STEM Perceptions and Barriers: The Influence of Gender and School Type among Junior High School Learners in the Central Region of Ghana

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Abstract
This study explores the perceptions and barriers to Science, Technology, Engineering, and Mathematics (STEM) education among junior high school learners in the Central Region of Ghana, focusing on the influences of gender and school type. The research utilised a descriptive survey design, and a structured questionnaire was used to collect data from 1,030 learners across 20 public and 10 private schools. A three-stage, multi-stage sampling approach was used to select the learners and the districts. The findings indicate that learners generally held positive perceptions of STEM courses, with the overall mean score suggesting that STEM education is considered valuable and relevant for future opportunities. However, the study revealed a gender disparity in perceptions, with male learners (M = 2.60, SD = 0.354) exhibiting a significantly more favourable view of STEM subjects compared to their female counterparts (M = 2.50, SD = 0.378). Additionally, learners attending private schools reported a higher perception of STEM education compared to those in public schools, suggesting that resource availability and school infrastructure influence learners' attitudes toward STEM. Despite the positive perceptions, the study identified significant barriers that hinder learners' engagement with STEM education. Financial constraints, limited access to resources, inadequate mentorship opportunities, and insufficient school infrastructure were highlighted as key challenges. The study found that these barriers, rather than cultural or gendered societal expectations, primarily affect learners' ability to pursue STEM fields. The influence of gender and school type on the barriers faced by learners was also significant, with public school learners reporting more challenges compared to private school learners. The findings call for specific solutions to address these barriers, with a focus on improving resource allocation in public schools, providing mentorship programmes, and fostering an inclusive educational environment that encourages both male and female learners to pursue STEM careers.

Keywords: STEM education, gender disparities, school type, barriers, perceptions of STEM

To cite this article: Kumazah, V., Addae, A. E. &Akayuure, P. (2026). STEM perceptions and barriers: The influence of gender and school type among junior high school learners in the Central Region of Ghana. *Ghana Journal of Education and Teaching, 14*(3), 64-78.

Introduction

Science, Technology, Engineering, and Mathematics (STEM) education is increasingly recognised as a fundamental driver of global innovation, economic progress, and solutions to contemporary challenges, including climate change, digital transformation, and public health (Fazio, 2024). Within Ghana, the government has placed significant emphasis on expanding STEM education to develop a highly skilled workforce, particularly among girls, capable of driving national development (Akon-Yamga et al., 2024; Ghana Business News, 2022). This initiative aligns with the United Nations Sustainable Development Goals (SDGs) 4 and 5, which prioritise quality education and gender equality (DeCoito et al., 2024). However, despite these efforts, gender disparities in STEM participation remain prevalent, particularly among Junior High School (JHS) learners, who are at a critical stage in shaping their academic and career aspirations.

STEM education is widely recognised as essential for national growth, technological advancement, and global competitiveness. However, gender disparities in participation remain a significant challenge, particularly in developing countries such as Ghana (Boateng, 2025). These disparities are often reinforced by sociocultural perception, inadequate infrastructure, and limited educational resources, all of which shape how male and female learners perceive and select STEM courses. In the Ghanaian context, societal expectations frequently encourage boys to pursue STEM-related subjects, while girls are often directed toward traditionally "feminine" career paths such as teaching or nursing (Osei-Bonsu, 2024). This pattern not only restricts girls' access to STEM education but also contributes to the persistent under-representation of women in STEM careers. Empirical studies further highlight the role of family influence, societal expectations, and gender stereotypes in shaping female participation in STEM programmes in Ghana (Quansah et al., 2020). Moreover, gendered cultural norms, limited access to mentorship opportunities, and expectations surrounding caregiving responsibilities continue to constrain women's participation and career advancement in STEM fields (Wrigley-Asante, Ackah & Frimpong, 2022). Broader socio-cultural factors, including traditional gender role expectations, early marriage pressures in some contexts, and the shortage of female STEM role models, also limit girls' progression into higher education and STEM-related career pathways (Ojong, 2025). However, evidence shows that when girls are provided with mentorship, career guidance, and strong support systems from families and schools, their interest in STEM and likelihood of pursuing STEM careers increase significantly (Guenaga et al., 2022). This suggests that participation gaps are largely driven by social and structural barriers rather than differences in ability or motivation (Awoniyi & Jokotagba, 2025).

Beyond gender disparities, several structural and systemic barriers continue to hinder learners' engagement with STEM education. These include limited access to quality learning resources and laboratory facilities, inadequate mentoring opportunities, financial constraints, and socio-cultural attitudes that discourage learners, especially girls, from pursuing STEM-related fields. In many cases, these barriers interact, further reinforcing inequalities in participation and academic achievement. Although the Central Region is widely regarded as one of Ghana's key educational hubs due to its concentration of basic, secondary, and tertiary institutions, disparities in STEM-focused development and access remain evident. For example, recent government initiatives to establish STEM-focused senior high schools have largely been implemented in other regions, leaving the Central Region with relatively fewer dedicated STEM-focused second-cycle institutions. Furthermore, many STEM outreach programmes and initiatives aimed at stimulating

learners' interest in STEM courses and careers are often concentrated in the regional capital, limiting access for learners in other districts within the region. This uneven distribution of STEM opportunities may contribute to differences in exposure, motivation, and participation among learners across the central region. Against this background, this study seeks to examine the role of gender, school type, and systemic barriers in shaping STEM perceptions among junior high school learners in Ghana's Central Region, leading to the following research questions:

1. What is the perception of STEM courses among JHS learners in the Central region of Ghana?
2. How does gender influence learners' attitudes toward STEM education in the junior high school in the central region of Ghana?
3. What is the influence of school type (public vs. private) on STEM-related subjects?
4. What are the barriers JHS learners face in pursuing STEM education?
5. What is the effect of gender and school type on the barriers learners face in pursuing STEM?

By exploring these dimensions, this study aims to offer a better insight that can inform policies and interventions designed to reduce gender disparities in STEM education and mitigate the barriers that limit overall participation in STEM fields.

Literature Review and Theoretical Framework

Global Trends in STEM Education

STEM education has become a cornerstone of national education strategy globally, as countries recognise its importance in addressing socio-economic challenges and preparing learners for future workforce demands. Numerous international studies have underscored the need to increase participation among women and minorities in STEM fields, yet substantial gender gaps persist, particularly in developing regions like Sub-Saharan Africa (Matete, 2021).

At the global level, the scale of gender inequality in STEM remains both persistent and deeply concerning. Data from the UNESCO Institute for Statistics, released as part of the 2024 Global Education Monitoring (GEM) Gender Report, reveal that women constituted just 35% of STEM graduates between 2018 and 2023, a proportion that has remained unchanged for over a decade (Montoya, 2024). In countries across sub-Saharan Africa, this figure is even more alarming, with 5 out of 12 nations in which women accounted for fewer than one in four STEM graduates located within the region (Montoya, 2024). These data reflect not only persistent structural disadvantages but also the failure of existing policy frameworks to produce meaningful and sustained change in women's STEM participation at tertiary level. Equally troubling is evidence from the same report showing that women held less than 25% of science, engineering, and information and communications technology jobs globally in 2022, reinforcing the view that educational inequalities translate directly into workforce disparities.

Regional studies from across the globe shed further light on the complexity of these trends. In Ghana, while the government has prioritised STEM education, gender imbalances in STEM enrolment remain entrenched, particularly in rural and economically disadvantaged areas (Partey, 2022). These gender disparities are compounded by societal perceptions that associate STEM fields with male-dominated careers, overshadowing the contributions women can make to technological and scientific innovation. Also, a longitudinal study by Namkunda and Mosha

(2025) examining gender parity trends across higher education institutions in Tanzania from 2018 to 2024 found that while medicine, veterinary science, and health sciences recorded notable progress, engineering remained severely unequal, with a Gender Parity Index of only 0.284 by the 2023 to 2024 academic year. These findings illustrate that gains in some STEM disciplines do not necessarily translate into broader systemic equity, and that fields such as engineering continue to present formidable barriers to female participation even in contexts where national education systems are expanding. Across the Middle East and North Africa (MENA) region, a scoping review by EL-Deghaidy and Anwar (2025) covering 26 publications from 2014 to 2023 found that socio-cultural factors, including entrenched gender role perceptions and stereotypes, were the dominant influences shaping women's educational choices and STEM career pathways. Crucially, the review noted that high female enrolment and strong academic achievement did not automatically translate into equitable workforce participation, highlighting a structural disconnect between educational attainment and professional opportunity. In China, research examining over 1,240 high school students in Hunan Province found that environmental factors such as school education, informal learning, social support, and media exposure significantly influenced female students' STEM career interests through the mediating roles of self-efficacy and career perception (Li et al., 2023). These findings suggest that STEM participation is shaped not merely by academic ability but by a broader ecosystem of social and institutional influences that differ meaningfully across gender lines.

In Latin America, a study by Pineda et al. (2025) examining gender trends in STEM programmes drew attention to the growing body of bibliometric evidence documenting the persistence of gendered participation patterns across multiple national contexts. The authors noted that while policy interventions have proliferated in recent years, structural inequalities remain deeply embedded in educational systems and continue to constrain women's progression into STEM fields. Similarly, a study in Chile by Dussaillant and Paredes (2023) found that exposure to STEM-related upper secondary curricula was positively associated with enrolment in STEM programmes at higher education level, yet gender gaps in persistence remained pronounced, indicating that early academic exposure alone is insufficient to close participation disparities without complementary social and institutional support. In the Asia Pacific region, a report published by the United Nations Development Programme (UNDP, 2024) underscored that gender gaps in STEM do not automatically diminish with increased economic or human development. The report identified complex intersections between cultural norms, institutional barriers, and economic constraints as the primary drivers of continued female underrepresentation in STEM across diverse national contexts, reinforcing the view that targeted, context-sensitive interventions are essential to achieving meaningful progress. These cumulative global findings provide an important backdrop for understanding the specific dynamics shaping STEM participation among junior high school learners in Ghana's Central Region, where gender and school-type inequalities operate within a similarly complex socio-structural environment.

Barriers to STEM Participation

In Ghana, multiple barriers hinder learners, especially girls, from pursuing STEM education. Cultural norms and gender stereotypes present significant challenges, as STEM fields are often seen as male-dominated, discouraging female learners from engaging with these subjects (Osei-Bonsu, 2024). Additionally, limited infrastructure in many schools, particularly in rural areas, restricts access to essential STEM resources such as laboratories, computers, and science equipment (Anning, 2024). Financial constraints also pose a significant challenge, as families in

economically disadvantaged areas may prioritise other fields over STEM education for their children, particularly for girls. Furthermore, there is an inadequacy of mentorship and career guidance, which prevents learners from fully understanding the opportunities available in STEM careers.

These barriers are not unique to Ghana but reflect patterns documented across the Global South. A broad analysis of STEM education in developing countries found that financial underfunding remains the primary structural impediment, with inadequate laboratory equipment, poor infrastructure, and the shortage of qualified STEM teachers being recurring features of under-resourced educational systems (Choo & Sarpong, 2024). A UNESCO science report further noted that sub-Saharan Africa spends an average of only 0.51% of its gross domestic product on research and development, far below the global average of 1.79%, reflecting a systemic underinvestment that extends directly into school-level STEM provision (Schneegans et al., 2021). These resource deficits compound the disadvantages faced by learners in public schools, where overcrowded classrooms, insufficient teaching materials, and limited extracurricular opportunities create conditions that are inherently unfavourable to STEM engagement.

The absence of mentorship has emerged in recent scholarship as one of the most consequential barriers to sustained female STEM participation. A study published in Frontiers in Education by Torres-Ramos et al. (2025), drawing on qualitative interviews with women occupying managerial, research, and teaching roles in STEM fields, found that mentorship was consistently identified as a critical enabler of both professional confidence and career persistence. The authors noted that while mentoring alone cannot dismantle structural bias, it plays a vital role in helping learners navigate discriminatory environments, building self-efficacy, expanding professional networks, and affirming identity within fields where women remain significantly underrepresented. Similarly, research by Kataeva and Durrani (2025), drawing on a bibliometric analysis of gender and STEM publications, found that teachers' perceptions and gender stereotypes frequently translate into differential expectations for male and female students, with female students' mathematical and scientific capabilities routinely underestimated. This dynamic operates as an early-stage barrier that can diminish girls' confidence and willingness to pursue STEM pathways long before they reach secondary school. Taken together, these studies point to a web of interlocking barriers, encompassing financial disadvantage, inadequate infrastructure, limited mentorship, and deeply embedded gender stereotypes, that collectively suppress STEM participation, particularly among girls in public school settings in developing country contexts.

Sociocultural Theory of Cognitive Development

This study is grounded in Vygotsky's Sociocultural Theory of Cognitive Development (Vygotsky, 1978), which emphasises that learning is a socially mediated process. According to Vygotsky, cognitive development occurs through interactions within a given cultural context. This theory underscores the influence of societal norms, values, and educational environments on learners' learning experiences and career choices. The theory provides a lens through which the impact of gendered societal expectations, educational barriers, and sociocultural influences on learners' STEM perceptions can be understood. In the context of this study, addressing these social and cultural factors is essential to promote gender equity in STEM education and overcoming barriers to participation.

Taken together, the literature reviewed and the theoretical framework adopted in this study provide a coherent and mutually reinforcing basis for the research methodology that follows. The body of

global and Ghanaian evidence reviewed highlights that STEM participation is shaped by a layered interplay of structural, sociocultural, and institutional factors, including school resource disparities, gendered stereotypes, financial constraints, and the availability of mentorship and guidance. Vygotsky's Sociocultural Theory of Cognitive Development offers a conceptually robust lens through which these influences can be systematically examined, given its emphasis on the socially situated nature of learning and how cultural context mediates cognitive development and educational choice. The theory directs attention towards the role of social interactions, institutional environments, and broader cultural norms in shaping how learners perceive, engage with, and make decisions about STEM education. This alignment between the theoretical framework and the documented empirical evidence justifies the adoption of a descriptive survey design, which is well-suited to capturing learners' perceptions and experiences across varied social and institutional contexts. The survey approach allows for the systematic collection of data from a large and diverse sample of junior high school learners, thereby enabling a nuanced examination of how gender and school type intersect with sociocultural influences to shape STEM perceptions and participation patterns in Ghana's Central Region.

Methodology

Research design

A descriptive survey design was employed for this study. Descriptive surveys are effective tools for capturing the current perceptions and opinions of a population without altering the natural environment (Siedlecki, 2020). In this case, the survey design enabled the collection of data regarding JHS learners' perceptions of STEM courses, the factors influencing their educational choices, the barriers they face in STEM education, and the role of gender and school type in shaping these perceptions.

Participants

The study was conducted in the Central Region of Ghana, which includes both urban and rural districts. In the context of this study, a junior high school learner is a learner in grade 9 and between the 12 to 15 years. A multistage sampling approach was used to select a representative sample of JHS learners. In the first stage, five assemblies were randomly selected, comprising one metropolitan assembly, two municipal assemblies, and two district assemblies. In the second stage, six schools (four public and two private) were randomly selected from each assembly. In the third stage, one Form 3 class from each school was purposively selected, as these learners were preparing for their transition to Senior High School (SHS). The final stage involved all learners from the selected Form 3 classes, resulting in a total sample size of 1,030 learners.

Data collection instruments

The primary data collection instrument was a structured questionnaire, adapted from a previous study by Verdugo-Castro, Sánchez-Gómez, and García-Holgado (2022). The questionnaire was designed to gather data on learners' perceptions of STEM courses, the barriers they encounter, and the factors influencing their decision to pursue STEM education. The instrument was contextualised to reflect the Ghanaian JHS environment, including school resources, common career aspirations among Ghanaian learners, and local sociocultural influences. To ensure contextual relevance, some items were modified to reflect the Ghanaian educational and social context. For example, one adapted item used in the questionnaire was: "STEM subjects will help me get a good job in Ghana in the future." This item was included to capture learners' perceptions

of the relevance of STEM education to career opportunities within the Ghanaian context while maintaining alignment with the constructs measured in the original instrument.

The instrument was piloted in four junior high schools whose students were not part of the main study sample to assess clarity, cultural relevance, validity, and reliability before being administered to the study participants. The pilot results confirmed that the instrument was clear and contextually appropriate, and internal consistency reliability analysis yielded a Cronbach alpha coefficient of 0.74, indicating an acceptable level of reliability for the scale (George & Mallery, 2003). The use of a structured questionnaire enabled the collection of standardised data across a large sample of learners, consistent with previous STEM perception studies conducted in similar educational settings.

Data analysis

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise the demographic characteristics of the respondents, their perceptions of STEM education, and the barriers to STEM participation. Inferential statistics, including independent sample t-tests and one-way ANOVA, were applied to assess significant differences in perceptions based on gender and school type. Post hoc tests were conducted to further investigate significant differences between groups, especially in relation to the barriers learners face in pursuing STEM education.

Results

Out of a total of 1030 JHS learners who participated in this study, as shown in Table 1, there were more females (53.5%) who participated than their male counterparts (46.5%). Regarding the school type, the majority of the participants were attending JHS (64.8%), while the remaining participants were in the private JHS (35.2%).

Table 1: Demographic Characteristics of Participants

Gender	n (%)	School types	n (%)
Male	479 (46.5)	Public school	667 (64.8)
Female	551 (53.5)	Private school	363 (35.2)
Total	**1030 (100.0)**	**Total**	**1030 (100.0)**

Perceptions of STEM Courses

The general perception of STEM courses among JHS learners was largely positive, with an overall mean score of 2.55 (SD = 0.37), indicating that learners viewed STEM courses favourably. Table 2 summarises the responses to specific items regarding perceptions of STEM courses. A majority of learners admitted that STEM courses were interesting and engaging (81.5%), that teachers made STEM subjects easy to understand (73.7%), and that STEM courses prepared learners for future opportunities (89.2%). However, almost half of the learners (47.6%) reported that resources for learning STEM subjects in their schools were inadequate.

Table 2: Perception of STEM Courses

Items	Agree n (%)	Not sure n (%)	Disagree n (%)	Mean	Std. Dev.
STEM courses are interesting and engaging	839 (81.5)	149 (14.5)	42 (4.1)	2.77	0.507
Teachers make STEM subjects easy to understand	759 (73.7)	178 (17.3)	93 (9.0)	2.65	0.640
Adequate encouragement to pursue STEM in their school	699 (67.9)	205 (19.9)	126 (12.2)	2.56	0.701
Resources for learning STEM subjects in schools are adequate	405 (39.3)	135 (13.1)	490 (47.6)	1.92	0.929
STEM courses prepare learners for future opportunities	919 (89.2)	78 (7.6)	33 (3.2)	2.86	0.431
Overall perceptions				**2.55**	**0.370**

****Mean score < 2.00 = poor perception and Mean score ≥ 2.00 = positive perception****

Gender and STEM Perceptions

An independent sample t-test was conducted to assess whether there was a significant difference in STEM perceptions between male and female learners. Equal variance is assumed as indicated by Levene's test (p = 0.10). The results showed that male learners (M = 2.60, SD = 0.354) had a significantly more favourable perception of STEM courses compared to female learners (M = 2.50, SD = 0.378); t (1028) = 4.025, p = 0.001. This suggests that while both male and female learners generally have a positive perception of STEM courses, male learners exhibit a stronger positive perception than females.

Table 3: Difference Between Learners' Perception of STEM Courses Across Gender

Gender	N	Mean	Std. dev.	t	df	Sig. (2-tailed)
Male	479	2.60	0.354	4.025	1028	0.001
Female	551	2.50	0.378			

p = 0.05

School Type and STEM Perceptions

To assess the effect of school type (public vs. private) on STEM perceptions, an independent sample t-test was performed. The results presented in Table 4 assume equal variance, as indicated by Levene's test (p = 0.721). The result reveals a statistically significant difference in the perception of STEM courses between public and private school learners. Specifically, learners in private schools reported a higher perception (M = 2.63, SD = 0.355) compared to their public-school counterparts (M = 2.50, SD = 0.370), t (1028) = -5.505, p = 0.001. This suggests that while public and private school learners generally have a positive perception of STEM courses, learners in private schools exhibit a slightly stronger positive perception than public school learners.

Table 4: Difference between learners' perception of STEM courses across school types

School types	N	Mean	Std. dev	t	df	Sig. (2-tailed)
Public school	667	2.50	0.370	-5.505	1028	0.001
Private school	363	2.63	0.355			

p= 0.05

Barriers to Pursuing STEM Education

The barriers to pursuing STEM education among JHS learners were significant, with the overall mean score for barriers reported as 2.18 (SD = 0.39), indicating that learners encountered several challenges in engaging with STEM courses. Table 5 summarises the specific barriers learners face when pursuing STEM education. A majority of learners reported that STEM subjects were difficult compared to other subjects (40.6%), that there was limited access to mentorship or guidance for pursuing STEM careers (48.2%), and that financial difficulties were a major barrier (54.7%). Furthermore, a significant proportion of learners (63.2%) reported that their schools lacked adequate facilities to support STEM education. However, cultural and societal expectations were less of a barrier, with only 33.7% of learners agreeing that such sociocultural expectations discouraged them from pursuing STEM.

Table 5: Challenges in STEM Courses and Careers

Items	Agree n (%)	Not sure n (%)	Disagree n (%)	Mean	Std. Dev.
STEM courses are too difficult compared to other subjects	418 (40.6)	322 (31.3)	290 (28.2)	2.12	0.820
Limited access to guidance or mentorship for pursuing STEM careers	496 (48.2)	259 (25.1)	275 (26.7)	2.21	0.839
Parents' financial difficulty hinders their ability to support their children's pursuit of STEM courses	563 (54.7)	227 (22.0)	240 (23.3)	2.31	0.826
Schools lack adequate facilities to support STEM education	651 (63.2)	115 (11.2)	264 (25.6)	2.38	0.865
Cultural and societal expectations discourage learners from pursuing STEM careers	347 (33.7)	224 (21.7)	459 (44.6)	1.89	0.878
Overall challenge				**2.18**	**0.399**

****Mean score < 2.00 = not a challenge and Mean score ≥ 2.00 = challenge****

Influence of gender and school type on the barriers learners face in pursuing STEM

The comparative analysis presented in Table 6 shows that there was no significant difference between male learners (M = 2.19, SD = 0.376) and their female counterparts (M = 2.18, SD = 0.417; t (1028) = 0.771, p = 0.441) regarding the challenges they faced in selecting STEM courses and careers. This suggests that both male and female learners experience similar levels of difficulties in choosing STEM-related courses and careers. Regarding the school type, however, there was a significant difference between the perceived challenges learners face in public schools (M = 2.23 & SD = 0.382) and those in private schools (M = 2.09 & SD = 0.412, t (1028) = 5.604, p = 0.001). This result suggests that learners in public schools encounter more challenges in selecting STEM courses and careers than their private school peers. This is evident as the public school has a higher mean score (M = 2.23) than the private school (M = 2.09). This disparity between the public and private schools may be attributed to differences in resource availability, the quality of STEM education, exposure to STEM career opportunities, or guidance and counselling services.

Table 6: Differences in the challenges in selecting STEM courses and careers across genders

Gender	N	Mean	Std. dev.	T	df	Sig. (2-tailed)
Male	479	2.19	0.376	0.771	1028	0.441
Female	551	2.18	0.417			
School type	N	Mean	Std. dev.	T	df	Sig. (2-tailed)
Public school	667	2.23	0.382	5.604	1028	0.001
Private school	363	2.09	0.412			

p= 0.05

Discussions

Perception of Pursuing STEM Courses

The findings of this study offer an in-depth understanding of the perceptions and barriers to STEM education among JHS learners. By examining the roles of gender and school type, this research contributes valuable insights for addressing gender disparities in STEM education, aligning with broader efforts to promote equity and innovation in education in Ghana. The finding indicates an overall positive perception of STEM courses among JHS learners, with the majority describing STEM as engaging, interesting, and essential for their future prospects. This is a promising development, indicating that learners across both public and private schools recognise the value and relevance of STEM for their aspirations and career futures. These findings align with the broader recognition of STEM education as a critical driver of national development (Fazio, 2024) and are consistent with recent global evidence suggesting that learner attitudes towards STEM tend to be positive even in resource-constrained environments (Akon-Yamga et al., 2024). However, the concern regarding inadequate resources remains significant, with nearly half of all learners reporting that their schools lacked the tools and materials necessary for effective STEM learning. This finding is consistent with existing literature highlighting the disparity in access to quality STEM infrastructure, particularly in rural and underfunded schools (Anning, 2024). The lack of adequate resources, including laboratories and technical equipment, can limit learners' practical learning experiences and discourage sustained engagement with STEM subjects (Osei-Bonsu, 2024). These resource gaps are not unique to Ghana. Evidence from a broad comparative analysis of STEM provision across sub-Saharan Africa found that financial underinvestment and the absence of functional laboratory infrastructure are recurring features of under-resourced educational systems across the continent (Choo & Sarpong, 2024), with UNESCO data confirming that sub-Saharan Africa allocates on average only 0.51% of gross domestic product to research and development (Schneegans et al., 2021). This underscores the urgency of improving resource allocation to foster learning environments that are conducive to STEM engagement, particularly in public schools, where such disparities are most pronounced (Partey, 2022).

The finding that male learners exhibited a more favourable perception of STEM courses compared to their female counterparts is consistent with the findings of numerous studies on gender disparities in STEM education. Gendered societal expectations frequently influence learners' choices, with boys more likely to gravitate towards STEM-related fields due to cultural norms that associate these disciplines with masculinity (Osei-Bonsu, 2024; Ojong & Kareem, 2025). These results echo the work of DeCoito et al. (2024), who discussed how societal expectations shape learners' academic aspirations, particularly in developing countries. The gender gap in STEM perceptions observed in this study also resonates with global trends. Data from the UNESCO Institute for Statistics show that women constituted only 35% of STEM graduates between 2018

and 2023, a share that has remained unchanged for over ten years, reflecting persistent structural and attitudinal barriers that begin during the school years (Montoya, 2024). A study examining over 1,240 high school students in China found that environmental factors, including school climate, social support, and media representation, shaped female students' STEM career perceptions through mediating pathways of self-efficacy (Li et al., 2023), suggesting that the gap begins long before learners make formal educational choices. Similarly, a scoping review of STEM gender disparities across the Middle East and North Africa found that high female enrolment did not automatically translate into equitable participation or career entry, as persistent socio-cultural stereotypes continued to undermine women's sense of belonging in STEM fields (EL-Deghaidy & Anwar, 2025). These patterns echo findings from Ghana, where societal expectations have traditionally positioned STEM as a domain for boys, with girls more often guided towards teaching, nursing, or caregiving roles (Osei-Bonsu, 2024; Wrigley-Asante et al., 2022). Although both male and female learners in this study held positive perceptions overall, the significant difference in mean scores highlights the need for targeted interventions, including mentorship from female STEM professionals, visible role models, and early career guidance, to encourage girls' sustained engagement with STEM education. Research by Guenaga et al. (2022) demonstrated that group mentoring sessions led by female STEM role models positively shifted young girls' attitudes towards technology and increased their awareness of women in scientific and technical careers. Gender stereotypes must be actively challenged to reduce the attitudinal barriers that continue to limit girls' STEM participation (Matete, 2021; Kataeva & Durrani, 2025).

The significant difference in STEM perceptions between learners from public and private schools is well supported by existing research. Partey (2022) noted substantial resource gaps between these two school types, with private schools generally offering better facilities and more opportunities for STEM-related engagement. The higher perception of STEM courses among private school learners may reflect their greater access to quality teaching, functional learning materials, and extracurricular STEM activities, as highlighted by Matete (2021). Private schools are also more likely to benefit from better-qualified teachers and smaller class sizes, both of which contribute to more effective and engaging STEM instruction. Public schools, particularly those located in rural areas, typically contend with overcrowded classrooms, limited teaching staff, and inadequate physical infrastructure (Anning, 2024). These structural challenges are compounded by wider systemic underinvestment in education, which disproportionately disadvantages learners who depend on the public school system. The experience of learners in the Central Region of Ghana in this regard mirrors broader patterns documented across sub-Saharan Africa, where inequalities between public and private schools continue to shape learners' academic trajectories and aspirations (Ojong & Kareem, 2025). These disparities in the quality of education significantly influence learners' attitudes toward STEM courses and ultimately affect who enters STEM pathways at the senior high school level and beyond.

Barriers to Pursuing STEM Education

The study identified barriers such as financial difficulties, lack of mentorship, and inadequate school facilities as the most significant challenges faced by learners in their attempts to engage with STEM education. These findings are consistent with existing research on barriers to STEM participation in Ghana and other developing countries, where financial constraints and limited access to mentorship are recognised as major structural obstacles (Ojong & Kareem, 2025; Anning, 2024). The financial barrier, in particular, warrants careful attention. More than half of all learners in this study reported that their parents' financial difficulties actively constrained their ability to

support STEM-related learning. This finding is consistent with evidence from across the Global South, where economic hardship at the household level reduces families' capacity to invest in supplementary learning materials, tuition support, or participation in STEM-focused extracurricular programmes (Choo & Sarpong, 2024). Moreover, the high percentage of learners who reported that STEM subjects were difficult compared to other courses echoes the findings of Osei-Bonsu (2024), who noted that many learners, particularly girls, find STEM subjects intimidating due to the perceived complexity of the content and the absence of consistent encouragement from teachers and significant others. Kataeva and Durrani (2025) noted that teacher expectations are themselves shaped by gender stereotypes, with female students' mathematical and scientific abilities routinely underestimated, a dynamic that compounds feelings of inadequacy and discourages sustained participation. Sociocultural barriers, however, were less frequently cited by learners in this study, with fewer than one in three indicating that cultural and societal expectations had discouraged them from STEM. This suggests that while gender stereotypes remain present in the social environment, they may not be as foregrounded in learners' subjective experience of STEM as the material and institutional barriers they encounter daily.

The absence of significant differences in the barriers faced by male and female learners in this study suggests that both groups encounter similar levels of difficulty in pursuing STEM education. This finding contrasts with the more traditional view that girls face uniquely gendered barriers arising from societal expectations alone (DeCoito et al., 2024). Instead, the evidence here indicates that socio-economic and educational barriers, including the lack of mentorship, financial difficulties, and limited school resources, affect learners of both genders in broadly comparable ways. This aligns with previous studies that have identified systemic barriers in STEM education that are not inherently gender-specific but tend to impact all learners from disadvantaged backgrounds (Osei-Bonsu, 2024). A body of global scholarship has similarly concluded that structural inequalities embedded within educational systems, rather than individual differences in aptitude or motivation, are the primary drivers of unequal STEM participation (Ojong, 2025; Awoniyi & Jokotagba, 2025). However, it is important to acknowledge that the absence of statistically significant differences in aggregate barrier scores does not necessarily mean that gender is irrelevant. The subtle and cumulative effects of gendered socialisation, documented by Quansah et al. (2020) in Ghana and by Kataeva and Durrani (2025) in a wider bibliometric analysis, may shape the types of STEM careers that male and female learners aspire to in ways not fully captured by the summary barrier measure, thereby contributing over time to the persistent under-representation of women in certain STEM fields. The mentorship gap is particularly consequential in this regard. Torres-Ramos et al. (2025) found through in-depth qualitative interviews with women in STEM that mentorship from female professionals was one of the most decisive factors in sustaining confidence, professional identity, and career persistence in environments where women remain structurally under-represented. That nearly half of learners in this study reported limited access to STEM career guidance or mentorship is therefore a finding of considerable concern.

The finding that learners in public schools reported significantly greater barriers to STEM participation than their counterparts in private schools reflects the deep resource disparities between these two types of institutions. Learners in public schools are more likely to lack access to laboratory equipment, up-to-date textbooks, and extracurricular STEM opportunities, all of which are more readily available in private school settings (Partey, 2022). This finding is supported by existing studies emphasising how the quality of educational provision and the availability of

STEM-related infrastructure directly influence learners' ability to engage with and persist in STEM subjects (Anning, 2024). Evidence from Tanzania illustrates how these disparities manifest even at the higher education level, with a longitudinal study finding that gender parity in engineering programmes remained critically low, with a Gender Parity Index of just 0.284 by the 2023 to 2024 academic year, in part because school-level disadvantages accumulate across the educational pipeline (Namkunda & Mosha, 2025). In Chile, exposure to STEM-related curricula at upper secondary level was found to be positively associated with higher education STEM enrolment, yet gender gaps in persistence remained pronounced, underscoring that resource access and curriculum quality at the school level have long-term consequences for who ultimately participates in STEM at advanced levels (Dussaillant & Paredes, 2023). Public schools, particularly those serving rural or economically disadvantaged communities in Ghana's Central Region, often struggle to provide the infrastructure, qualified teaching staff, and learner support services necessary for building a strong STEM education pipeline. Addressing these structural inequalities through deliberate resource allocation and targeted investment is essential if equitable STEM participation is to be achieved across school types and social contexts.

Conclusions

This study provides valuable insights into the perceptions and barriers to STEM education among junior high school learners in Ghana, with a particular focus on the influence of gender and school type. The findings indicate that while learners generally perceive STEM courses positively, significant barriers, such as inadequate resources, lack of mentorship, and financial constraints, hinder their ability to fully engage with these subjects. The gender disparity in STEM perceptions and the differences in challenges faced by public and private school learners highlight the need for targeted interventions to address these issues. By improving resource allocation, providing mentorship opportunities, and challenging gender stereotypes, it is possible to create a more inclusive and equitable STEM education system that encourages all learners to pursue STEM careers. These efforts will contribute to the development of a diverse and skilled workforce capable of driving innovation and addressing the challenges of the future.

Recommendations

To address the challenges identified in this study, it is recommended that first, the government continuously prioritise increased investment in STEM education by enhancing funding for public schools, particularly in rural and under-resourced areas, to ensure equal access to quality resources and facilities. This includes providing adequate STEM teaching materials and modern laboratory equipment and improving infrastructure. Secondly, for teachers, professional development programmes should be implemented to equip them with updated knowledge in STEM content, as well as gender-responsive teaching strategies to foster an inclusive classroom environment. Thirdly, mentorship programmes and career guidance should be made available to both male and female learners, encouraging them to explore and pursue STEM careers. Learners, particularly females, should be actively encouraged to participate in STEM activities, with schools offering extracurricular opportunities such as STEM clubs, workshops, and competitions to nurture interest and build confidence in these fields. By fostering collaboration between the government, educators, and learners, these recommendations can help overcome barriers to STEM education and create a more equitable and inclusive environment for all learners.

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