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The influence of gender disparities on high school students' mathematics performance

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ABSTRACT

The differences in gender have consequence on mathematics achievement. Nonetheless, the dominance in the performance of mathematics with regards to both sexes remains skewed. Thus, the current study sought to measure the impact of gender disparities on mathematics performances and investigate the attitudes and perceptions towards the learning of mathematics in some selected senior high schools (SHS) in Ghana. A descriptive research design was employed. A total of 311 students were sampled using stratification approach. The analysis of the data was achieved using means, standard deviation and paired sample t-test. The findings show significant differences in both sexes' perceptions and attitudes towards mathematics, with males having better perception and attitudes than females. Further, males exhibited superior mathematics performance to females on an account of the test administered. Finally, the study established that students' mathematics background, learning environment, gender stereotype and career aspirations are factors that influence performance in mathematics at the SHS level. The study recommends heads of educational institutions to hire more female teachers to take up the teaching of mathematics with the view to modelling favourable high school female perceptions about mathematics. Implications for policy, practice and further research are addressed.

INTRODUCTION

Gender differences have gained currency in recent mathematics educational research in view of the dwindling students' performance especially at the second cycled institutions of learning (Asomah et al., 2023). The skewed perception of the superiority of both sexes in mathematics performance has given cause to mathematics educators (Daud et al, 2020). Thus, making it difficult to prioritize a type of differentiated pedagogy to provoke students' interest and understanding in mathematics (Asomah et al., 2024b). Both old and current literature affirm this position. Chipman (2005) in his study, posited that in the United States females accounted for only 24 % of the degrees (Bachelor of Arts [BA]) in mathematics. Again, in South Africa, Mahlomaholo and Mathamela (2004) commented on the effects of the pervasiveness of an orthodox patriarchal system on education which benefits the males. In Ghana, recent studies (Anokye-Poku & Ampadu, 2020; Asomah et al., 2024a; Efya & Frimpong, 2023; Issahaq, 2018) on gender and mathematics achievement revealed significant differences, puny basis as well as diverse perceived and attitudinal predispositions of students about mathematics based on gender. Thus, fuelling perception males' dominance in mathematics related fields of study both in the past and current studies. Although, studies of (Devine et al., 2012; Mauel, 2022; Nartey, 2018), found no disparities in gender in view of their performance in mathematics.

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Further, in the wake of events where Ghana is advocating for Gender Equality and Social Inclusion (GESI), there need to be thorough studies in gender related areas in mathematics with the view to promoting inclusivity, provoking both sexes interest in the learning of mathematics and alienate bottlenecks that militate against genders' equity in mathematics performance (Asomah et al., 2024b; Wrigley-Asante et al., 2023). Hence, the conduct of this study to ascertain whether there is some difference in their performance and to investigate the attitudes and perceptions of both sexes towards mathematics.

The context of the study

In Ghana, mathematics is a requisite as a result of which a learner must pass with a grade of C6 or better to further one's education either at the SHS level (MOE, 2012) or at the tertiary level (Ghana Tertiary Education Commission [GTEC], 2024). It is also a requirement for professional studies in areas like engineering, statistics, law and scientific research. (Abreh et al., 2018). Although, literature enumerates problems that affect students' performance in mathematics, gender has long been regarded a factor that contribute to disparities in performance of both sexes in all levels at the institutions of learning (De laine, 2000; Ramaprabha & Selvaganapathy 2024). Thus, pitching gender disparities as an issue in educational research of which mathematics is no exception (Haynes, 2008). Additionally, literature characterizes attitudes and perceptions as the blight in the enhancement of students' performance in mathematics (Asomah, et al., 2019; Devine et. al., 2012). In a more resent study, Anokye-Poku and Ampadu, (2020), also highlighted gender-based attitudes and perceptions as problematic across the length and breadth of academic education especially when it comes to mathematics. Such attitudes and perceptions could lead to a high or low performance in mathematics. Gunderson et al. (2012) reported that undesirable attitudes, perceptions and anxiety about mathematics are inclined in the direction of females than in males. The cause of these negative attitudes and anxiety could be anchored on the experiences of inferiority complex in relation to the study of mathematics from the perspectives of the females (Asomah et al., 2018). The relevance of the current study is contingent on the recent poor performance of female students in mathematics in Gushegu Municipality in the Northern Region of Ghana. In particular, the West Africa Senior Secondary Certificate Examination (WASSCE) Chief Examiner's report summarized the overall performance of both sexes were in their summative examination as "most students who attempted to answer questions related to the theory section of their mathematics final examinations got it wrong especially among the female students who participated in the WASSCE" (Chief Examiners Report, 2022; 2023). Although several studies (Asomah et al., 2018; Devine et. al., 2012; Ramaprabha & Selvaganapathy 2024) have been conducted about gender differences in mathematics performance, no comprehensive study has been conducted on the influence of gender disparities in mathematics performance in the Gushegu Municipality. Gender differences in attitudes and perceptions in mathematics continues to attract the attention of researchers (Asomoah-Gyawu, 2023, Asomah, Wilmot, & Ntow, 2018, Moreno-Guerrero et al., 2020). It is therefore worth considering the effects of these variables that impact performance in mathematics. Thus, this study seeks to investigate the influence of gender disparities in mathematics performance, perception and attitudes among SHS students in the Gushegu Municipal in the Northern Region of Ghana.

Theoretical underpinning of the study

The study draws its theoretical basis from four theories: the equity theory, the deficit theory, the expectancy-value theory, and the implicit theory. The Equity Theory describes equity as the result of equality in the accessibility to learning in education (Bishop & Forgasz, 2014). This theory emphasises the need to give each learner equal opportunities to learn. Thus, entailed in equity are the qualitative traits of fairness and justice. According to Nanni (2023), treating gender equally leads to equal outcomes, opportunities and development. The theory affords this study the window to investigate whether both sexes are recipients of equal opportunities from their educators in the classroom setting.

In addition, the deficit theory assumes that some individuals are academically better than others in a learning environment. Thus, differential outcomes in education are attributable to the inward incapacities of female's experiences, knowledge, and skills (1989). Pivotal to equity are the

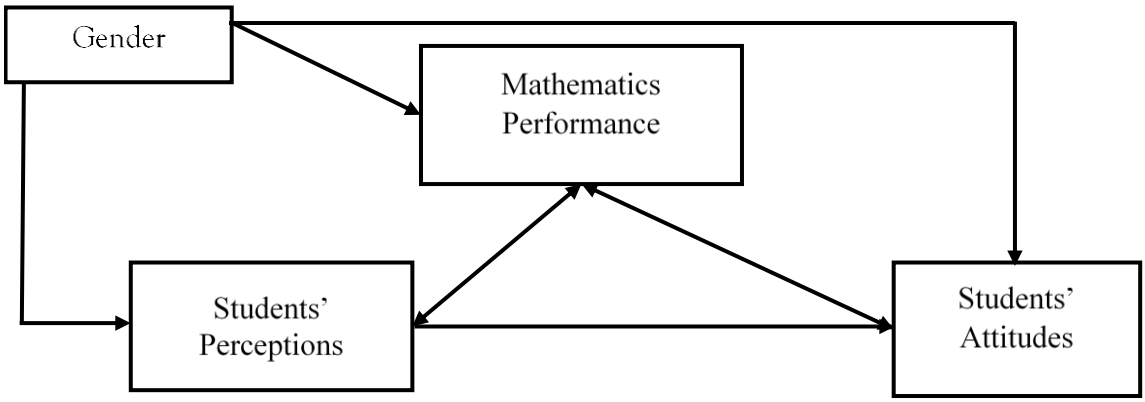

Figure 1. Conceptual framework of the study (Authors' Own Construction, 2024)

inter and intra association of the dimensions of the interactions, the diverse learning needs and the differences in the of students within the classroom setting. To this end, Deficit theory is vital since it offers an opportunity to explain why certain disadvantaged students show a high failure rate in schools.

Moreover, the expectancy-value theory delineates the association that exist in the expectations in relation to the successful nature in the execution of a task or in the accomplishment of a related work (Lubrick et al., 2019). The theory advocates that, an individual's eagerness to accomplish a given task is to a large extent conditioned on the his or her ability and motivation devoid of external factors (Eccles, Wigfield, Harold & Blumenfeld, 2012). McBride and Bruene (2006) and Xiang et al. (2005) argued that, the predictions of the learner's accomplishment is central to their expectancy-related beliefs.

Implicit theory provides a comprehensive perspectives of the traits (intelligence or mathematics ability) individuals have about themselves (Burkley et al., 2010). Embedded in implicit theory are entity theory and an incremental theory (Dweck & Leggett, 1988). Individuals with the belief of a "fixed" form of their intelligence whereas those who hold the belief of varied forms of intelligence are said to be entity and an incremental theory respectively. Thus, with entity intelligence cannot be broadened while incremental views intelligence as expandable (Dweck, 2000). Some studies (Siegle, Rubenstein, Pollard, & Romey, 2010; Blackwell, Trzesniewski, & Dweck, 2007) have investigated the impact of gender differences in implicit theories of intelligence on students. This theory holds relevance as it provides an opportunity to evaluate the beliefs students hold about their ability to perform mathematics at the SHS level, particularly from the perspectives of students in the Gushegu Municipality.

Conceptual framework

The variables that informed the conduct of this study were conceptualised and operationalised in this study. Figure 1 provides the conceptual framework of the study**.** In this study, it is believed that student mathematics performance (dependent variable) is contingent on the independent variables, which include gender (male or female), student perception towards mathematics, and student attitudes towards mathematics. These factors invariably affect the performance of students. Further, gender as conceptualised to mean being a male or a female student may have influence on the attitudes and perceptions of students as depicted in the diagram.

Research questions

The following are the research questions and hypotheses that guided the conduct of this study.

1. Are there differences in the perceptions of male and female students towards mathematics?
2. Are there differences in the attitudes of male and female students towards mathematics?
3. Are there differences in mathematics performance between male and female SHS students?
4. What factors influence performance in mathematics?

Table 1
Demographic characteristics of respondents

Variable	Frequency	Per cent
Gender		
Males	153	49.2
Females	158	50.8
Total	311	100.0

Research hypotheses

1. $H_0$1: There is no significant difference in the perception of male and female students towards mathematics.
2. $H_0$2: There is no significant difference in the attitudes of male and female students towards mathematics.
3. $H_0$3: There is no significant difference in mathematics performance between male and female students.

METHODS

Research design

The study adopted a descriptive survey design, gathering data through questionnaires and a mathematics achievement test. This design was deemed appropriate because it offered a comprehensive understanding of gender-based differences in students' perceptions, attitudes towards mathematics, and performance. Additionally, this approach supported the development and testing of research hypotheses relevant to the study (Creswell, 2015). Consequently, the design facilitated the examination of observed facts and allowed the researchers to investigate potential performance differences between male and female students (Jong & Voordt, 2002). Ultimately, this design enabled a factual analysis and a deeper understanding of the research problem, aligning with emerging trends in the literature

Sample and sampling technique

This study employed a stratified random sampling technique, allowing the researcher to organise participants by gender to highlight differences in male and female students' perceptions of mathematics. The researcher obtained a list of male and female mathematics students across various programmes and then randomly selected a proportional number from each group. Slovin's formula was used to determine the sample size for the quantitative phase, providing a method to select a representative sample with the desired level of accuracy (Stephaine, 2003). The formula is given by:

$$n = \frac{N}{1+N(e)^2},$$ where N = total population, e = Error tolerance, n = sample size.

The target population is 1608. Given a confidence interval of 95% and a sampling error of 5%., so we obtain

$$n = \frac{1608}{1+1608(0.05)^2} = 320.3287.$$

Hence a minimum of 311 mathematics students is deemed representative of the population for the study. The stratified random sampling technique was used to select proportional allocations of students from each stratum. Table 1 presents the data of the participants of the study. In the analysis of the data, there were more females (50.8%) than males (49.2%). Additionally, 85.5% of the students were under the age of 18-20 years, followed by those aged 21-23 years (10.9%), 15-17 years (3.2%), and a small number of students aged 24-26 years (0.3%). Most students also belonged to Form 3 (55.0%), while a few students belonged to Form 2 (45.0%).

Instrument

The study used an adapted questionnaire with close-ended items (Asomah et al., 2024b) and the Mathematics Achievement Test (MAT) (West Africa Examination Council [WAEC], 2023) for the

purposes of responding to participant's perceptions, attitudes and performance respectively. The survey was divided into three sections. The first section collected demographic information, such as sex, age, and school stage. The second section included close-ended items to explore how gender disparities affect SHS students' perceptions, and attitudes towards mathematics, using a 5-point Likert scale: strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). Respondents were asked to rate each item based on their personal judgement.

The third section was used to assess the performance of the students. In particular, the section consisted of 20 multiple-choice questions covering algebra, statistics, probability, and geometry—topics from the Form 1 and Form 2 curriculum. The inclusion of these topics was verified through the lesson notes of participating teachers and students' mathematics notebooks, ensuring that these areas had already been taught. This verification informed the choice to include only Form 2 and Form 3 students in the study. The test items were reviewed by experienced teachers using standard criteria established by WAEC to ensure quality and alignment with the curriculum.

Piloting of the instrument

Senior High School students in the Gushegu Municipality in the Northern Region of Ghana whose characteristics are similar to those in the area of the study were chosen to participate in the pilot testing of the instrument. In accordance with Perneger et al. (2015), who suggest that a population sample size of thirty (30) is mostly accepted to ensure statistical reliability and identify key themes in a study, 35 students were used for the pilot phase. The results from the pilot test yielded reliability coefficients ranging from 0.60 to 0.9. The instruments were refined based on the feedback from the piloting stage, which resulted in the final Cronbach's alpha value reliability for the study. Specifically, the trustworthiness of the scores for the perception subscales were perception of gender abilities (15 items, $\alpha = .81$), perception of self-abilities (11 items, $\alpha = .80$), perception towards teaching mathematics (11 items, $\alpha = .76$). For the attitude subscales, the reliability scores were: personal mathematics attitudes (13 items, $\alpha = .79$), mathematics interest and engagement (7 items, $\alpha = .87$). On the factors that influence mathematics performance, the subscales were: students' mathematics background (8 items, $\alpha = .89$), the learning environment (8 items, $\alpha = .78$), gender stereotype (6 items $\alpha = .86$), career aspirations (8 items $\alpha = .89$). The mathematics test had a reliability coefficient of (20 items, $\alpha = .86$). Kothari (2004) and Zohrabi (2013) indicate that reliability coefficients above 0.7 are considered acceptable, and those exceeding 0.8 are deemed excellent. To assess the content, criterion, and face validity of the questionnaire, experts from the Teacher Education Department (TED), University of Ghana (UG), reviewed and provided feedback on the items tested. Their revisions were incorporated to enhance the items' relevance and consistency in achieving the intended objectives.

Data collection and analysis

The questionnaires and the mathematics test (standardised objective test) were administered from 13th July, 2024, to 2nd August, 2024, at the Gushegu Senior High School. The mathematics test was scored out of 100 and employed as means of assessing performances of the individual students in the study. The grading of the outcome of the test was informed by the West Africa Examination Council Grading System for Examinations (2023). Further, the performance of both sexes were computed using the t-test to find out if their means were statistically different. Additionally, means and standard deviations as well as percentages were used in analysing survey responses in relation to students' perceptions and attitudes and the academic performance data.

FINDINGS

The nexuses of SHS students' perceptions, attitudes, and performance in mathematics were quantitatively measured using a 5-point Likert scale questionnaire and a 20 multiple-choice mathematics achievement test administered to 311 students at the Gushegu Senior High School. The results were presented in three sections: the disparities in both sexes perceptions, attitudes, performance and factors influencing performance in mathematics as well as the testing of corresponding hypotheses.

Table 2
Levene's test for equality of variances

	F	Sig.	T	Df	Sig. (2 tailed)
Equal variances assumed	1.043	.308	17.691	308	.000
Equal variances not assumed			17.663	301.391	.000

Source: Field Survey (2024)

Table 3
Gender differences in students' perception

Gender	N	M	SD	Df	t-value	p-value
Male	153	135.3399	12.80428	308	17.691	.000
Female	158	111.0701	11.32227			

Research question one: Are there differences in the perceptions of male and female students towards mathematics?

This research question measured the differences if any in the perceptions of male and female students towards about mathematics. Respondents were asked to specify their level of contentment or discontentment to items based on sub scales; Perception of gender abilities, Perception of self-abilities, and Perception towards teaching mathematics. The measurement of students' perceptions towards mathematics based on gender ranged on a scale of five items from "SD" "D", "N", "A", "SA", for "Strongly Disagree", "Disagree" "Neutral", "Strongly Agree", "Agree", respectively. The scores of male and female students were analysed using the t-test.

Hypothesis one:

$H_0$1: There is no significant difference in the perception of male and female students towards mathematics.

$H_1$1: There is a significant difference in the perception of male and female SHS students towards mathematics.

At the 0.05 alpha level of significance, hypothesis one measured whether gender differences existed in perception. The independent sample t-test was considered apropos for the analysis. This assumption was anchored since hypothesis one measured whether a significant difference existed between the means of two different sexes (male and female students' perception). Prior to the analysis, the Levene's test for homogeneity of variances was carried out to check whether equality of variances was assumed or not. Table 2 presents the outcomes of the analysis. The analysis from Table 2, showed a significant value of .308 being above .05. This implies that equal variances were assumed.

Table 3 further presented the actual analysis, testing the differences between the two groups with regards to the dependent variable (students' perception). The analysis in Table 3 shows that there is a statistically significant difference between male and female students' perception, t (308) = 17.691, p=.000, which is below the sig. value of 0.05. This means that males (M= 135.3399, SD=12.80428) did differ significantly from females (M=111.0701, SD= 11.32227) with regards to their perception. Thus, male students had better perceptions than their female counterparts based on the recorded means. This result rejects the null hypothesis, which asserts a no significant difference in perception between male and female SHS students, in favour of the alternative hypothesis.

Research question two: Are there differences in the attitudes of male and female SHS students towards mathematics?

This research question was aimed at investigating potential differences in attitudes towards mathematics between male and female SHS students. Respondents were asked to specify their level of contentment or discontentment to items based on subscales of personal mathematics attitudes and mathematics interest and engagement. The measurement of students' attitudes towards

Table 4
Levene's Test for Equality of Variances

	F	Sig.	T	Df	Sig. (2 tailed)
Equal variances assumed	15.494	.000	8.687	309	.000
Equal variances not assumed			8.706	305.762	.000

Source: Field Survey (2024)

Table 5
Gender differences in students' attitude

Gender	N	M	SD	Df	t-value	p-value
Male	153	65.3791	6.15801	305.762	8.706	.000
Female	158	58.8481	7.05319			

mathematics was ranged on a scale of five items from "SD," "D," "N," "A," and "SA" for "Strongly Disagree", "Disagree" "Neutral", "Strongly Agree", "Agree", respectively. The results were analysed using the t-test.

Hypothesis two:

$H_0$2: There is no significant difference in the attitudes of male and female students towards mathematics.

$H_1$2: There is a significant difference in the attitudes of male and female students towards mathematics.

At the 0.05 alpha level of significance, hypothesis two measured whether gender differences existed in attitude. The independent sample t-test was regarded apropos for the analysis. This assumption was anchored since hypothesis two measured whether a statistically significant differences existed between the means in two different sexes (male and female students' attitudes). Prior to the analysis, the Levene's test for homogeneity of variances was carried out to check whether equality of variances was assumed or not, and the results are presented in Table 4. The analysis from Table 4, depicted a significant value of .000 being below .05. This means that equal variances were not assumed.

Table 5 further presented the actual analysis, testing the differences between the two groups with regards to the dependent variable (students' attitude). The analysis in Table 5 shows that there is a statistically significant difference between male and female students' attitudes, t (305.762) = 8.706, p=.000, which is below the sig. value of 0.05. This means that males (M= 65.3791, SD=6.15801) did differ significantly from females (M=58.8481, SD= 7.05319) with regards to their attitude. Thus, male students had better attitudes than their female counterparts based on the recorded means. Hence, the null hypothesis, which states that "*there is no significant difference of attitude between male and female SHS students,"* is rejected in favour of the alternative hypothesis.

Research question three: Are there differences in mathematics performance among male and female SHS students?

This research question sought to measure if there exist some differences in mathematics performance of male and female SHS students. Respondents were asked to answer 20 multiple Mathematics Achievement Test (MAT).

Hypothesis three:

H_0: There is no significant difference in mathematics performance between male and female SHS students.

H_A: There is a significant difference in mathematics performance between male and female SHS students.

At the 0.05 alpha level of significance, hypothesis one was tested to find out whether gender differences existed in mathematics performance. The independent sample t-test was regarded apropos for the analysis. Thus, this assumption was anchored hypothesis three measured whether

Table 6
Levene's Test for Equality of Variances

	F	Sig.	T	Df	Sig. (2 tailed)
Equal variances assumed	3.897	.049	8.738	309	.000
Equal variances not assumed			8.755	306.566	.000

Source: Field Survey (2024)

Table 7
Gender Differences in Students' mathematics performance

Gender	N	M	SD	Df	t-value	p-value
Male	153	63.7908	13.24151			
				306.566	8.755	.000
Female	158	49.7785	14.95583			

a statistically significant difference existed between the means in two different sexes (male and female students' mathematics performance). Prior to the analysis, the Levene's test for homogeneity of variances was carried out to check whether equality of variances was assumed or not, and the outcomes are presented in Table 6. The analysis from Table 6, posited a significant value of .049 which is below .05. This means that equal variances were not assumed.

Table 7 further presented the actual analysis, testing the differences between the two groups with regards to the dependent variable (students' mathematics performance). The analysis in Table 7 shows that there is a statistically significant difference between male and female students' mathematics performance, t (306.566) = 8.755, p=.000, which is below the sig. value of 0.05. This means that Males (M= 63.7908, SD=13.24151) did differ significantly from females (M=49.7785, SD= 14.95583) with regards to their mathematics performance. Thus, male students out performed their female counterparts based on the recorded means. Based on this result, the null hypothesis is rejected in favor of the alternative hypothesis.

Research question four: What are the factors that influence performance in mathematics?

This research question sought to identify factors influencing performance in mathematics. Respondents were asked to specify their level of contentment or discontentment to items anchored on the subscales of (student mathematics background, the learning environment, gender stereotypes, and career aspirations) measuring factors that influence performance in mathematics on a scale of five items ranging from "SD," "D," "N," "A," and "SA" for "Strongly Disagree", "Disagree" "Neutral", "Strongly Agree", "Agree", respectively. The results were presented using means (M) and standard deviations (SD), such that mean scores above 2.5 indicate respondents agreed and less than 2.5 indicate respondents disagreed. Consequently, each of these domains that underpinned factors that influence performance in mathematics was presented in Tables 10, 11, 12, and 13.

Students' mathematics background

The survey results indicate various students' mathematics background items regarding factors that influence mathematics performance. The students reached consensus on the related courses in mathematics they have had in the past (M=4.44, SD=.613). Also, the students generally were in agreement of having received an excellent mathematics education so far (M=3.41, SD=1.392). The students agreed also that they often solve mathematics problems outside of school (M=3.22, SD=1.540). Furthermore, the students did also consider themselves as better in mathematics (M=3.75, SD=1.245) as well as see themselves as very confident in their mathematics ability (M=3.68, SD=1.405). This suggests an optimistic viewpoint regarding students' mathematics backgrounds. Table 8 further presents the results for students' mathematics backgrounds. Further, the results from Table 8 show that most students often participate in mathematics competitions in the school (M=3.28, SD=1.399) and often participate in mathematics club activities in the school (M=3.23,

Table 8
Students' mathematics background

No	Statement	M	SD
1.	I have taken enough mathematics related courses in past.	4.44	.613
2.	I have had an excellent mathematics education so far.	3.41	1.392
3.	I often solve mathematics problems outside of school.	3.22	1.540
4.	I consider myself as better in mathematics.	3.75	1.245
5.	I am very confident in my mathematics ability.	3.68	1.405
6.	I often participate in mathematics competitions in the school.	3.28	1.399
7.	I often participate in mathematics club activities in the school.	3.23	1.507
8.	I use mathematics in my hobbies and interests.	3.08	1.347
Overall		3.51	1.29

M-Mean, SD-Standard Deviation

Table 9
The learning environment

No	Statement	M	SD
1.	I often feel encouraged to ask questions in mathematics class.	3.68	1.245
2.	My mathematics classroom is conducive enough to support learning.	4.05	1.105
3.	There are enough resources (textbooks, technology etc.) in my mathematics class to support learning.	3.00	1.440
4.	In my class, mathematics is often connected to real-life scenarios making it relevant and meaningful.	3.33	1.253
5.	My mathematics teacher uses different teaching methods to meet students' individual needs, interests and learning styles in class.	2.80	1.278
6.	In my class, my mathematics teacher uses our experiences at home to explain mathematical concepts to our understanding.	4.23	.633
7.	I am encouraged to think during mathematics lessons in my class.	3.64	1.159
8.	I am motivated to get myself to be more engaged in mathematics lessons in my class.	3.72	1.111
Overall		3.56	1.15

M-Mean, SD-Standard Deviation

SD=1.507). They also acknowledged that they use mathematics in their hobbies and interests (M=3.08, SD=1.347). This indicates a positive trait regarding students' mathematics backgrounds.

Table 9 delineates the results for the learning environment subscale. The survey results reveal that students' learning environment influences their math performance. The students generally agreed that they often feel encouraged to ask questions in mathematics class (M=3.68, SD=1.245). Also, the students generally agreed that their learning environment setting is conducive enough to support learning (M=4.05, SD=1.105). Most students also agreed that there are enough resources (textbooks, technology, etc.) in their mathematics class to support learning (M=3.00, SD=1.440). Majority of the respondents also asserted that in their class, mathematics is often connected to real-life scenarios, making it relevant and meaningful (M=3.33, SD=1.253). The respondents also said that their mathematics teacher uses different teaching methods to meet students' individual needs, interests, and learning styles in class (M=2.80, SD=1.278). They also asserted that in their class, their mathematics teacher uses their experiences at home to explain mathematical concepts to our understanding (M=4.23, SD=.633). Furthermore, the students expressed their belief that the class encourages them to think during mathematics lessons. (M=3.64, SD= 1.159). Lastly, the students consented to the fact that they were motivated to get themselves to be more engaged in mathematics lessons in the class (M=3.72, SD=1.111).

Table 10 describes the results for gender stereotyping sub-scale. The survey results indicate various gender stereotypes regarding factors that influence math performance. The students generally agreed that men are naturally talented in mathematics (M=3.63, SD=1.570). Also, the students agreed that mathematics is a male dominated field (M=4.27, SD=.902). Again, it was generally believed that females are not better at mathematics than males (M=4.27, SD=.649). Most students also asserted that females need to recognise the need to outperform their male colleagues

Table 10
Gender stereotype

No	Statement	M	SD
1.	Men are naturally talented in mathematics.	3.63	1.570
2.	Mathematics is a male dominated field	4.27	.902
3.	It is generally believed that girls are not as good at math as boys.	4.27	.649
4.	Females need to work harder than men in order to perform better in mathematics.	3.42	1.448
5.	One is born with mathematics ability and cannot be developed.	2.88	3.282
6.	Some people are naturally gifted in mathematics, while others are not.	4.26	.735
Overall		3.78	1.43

M-Mean, SD-Standard Deviation

Table 11
Career aspirations

No	Statement	M	SD
1.	Girls are often discouraged from pursuing mathematics related careers.	4.16	.803
2.	I am highly motivated to pursue a career in mathematics.	3.85	1.289
3.	Mathematics careers are to be pursued by males.	2.79	1.250
4.	I don't want to pursue a career in mathematics because I don't like mathematics.	2.61	1.440
5.	Girls need to work harder than men in order to pursue a career in mathematics.	3.84	1.242
6.	I know female role models who pursue a career in mathematics than males.	1.55	.719
7.	I know male role models who pursue a career in mathematics than females.	3.96	1.393
8.	I am able to overcome difficulties in learning mathematics because of the job I want to do in the future.	2.95	1.626
Overall		3.21	1.17

M-Mean, SD-Standard Deviation

in order to perform better in mathematics (M=3.42, SD=1.448). Furthermore, the students did also state that one is born with mathematics ability and cannot be developed (M=2.88, SD=3.282). Lastly, the students consented to the fact that they have self-confidence in their aptitude to learn mathematics (M=4.26, SD=.735).

Table 11 outlines the results for the career aspirations subscale. The survey results indicate various career aspirations among students regarding factors that influence math performance. The students generally agreed that girls are often discouraged from pursuing mathematics-related careers (M=4.16, SD=.803). Also, the students agreed that they are highly motivated to pursue a career in mathematics (M=3.85, SD=1.289). Moreover, most students said that mathematics careers are to be pursued by males (M=2.79, SD=1.250). The students also claimed that they don't want to pursue a career in mathematics because they don't like mathematics (M=2.61, SD=1.440). The majority of the students also asserted that females ought to work harder than males in order to pursue a career in mathematics (M=3.84, SD=1.242). Furthermore, the students did also state that they know more male role models who pursue a career in mathematics than females (M=3.96, SD=1.393). The students finally agreed that they are able to overcome difficulties in learning mathematics because of the job they want to do in the future (M=2.95, SD=1.626). However, the students disagreed that they knew more female role models who pursued a career in mathematics than males (M=1.55, SD=.719).

In summary, the results indicate a positive view on favourable conditions for all dimensions measuring factors that influence mathematics performance. Based on the results for the subscales such as student mathematics background, the learning environment, gender stereotypes, and career aspirations, measuring factors that influence mathematics performance, it can be inferred that all means were above the criterion mean of 2.5. This indicates that a student's mathematics background, the learning environment, gender stereotyping, and their career aspirations have influential effects on the students mathematics performance.

DISCUSSION

Gender differences in perceptions about mathematics

The outcome of the study showed that there is a significant difference in male and female students' perceptions about mathematics. The study confirms that boys have better perceptions about mathematics than girls. The students generally agreed that boys are naturally better than girls in mathematics. In addition, students also generally agreed that males are better fit for pursuing a career in mathematics than females. The results revealed that males (M = 135.3399, SD=12.80428) did differ significantly from females (M=111.0701, SD= 11.32227) with regards to their perception. Thus, male students had better perceptions than their female counterparts based on the recorded means.

This finding confirms the findings of Mauel (2022), who reported the existance of a significant difference in the perceptions of the students, specifically in identity in relation to mathematics, science, self-efficacy in mathematics, and self-efficacy in science. The findings also conform with Asante (2010), who reported of a large differences in mathematics performance on the account of gender in Ghana may be attributed to social perception. However, the result of the current study disagrees with Daud et al. (2020), who reported non-existence significant differences in perception about mathematics across genders. Also, this study is inconsistent with the result of Effa and Frimpong (2023), who argued of non-existence of differences in perception about core mathematics between the two sexes.

Gender differences in attitude towards mathematics.

The attitudinal outcomes of the current study depicts the existence of differences that is significant in both sexes towards mathematics. The study confirms that boys have better perceptions about mathematics than girls. This study corroborates the findings of Bashir et al. (2023), which revealed the existence of significant differences in the attitudes of the two sexes towards mathematics. Moreover, Bashir et al. (2023) revealed that gender differences were found regarding fear and anxiety about mathematics; females had more anxiety and fear than males. The study also confirms the findings of Ramaprabha and Selvaganapathy (2024), which revealed that gender differences in attitude exist between male and female secondary school students, with male students having better attitudes towards mathematics than female students. Rodriguez et al. (2020) identified that girls have a less positive attitude towards math, as he reported a higher level of anxiety in females than in males. However, the findings of the current study disagree with the findings of Asare-Inkoom (2008), who found no significant difference in attitudes towards mathematics between boys and girls at the JSS level, indicating that students of both sexes have the same attitudes towards mathematics.

Difference in mathematics performance between male and female SHS students

The analysis showed that there is a significant difference between male and female students' mathematics performance. This means that males did differ significantly from females with regards to their mathematics performance based on the recorded means. The outcome of this study is consistent with that of Asante (2010) and Wrigley-Asante et al., (2023) whose results showed that males outperform their female counterparts in mathematics. Again, this study is in consonance with the studies of (Tetteh et al., 2018; Anokye-Poku & Ampadu, 2020; Asomah et al., 2023), which also demonstrated that males outperform females in mathematics performance. However, the present study, unlike the findings of Efa and Frimpong (2023), revealed that female students did better than their male counterparts, which is contrary to the equity theory. Also, Anjum (2015) conducted gender-based research on the differences in the achievement of mathematics and proved the existence of a significant difference in the achievement of girls and boys at the basic school, where girls outperformed their colleague boys. Given that the current study took place at the SHS, the age gap could also account for the differences.

Factors that influence performance in mathematics

The study established that students' mathematics background, learning environment, gender stereotype and career aspirations are factors that influence performance in mathematics at the SHS level. Notably, students were on consensus in relation to the related courses offered in mathematics in the past. Also, the students generally agreed that they have had an excellent mathematics

education so far. Interestingly, they also asserted that in their class, mathematics teachers use their experiences at home to explain mathematical concepts to our understanding. Furthermore, the students agreed to the fact that they believe in their capabilities to study mathematics. However, the students disagreed that they knew more female role models who pursued a career in mathematics than males.

This finding is in alignment with several studies (Salifu et al., 2017; Asomah et al., 2022). The results of the aforementioned studies, like the present study, revealed that performance assessment tests are not biased on the account of gender and contradict the notion that boys outperform girls in mathematics. On the contrary, the results of this study was not in consonance with the findings of Samuel (2017), whose recommendation supported a surge in the intake of female teachers in the teaching of mathematics as a means of modeling favourable female dispositions towards the learning of mathematics.

CONCLUSIONS

The study explored the influence of disparities in gender in view of performance in matematics, attitudes, and perceptions, as well as the causes of these disparities among senior high school students in the Gushegu Municipality. It was found that gender plays a key role in mathematics performance, as students generally agreed that, in their opinions, boys were naturally better than girls in mathematics. The results of the study also demonstrated that most students agreed that they are sure that they can learn mathematics. The students did also consider themselves better in mathematics and perceived themselves as very confident in their mathematics ability. In a nutshell, the study further elucidated of the existence of significant difference between male and female students' performance in mathematics.

This study was limited to only students in the only public SHS in the Gushegu Municipality in the Northern Region of Ghana. Therefore, its findings cannot be generalised to all SHS students in Ghana. Further studies need to be done using different schools and qualitative methods to investigate students' perceptions, attitudes, and performance in mathematics to either confirm the findings of this study or to unearth detailed areas of interest to provoke a comprehensive understanding of gender and mathematics performance.

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AUTHOR'S DECLARATION

Authors' contributions	The initial conception of this study was partly organized by all the authors in this study. The initial stage in writing the manuscript was made by RKA and EKB. Then during the revision, it was done together by FCA, PBKD, and RKA. Finally, in adjusting to the journal template, and literature search was done by RKA, FCA, EKB and PBKD. All authors read and approved until the end.
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