participation)

3.2. Research Question 2

What factors do teachers perceive as influencing female participation in Mathematics, Chemistry and Physics in public secondary schools in Gombe and Bauchi?

Table 2: Teachers' Perceived Factors Influencing Female Participation in STEM Subjects

S/N	Factors	Mean Rating (X)
1	Interest and motivation	3.60
2	Beliefs about STEM and girls' self-confidence	3.52
3	Availability of laboratories and practical activities	3.43
4	Parental support and involvement	3.45
5	Influence of peers	3.30
6	Female role models and their representation in STEM	3.39
7	Cultural norms and societal expectations	3.27

Table 2 presents teachers' perceptions regarding the factors that influence girls' participation in STEM subjects (Mathematics, Chemistry, and Physics). Based on the mean ratings provided, the most influential factors include interest and motivation (3.60) and beliefs about STEM and girls' self-confidence (3.52), which are considered highly important. Other significant factors include the availability of laboratories and the quality of practical activities (3.43), which are critical for engaging students in hands-on learning. Teachers also cited the role of parental support, peer influence, female role models, and cultural norms as important but somewhat

less influential compared to the top factors. These insights suggest that improving access to resources, fostering motivation, and enhancing self-confidence are key strategies for improving girls' participation in STEM education.

3.3. Research Question 3

What do teachers perceive as the factors that affect the participation of girls in Mathematics, Chemistry, and Physics in public secondary schools in Gombe and Bauchi?

Table 3: Teachers' Perceptions of Factors Influencing Girls' Participation in STEM Subjects.

Factors	Teachers' Perceptions (Influence Rating)
Interest and Motivation	Highly influential
Beliefs about STEM and Girls' Self-Confidence	Moderately influential
Availability of Laboratories and Practical Activities	Highly influential
Parental Support and Involvement	Moderately influential
Peer Influence	Moderately influential
Female Role Models and Representation in STEM	Moderately influential
Cultural Norms and Societal Expectations	Moderately influential

This table summarizes teachers' perceptions of the various factors that impact girls' participation in STEM subjects across the two regions of Gombe and Bauchi. Teachers ranked factors such as *interest and motivation*, availability of practical activities, and beliefs about STEM and self-confidence as highly influential, meaning they believe these factors play a crucial role in encouraging or discouraging girls' engagement with STEM subjects. Other perceived influences such as parental support, peer influence, and female role models were also considered moderately influential, highlighting the role of societal and familial expectations in shaping girls' participation. The presence of cultural norms and societal expectations were also seen as factors that impact participation, but their influence was considered slightly lower compared to the other factors.

4. Discussion

This section explores how the study's findings align with existing research on gender and STEM participation. It focuses on classroom presence, engagement, learning opportunities, and sustained interest, beyond enrollment and performance. Findings are discussed through the lens of sociocultural, institutional, and pedagogical influences on girls' involvement in Mathematics, Chemistry, and Physics in Gombe and Bauchi public schools.

4.1. Girls' Participation in Mathematics

The study reveals moderate participation of girls in SS2 Mathematics, with estimates ranging from 40-49% in Gombe and Bauchi. While girls are increasingly present in Mathematics classrooms, gender parity remains unmet. This reflects global trends, where despite girls performing similarly to boys, their participation lags. Factors influencing participation include confidence, sociocultural barriers, and the expectancy-value theory, which posits that students' expectations and perceived value of the subject affect their engagement. In many contexts, girls may lack confidence in their mathematical ability, influencing their decision to drop out or avoid Math-intensive pathways. National studies confirm that gendered expectations and societal norms shape

girls' Mathematics participation. While access has improved, this study highlights the need for more supportive classroom dynamics to ensure girls' sustained engagement in Mathematics.

4.2. Girls' Participation in Chemistry

Girls' participation in Chemistry is also moderate, estimated between 40-49%, slightly lower than in Mathematics. This is partly due to Chemistry's theoretical and experimental nature, where hands-on laboratory experiences are crucial. International research emphasizes the importance of laboratory-based learning in fostering confidence and interest, particularly for girls. Lack of consistent access to such opportunities affects girls' participation, as they are more sensitive to stereotype threats. In Nigeria, inadequate laboratory facilities and overcrowded sessions exacerbate this issue. These structural barriers, coupled with sociocultural pressures, limit girls' confidence and engagement. As per Social Cognitive Theory, mastery experiences, such as successful experiments, are critical for maintaining participation and self-efficacy in STEM.

4.3. Girls' Participation in Physics

Physics shows the lowest female participation, with over half of the teachers estimating less than 30% female involvement. This aligns with global trends, where Physics is the most gender-segregated STEM subject. Girls perceive Physics as abstract, mathematically difficult, and socially masculine, contributing to their disengagement. The study found that inadequate exposure to female role models, gender stereotypes, and institutional barriers discourage girls from pursuing Physics. According to the Expectancy-Value and Social Cognitive theories, girls' low expectations of success and lack of support further hinder their participation. These findings suggest that targeted interventions are needed to improve girls' engagement with Physics.

4.4. Teachers' Perceptions of Participation Influencers

Teachers identified several factors influencing girls' participation in STEM: interest and motivation, beliefs about

STEM, self-confidence, laboratory availability, parental support, peer influence, role models, and cultural stereotypes. International literature supports the idea that interest in STEM is highly malleable, influenced by teacher encouragement and exposure to relatable role models. Parental and peer support plays a crucial role in overcoming societal stereotypes and fostering engagement. The study also highlights the importance of female role models, particularly in Physics, where gender stereotypes are entrenched. These factors demonstrate the need for a holistic approach to encourage girls' STEM participation.

5. Conclusion

This study reveals subject-specific differences in girls' participation in STEM. While there is moderate participation in Mathematics and Chemistry, Physics remains a major gap. The study shows that sociocultural and institutional factors, rather than ability, influence girls' STEM participation. Teacher perceptions align with existing literature, highlighting the importance of supportive, inclusive learning environments. Addressing these gaps at the classroom level is critical to ensuring girls' continued engagement in STEM and reducing underrepresentation in future STEM careers.

Recommendations:

1. Strengthen Gender-Inclusive Pedagogies: Teachers should adopt strategies that actively engage girls in STEM subjects, especially in problem-solving and practical work.
2. Policy Investment in STEM Infrastructure: Governments should prioritize funding for laboratory facilities, instructional materials, and professional development to enhance STEM education.
3. Encourage Peer Support Networks: Schools should foster STEM clubs and peer support groups for girls, promoting collaboration, confidence, and sustained interest in STEM fields.

Abbreviations

STEM	Science, Technology Engineering and Mathematics.
AI	Artificial Intelligence
CTST	Critical Thinking Skills Test
SPSPT	STEM-Problem-Solving Performance Test

Author Contributions

Hassan Muhammad: Conceptualization, Investigation, Validation, Writing –Review & Editing, Project Administration, Methodology.

Mudassir Umar: writing –Review & Editing.

Attahiru Tahir Aliyu: writing –Review & Editing.

Firdausi Erena Adamu: Data Curation, Investigation, Formal Analysis, Writing - original draft.

Nura Alhaji Yahaya Musa: writing –Review & Editing.

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Conflicts of Interest

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