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Research Article

Gender Dynamics in High School Mathematics Education: Impact of Teachers and School Environment on Female Students Attitudes and Achievement

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Abstract

This study investigates the impact of teacher gender and school type on the attitudes and academic performance of female high school students in mathematics. Utilizing a sample of 262 final-year high school girls and 10 mathematics teachers from both mixed-gender and single-sex schools in the Sunyani West District located in Ghana, the study employs surveys and achievement tests to gather quantitative data. Statistical analyses reveal several key findings. Male and female teachers shared similar beliefs regarding female students in general. Significant differences emerged in perceptions of students' mathematical abilities. Girls taught by male teachers exhibited lower anxiety levels ($t(260) > 1.96$, $p < 0.05$) and higher self-confidence ($t(260) > 1.96$, $p < 0.05$) in mathematics compared to those taught by female teachers. Additionally, mixed-gender schools fostered more positive attitudes towards mathematics among female students compared to single-sex schools ($t(260) > 1.96$, $p < 0.05$). There were positive correlations observed between students' attitudes towards mathematics and their academic performance, highlighting the importance of teacher-student relationships in shaping students' perceptions and achievements in mathematics. These findings underscore the need for inclusive teaching practices and the recruitment of qualified mathematics educators to support the academic success of female students in mathematics. Future research could explore the disparate treatment of male and female students in mathematics classrooms and investigate effective pedagogical strategies to promote equitable learning outcomes.

Keywords

Achievement, Gender Dynamics, High School Mathematics, Female Students

1. Introduction

Gender disparities in mathematics education continue to be a significant concern worldwide [1, 16, 18, 20], with girls often exhibiting lower achievement levels and less favourable attitudes toward the subject compared to boys. Understanding the underlying factors contributing to these disparities is essential for promoting equity and enhancing the standard of mathematics education accessible to all students.

The nature of attitudes toward mathematics is complex,

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influenced by various factors such as experiences, socialization, and perceptions of ability [11, 24]. Mathematics anxiety, characterized by feelings of panic and helplessness when confronted with mathematical tasks, is a common experience among students, particularly girls [20]. Gender stereotypes associating mathematics with males perpetuate the belief that boys are inherently more skilled in math, resulting in unequal treatment of boys and girls by teachers.

Teachers' beliefs about students' mathematical abilities and the impact of gender on these beliefs have been well-documented in literature [1, 5, 15, 18]. Studies have shown that teachers may hold gender-loaded views about their students' capabilities, attributing boys' success in mathematics to innate ability while expecting girls to exert more effort to achieve the same level of performance. Such biases result in disparate treatment of male and female students within the classroom setting [11, 12, 14], impacting their attitudes and achievement in mathematics.

The gender of the teacher has also been found to influence students' attitudes and achievement in mathematics [3, 17, 21], albeit with mixed results. While some studies suggest that female teachers have a positive impact on girls' attitudes toward mathematics, others have found no significant association between teachers' gender and students' achievement gains. Moreover, the effects of single-sex schooling on girls' attitudes and achievement in mathematics have been examined [22], with research indicating both positive and negative outcomes depending on various contextual factors.

Researchers have consistently shown that attitudes toward mathematics play a crucial role in students' engagement and achievement in the subject [5, 10, 14, 16]. Mathematics anxiety, in particular, has been identified as a significant barrier to learning, with girls often experiencing higher levels of anxiety compared to boys [6, 13]. Gender stereotypes regarding mathematics ability further contribute to girls' reluctance to pursue advanced mathematics courses and careers in Science, Technology, Engineering and Mathematics (STEM) fields. Additionally, teachers' beliefs and behaviours in the classroom can influence students' attitudes and performance [9, 11, 23], with studies indicating that gender biases lead to differential treatment of boys and girls in mathematics education.

The persistent gender disparities in mathematics education, characterized by lower achievement levels and less favourable attitudes among girls compared to boys, pose a significant challenge to achieving equity and excellence in education [15, 17, 22, 24]. Despite efforts to address these disparities, they persist, indicating a need for further investigation into the underlying factors contributing to them [12]. Specifically, there is a gap in understanding how teachers' beliefs, behaviours, and gender, as well as the learning environment, impact girls' attitudes and achievement in mathematics. Therefore, the problem statement of this study is to examine the role of teachers' beliefs and behaviours, teachers' gender, and the effects of single-sex schooling on girls' attitudes and achievement in mathematics, with the aim of identifying strategies to promote gender equity and enhance the quality of mathematics education for all students.

This study focuses on Senior High Schools (SHS), specifically Notre Dame and Sacred Heart SHS. These schools serve as the setting for investigating gender differences in teaching mathematics and the attitudes of female students towards the subject. By conducting the study in these specific SHS, we aim to gain insights into how gender dynamics manifest in the teaching and learning of mathematics among students in this educational context.

The study involves a survey design. This design includes the collection of data through questionnaires and Achievement Tests (AT) administered to SHS form three girls and mathematics teachers. The study utilized purposive sampling to select participants from two schools (one single-sex and one missed respectively) in the Sunyani West District in the Brong Ahafo (BA) Region of Ghana. The data collected from the questionnaires and tests were analysed quantitatively to investigate gender differences in teaching mathematics and the attitudes of female students towards the subject. The survey design was chosen for its ability to provide a snapshot of attitudes and achievements among students [20, 21] and to describe characteristics of the population using a sample.

By exploring these factors, this study provides insights that can inform strategies to address gender-based inequities in mathematics education [8, 16, 18]. Specifically, this study (1) examines the variations in beliefs about female students among different categories of mathematics teachers; (2) investigates the perceptions of female students regarding their mathematics teachers' behaviour towards them and (3) assesses potential differences in mean academic performances (a) between girls in all-girls schools and those in mixed-gender schools; (b) between girls taught by male teachers and those taught by female teachers. Through its comprehensive investigation, this study seeks to not only deepen our understanding of the challenges faced by female students in mathematics education but also to offer actionable insights for educators, policymakers, and stakeholders striving to promote gender equity and excellence in mathematics learning. This study holds significant promise in addressing the persistent gender disparities prevalent in mathematics education by delving into the complex interplay of teachers' beliefs, behaviours, and gender dynamics, alongside the impact of single-sex schooling, on girls' attitudes and achievement in mathematics. By scrutinizing these multifaceted factors, the research aims to shed light on the underlying mechanisms contributing to girls' underperformance and disengagement in the subject, thereby paving the way for the development of targeted interventions and strategies aimed at fostering a more inclusive and equitable learning environment.

2. Methodology and Materials

2.1. Study Design

The research design employed in this study was a survey, which involved gathering data through questionnaires and an achievement test. Surveys are valuable for capturing information from a predetermined population, providing a snapshot of existing conditions, and identifying relationships between specific events [1]. Given the focus on understanding the attitudes and achievements of students concerning their mathematics teachers' gender and school type, a survey design was deemed appropriate. This method allowed for the collection of data from a sample representing the target population of senior high school form three girls and their mathematics teachers.

2.2. Data Collection

Convenience sampling was employed for this study, with one single-sex (all-girls) school and one mixed school selected in the Sunyani West District, located in the BA Region of Ghana. The study involved a total of 262 girls and their 10 mathematics teachers, consisting of 4 females and 6 males, who were selected for participation.

2.2.1. Instruments

The study utilized questionnaires and an AT as its primary instruments. A questionnaire was crafted to gather responses from girls regarding several attitudinal variables and their perceptions of mathematics teachers' conduct towards them. The questionnaire items centered on factors such as the perception of mathematics as a male-dominated domain, mathematics-related anxiety, confidence levels in mathematics, and perceptions of teacher behavior. Seven items were formulated for each attitudinal variable, rated on a 5-point Likert scale, with response options including ‘strongly agree’, ‘agree’, ‘uncertain’, ‘disagree’, and ‘strongly disagree’. Additionally, a set of 10 items aimed to elicit girls’ perceptions of their teacher's behaviour, also rated on a 5-point Likert scale with response options ranging from ‘Very true’ to ‘not true at all’.

Furthermore, an AT was devised and given to the girls, modeled on the SHS syllabus. Multiple-choice items were included to ensure coverage of a wide range of syllabus topics. A distinct questionnaire was devised for mathematics teachers to collect insights into their perceptions regarding female students and effective pedagogy for all students. Ten items were dedicated to probing teachers' perceptions regarding female students, while another ten items focused on effective teaching methodology for females. Response options were structured to gauge agreement with statements, offering choices such as ‘agree with the statement’ and ‘the opposite is true for this statement’.

2.2.2. Validity and Reliability of the Instruments

The AT was meticulously crafted in alignment with the SHS syllabus, drawing inspiration from sample questions from the 2011 West African Senior School Certificate Examination (WASSCE) mathematics papers to shape the test items. As for the girls' questionnaire, items pertaining to the male domain and self-confidence variables were derived from the "Fennema-Sherman Attitude Scales," while those addressing anxiety were adapted from Eshun's instruments. Furthermore, items regarding the perception of mathematics teacher behavior were adapted from the availability and acceptance sub-scale.

Similarly, the items on the teachers' questionnaire, which aimed to capture teachers' perspectives on beliefs regarding female students and effective teaching methodologies, were modified from existing instruments used by Chirume & Chikasha, [8] in surveys on teachers' gender-related beliefs. After undergoing evaluation by an expert in the field to ensure their face validity, these instruments were then pilot-tested on 262 SHS girls and 10 mathematics teachers in the Sunyani West District of the BA region.

Reliability analysis was conducted for both the questionnaires and the achievement test. The coefficient alpha method was utilized to assess the reliability of the test, with each item scored across a range of values. For items scored dichotomously, the Kuder-Richardson (K-R) 21 formula was applied to estimate reliability, specifically for the AT. The resulting reliability coefficient for the AT was calculated to be 0.75.

For the girls' questionnaire, Cronbach's Alpha (CA) was computed for each variable. The mathematics anxiety sub-scale exhibited a reliability coefficient of 0.83, while the mathematics as a male domain sub-scale yielded 0.77. Furthermore, 0.79 was obtained for the self-confidence sub-scale, and the students' perception of teacher behavior sub-scale scored 0.86.

Similarly, the reliability coefficient of the teachers' questionnaire was determined. Items related to teachers' perceptions about female students achieved a CA of 0.77, while those concerning effective pedagogy scored 0.75.

2.3. Data Analysis

After data collection, responses to items on both the teachers' and students' questionnaires were encoded. For the students' questionnaire, responses were assigned numerical values: '5' for 'strongly agree', '4' for 'agree', '3' for 'undecided', '2' for 'disagree', and '1' for 'strongly disagree'. In instances where a student disagreed with a statement indicating a negative attitude, such as "I know I will not do well in mathematics", the response was interpreted as 'agree', and if strongly disagreed, it was interpreted as 'strongly agree'. A score below 3 indicated a negative aspect of the attitudinal variable, while a score above 3 indicated a positive aspect. Each attitudinal variable had a maximum score of 35 and a minimum of 7. A total score exceeding 21 denoted a positive characteristic,

while a total score below 21 denoted a negative characteristic.

(i). Exploring Gender Disparities in Mathematics Education

The independent t-test was employed to assess whether there existed a significant difference between responses to items on the attitudinal variables among; (1) girls in mixed schools and girls in single-sex schools, and (2) girls taught by female mathematics teachers and girls taught by male mathematics teachers. Subsequently, the section of the students' questionnaire focused on their perceptions of their mathematics teachers' behavior towards them. Responses to items in this section were coded as follows: '5' for 'very true', '4' for 'true', '3' for 'not sure', '2' for 'not true to some degree', and '1' for 'not true at all'.

Responses indicating negative behaviour were reverse-coded. A total score above 30 indicated a positive perception of the teacher‘s behaviour, while less than 30 indicated a negative perception. An independent samples t-test was employed to assess whether there was a significant difference in how girls perceived their mathematics teachers' behaviour.

(ii). Teachers' Questionnaire, Achievement Test Analysis, and Correlation Assessment

The teachers’ questionnaire comprised three sections: the first section sought personal information, section B solicited teachers’ views about beliefs regarding female students, and section C. Participants were asked to provide their opinions on various teaching strategies. Items in sections B and C were encoded similarly: '1' denoted agreement with the statement, '2' indicated believing boys and girls are equal in this respect, and '3' reflected believing the opposite to be true for the statement. Subsequently, means and standard deviations (SD) were computed, where a mean closer to 1 indicated belief in the statement, closer to 3 indicated belief in the opposite, and closer to 2 indicated belief in equality between boys and girls. An independent samples t-test was performed to assess differences in responses by teachers' gender.

The AT, scored out of 30, had means and SD calculated for students' scores. An independent samples t-test was conducted to ascertain whether there existed a significant difference in mean performance between: 1. Girls in mixed schools and single-sex schools, and 2. Girls taught by female mathematics teachers and those taught by male mathematics teachers. Finally, the Pearson-product moment correlation was employed to evaluate correlations between girls' perceptions of their mathematics teachers' behavior and their attitudes toward mathematics, as well as between attitudes and achievement.

3. Results and Discussion

3.1. Mathematics Teachers’ Beliefs Regarding Female Students

An independent samples t-test [16, 18] conducted on the examination of responses from both male and female teachers to all items showed no notable distinction in the beliefs held by male and female mathematics teachers regarding their female students. However, individual item analysis revealed a significant difference on one item: "Girls show less ability in mathematics than boys [13]." Patterns of responses to the statements are presented in Table 1, with explanations provided for some of the responses.

Male teachers had a mean score of 1.5, while female teachers had a mean score of 1.3 (Table 1). These mean scores suggest that male teachers consider both girls and boys to have equal perceptions of their abilities more so than female teachers [2, 22]. The independent samples t-test conducted on these mean scores revealed no significant difference between them ($t(16) < 1.96$, $p > 0.05$), indicating that mathematics teachers, regardless of gender, do not significantly vary in their perceptions of students' abilities in mathematics. [7]

Table 1. *Mathematics Teachers’ Responses to items on Beliefs about Female Students by Gender at alpha = 0.05.*

Items	Gender	Mean	SD	t	P	
1.	Girls are less motivated to work hard in math if they dislike it, unlike boys.	Males	1.8	0.6	0.6	0.5
		Females	1.6	0.5		
2.	Girls perceive their abilities in mathematics to be lower compared to boys.	Males	1.5	0.5	0.9	0.4
		Females	1.3	0.5		
3.	Girls demonstrate less independent work in mathematics compared to boys.	Males	1.5	0.5	0.0	1.0
		Females	1.5	0.5		
4.	Girls demonstrate less ability in math than boys.	Males	1.9	0.7	2.2	0.1
		Females	1.3	0.5		
5.	Girls show less willingness to work hard in math compared to boys.	Males	1.6	0.7	1.7	0.1

Items	Gender	Mean	SD	t	P	
6.	Girls exhibit less interest in math compared to boys.	Females	1.3	0.4		
		Males	1.4	0.7	0.7	0.5
7.	Girls are less prone than boys to envision themselves pursuing careers in math.	Females	1.6	0.7		
		Males	1.3	0.5	1.4	0.2
8.	Girls regard math as unimportant for their future careers.	Females	1.8	0.9		
		Males	2.0	0.6	1.5	0.2
9.	Girls are more inclined than boys to attribute success in math to luck.	Females	1.5	0.5		
		Males	2.1	0.6	0.1	1.0
10.	Girls achieve less in math compared to boys.	Females	1.3	0.6		
		Males	1.4	0.7	0.5	0.6
11.	All items	Females	1.3	0.5		
		Males	1.6	0.3	0.8	0.5
		Females	1.5	0.5		

3.2. Comparison of Teachers' Perceptions Regarding Girls' Ability and Willingness in Mathematics

On the item "Girls show less ability in mathematics than boys," male teachers had an average score of 1.9, while female teachers scored 1.3 on average. These findings indicate that female teachers perceive girls to have lower abilities in mathematics compared to boys, whereas male teachers perceive both genders as having equal abilities. An independent samples t-test showed a significant disparity between the mean scores ($t(16) > 2.0$, $p < 0.05$).

Regarding the statement "Girls are less willing to work hard in mathematics than boys," male teachers had a mean score of 1.6, while female teachers had an average score of 1.1, suggesting they believe girls are less inclined to work hard in mathematics, whereas male teachers perceive equality between genders in this aspect. However, an independent samples t-test indicated no significant disparity in the mean scores ($t(16) < 2.0$, $p > 0.05$).

3.3. Perceptions of Girls Regarding Mathematics Teachers' Behaviour: A Comparative Analysis Based on Teacher Gender

Analysis of the data revealed that both groups of girls, those taught by female teachers and those taught by male teachers generally had a positive perception of their teachers' behaiours.

Table 2. *Means Scores on Perceived Teacher's Behaviour by Gender of Teacher.*

Gender	Means	SD	t	p	d
Male	40.7	6.0	3.5	0.1	0.4
Female	37.9	7.0			

Alpha = 0.05

However, an independent samples t-test conducted on the mean scores (Table 2) revealed a notable difference between the means of the two groups. Specifically, girls instructed by male teachers rated their teachers' behavior more favorably than those taught by female teachers ($t(260) > 2.0$, $p < 0.05$). This implies that male teachers tend to establish better rapport with their female students compared to female teachers. Moreover, the effect size ($d=0.43$) indicates a moderate difference between the two groups.

3.4. Correlation Between Girls' Perceptions of Teachers' Behaviour and Math Attitudes

(a) Hypothesis testing

H_0: There exists no correlation between girls' perceptions of their mathematics teachers' behavior towards them and their attitude towards mathematics.

H_1: A correlation exists between girls' perceptions of their mathematics teachers' behavior towards them and their atti-

tude towards mathematics.

The analysis examined the correlation between girls' perceptions of their mathematics teachers' behavior and their attitudes towards mathematics, the study tested the hypothesis that there is no relationship between these variables. Employing Pearson product-moment correlation, the research identified significant correlations between girls' perceptions of their teachers' behavior and their anxiety levels in mathematics ($r = 0.5$, $p < 0.05$), as well as their perception of mathematics as a male domain ($r = 0.4$, $p < 0.05$), and their self-confidence in mathematics ($r = 0.5$, $p < 0.05$). The coefficients of determination (r^2) indicated that 28%, 18.8%, and 26% of girls' anxiety, perception of mathematics as a male domain, and self-confidence in mathematics, respectively, could be explained by their perceptions of their teachers' behaviour [4]. These findings suggest that girls' attitudes towards mathematics are significantly influenced by their perceptions of their teachers' behaviour, highlighting the importance of positive teacher-student interactions in shaping students' attitudes towards the subject.

Table 3. *Correlation between the Scores on Girls' Perceptions of the Mathematics Teachers' Behaviour and the Scores on the Attitudinal Variables.*

		Perceived Teacher Behaviour	anxiety	male domain	self- onfidence
Perceived	Correlation	1			
Teacher	Covariance	42.1			
Behaviour					
Anxiety	Correlation	0.5**	1		
Covariance	17.8	27.0			
Male	Correlation	0.4**	0.5**	1	
Domain	Covariance	11.6	9.9	17.4	
Self-	Correlation	0.5**	0.7**	0.4**	1
Confidence	Covariance	17.3	18.8	9.1	27.1

Alpha=0.05 **significant 2-tailed, N=262

The findings reveal a significant positive correlation between students' perception of their teachers' behavior and three attitudinal variables: anxiety, perception of mathematics as a male domain, and self-confidence, suggesting that a positive teacher-student relationship promotes favourable student attitudes [1, 4, 15, 20, 24]. This finding aligns with research by Mata et al., [16] who highlighted the influential role of teacher-student relationships on overall school and behavioural adjustment. Similarly, Poku & Ampadu, [20] found that positive teacher-student relationships, characterized by warmth and communication, correlate with behavioural competency and better school adjustment. Additionally, Madu et al., [15] findings underscore the negative impact of teachers' negative attitudes on students' attitudes toward mathematics.

3.5. Gender Differences in Mathematics Education: Impact of Teachers and School Environment

Girls taught by male mathematics teachers experienced significantly less anxiety compared to those taught by female teachers, although the mean difference was small (effect size = 0.1). However, there was no significant difference between the two groups in their perceptions of mathematics as a male domain. Regarding self-confidence, girls taught by male teachers demonstrated higher confidence than those taught by female teachers (Table 4), with a medium effect size of 0.4. Overall, girls taught by male teachers exhibited a significantly more positive attitude toward mathematics compared to those taught by female teachers. Additionally, girls in mixed schools showed lower anxiety levels and were less likely to perceive mathematics as a male domain compared to girls in all-girls schools, with medium effect sizes of 0.4 and 0.3, respectively.

Table 4. Mean Scores on the Attitudinal Variables by Gender of Teacher.

Attitudinal Variable	Teacher's sex	Mean score	Std. deviation	t-value	p-value	d
Anxiety	Male	26.4	5.1	3.0	0.0	0.1
	Female	24.5	5.1			
Male Domain	Male	26.7	4.4	1.3	0.2	
	Female	26.0	3.8			
Self Confidence	Male	28.4	4.6	3.6	0.0	0.4
	Female	26.1	5.6			
All Variables	Male	27.2	4.0	3.3	0.0	
	Female	25.6	4.0			

Alpha=0.05

However, there was no significant difference in self-confidence between the two groups. Despite both groups displaying positive attitudes toward mathematics, girls in mixed schools demonstrated a significantly more positive attitude than those in all-girls schools.

3.6. Correlation Between Girls' Attitudes and Achievement in Mathematics

Further analysis indicates a significant positive correlation between girls' attitudes toward mathematics and their achievement in the subject. To test this hypothesis, scores on each attitudinal variable were calculated for each student, along with the AT scores. The Pearson product-moment correlation coefficients between the AT scores and the three attitudinal variables were then computed. The correlation between the AT and anxiety was calculated to be 0.4, which was found to be significant at a 0.05 significant level (2-tailed). This suggests that mathematics anxiety explains 13.9% of the girls' achievement in the test. Similarly, the correlation between the AT scores and the male domain variables was found to be 0.4, also significant at the 0.05 alpha level.

The coefficient of determination indicates that the male domain variable explains 12.5% of the girls' scores on the achievement test (Table 5). Furthermore, the correlation between the test scores and the self-confidence variable was found to be 0.3, significant at the 0.05 alpha level, with self-confidence explaining 8.6% of the test scores. Overall, all 3 selected attitudinal variables correlated significantly with the girls' scores on the AT, aligning with the argument that achievement gaps are more closely related to attitudes than to course-taking [6, 11, 18]. Additionally, it was observed that low anxiety levels are associated with high achievement gains (Table 6).

Table 5. Mean Scores on the Attitudinal Variables by School Type.

Variables	School type	Mean	SD	t	P	D
Anxiety	all-girls	24.2	5.0	3.2	0.0	0.4
	mixed	26.3	5.2			
Male domain	all-girls	25.7	3.8	2.0	0.0	0.3
	mixed	26.8	4.3			
Self-Confidence	all-girls	27.1	4.9	0.5	0.6	
	mixed	27.5	5.3			
All Variable	all-girls	26.9	26.9	2.4	0.0	
	mixed	25.7	3.7			

Alpha = 0.05

3.7. Correlation Between Attitude and Achievement in Mathematics: A Comprehensive Analysis

This finding aligns with previous research by Asante, [6] who identified a correlation between anxiety and achievement, as well as with the works of (Meelissen & Luyten, [17]; Okwara & Raburu, [19]; Third et al., [23]) which suggest that high anxiety is associated with lower achievement in mathematics (Table 6). Additionally, the significant correlation between confidence and achievement is consistent with Fletcher, [9] findings that confidence, a key component of self-concept, positively correlates with achievement. This result also resonates with the research of (Aboagye et al., [1]; Asante, [6]; Iddrisu et al., [13]; Meelissen & Luyten, [17]).

Table 6. *Correlation between the Scores on the Achievement Test and the Attitudinal Variables.*

		Score on Test	anxiety	male domain	self-confidence
Score on Test	Correlation	1			
	Covariance	27.1			
Anxiety	Correlation	0.4**	1		
	Covariance	10.1	27.0		
Male domain	Correlation	0.4**	0.4**	1	
	Covariance	7.7	9.9	17.4	
Self-confidence	Correlation	0.3**	0.7**	0.4**	1
	Covariance	8.0	18.8	9.1	27.1

Alpha=0.05 **significant 2-tailed, N=262

Furthermore, a longitudinal study by Iddrisu et al., [13] on self-confidence, identified that mathematics learning is influenced by students' mathematics-related beliefs, particularly their self-confidence. Similarly, Okwara & Raburu, [19] indicated that confidence in mathematics learning correlates more strongly with achievement than any other affective variable.

3.8. Advancing Research on Math Attitudes and Academic Performance

Further studies and analysis are needed to deepen our understanding of several aspects identified in this research. Firstly, exploring the underlying mechanisms that drive the correlations found between attitudes toward mathematics and achievement could provide valuable insights into effective interventions to improve student performance [11, 17, 19]. Additionally, investigating how these correlations may vary across different demographic groups, educational settings, and cultural contexts could offer a more nuanced understanding of the factors influencing academic outcomes. Moreover, longitudinal studies tracking students' attitudes and achievement over time could shed light on the causal relationships between these variables and provide valuable information for educational policymakers and practitioners. Finally, considering the potential impact of various teaching methodologies, classroom environments, and support structures on students' attitudes and achievement in mathematics could inform the development of evidence-based interventions to enhance educational outcomes [13].

4. Conclusion and Recommendation

The study set out to explore gender disparities in teaching high school mathematics and their impact on the attitudes of female students towards the subject. Through purposive sampling, 262 girls and 10 mathematics teachers from two schools in Ghana were selected for participation. Utilizing surveys and ATs, quantitative data were gathered and analysed to discern patterns and relationships.

The findings illuminated several key insights. Firstly, while teachers' gender did not significantly affect girls' academic performance in mathematics, male teachers seemed to exert a more positive influence on girls' attitudes towards the subject compared to their female counterparts. Additionally, the type of school - whether mixed or single-sex - did not markedly impact girls' math performance, though mixed schools appeared to foster more positive attitudes towards the subject among female students.

Moreover, girls taught by male teachers exhibited lower levels of anxiety and higher self-confidence in mathematics, highlighting the potential impact of teacher gender on students' psychological well-being and academic self-concept.

Furthermore, positive teacher-student relationships emerged as significant factors influencing girls' attitudes towards mathematics and their academic performance.

From these findings, several conclusions can be drawn. While teachers' beliefs about female students did not significantly differ between genders, discrepancies existed in perceptions of students' mathematical abilities and preferred teaching methodologies. Mixed schools appeared to offer a more conducive environment for fostering positive attitudes towards mathematics among female students.

Based on these conclusions, several recommendations are proposed. Mathematics educators should strive to create supportive and inclusive learning environments that empower female students and address any practices or biases that may hinder their engagement with the subject. Additionally, education authorities should prioritize the recruitment and training of qualified mathematics teachers, particularly those with a background in mathematics education.

Looking ahead, future research endeavours could delve deeper into senior high school mathematics teachers' beliefs about students and effective teaching strategies on a larger scale. Moreover, investigating potential gender-based differential treatment of students in mathematics classes could provide valuable insights into fostering equitable learning environments and promoting positive attitudes towards mathematics among all students.

In sum, the study sheds light on the multifaceted dynamics of gender, teaching practices, and student attitudes in the context of high school mathematics education, offering valuable insights for shaping future educational policies and practices.

Abbreviations

AT: Achievement Test
BA: Brong Ahafo
CA: Cronbach's Alpha
K-R: Kuder-Richardson
SD: Standard Deviation
SHS: Senior High School
STEM: Science, Technology, Engineering and Mathematics
WASSCE: West African Senior School Certificate Examination

Author Contributions

Ishmael Karadaar Besing: Conceptualization, data curation, Validation, Investigation, writing-original draft, Project administration, Writing - review & editing.

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Data Availability Statement

Data will be made available upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Aboagye, K. O., Ke, Y. D., & Mante, D. A. (2021). Factors influencing students' perceived difficulties in studying Geometry: a case of Konogo-Odumasi, Ghana. Open Journal of Social Sciences, 9, 526–540. https://doi.org/10.4236/jss.2021.99038

[2] Adetunde, I. (2016). Improving the teaching and learning of mathematics in second circle institutions in Ghana. Report and Opinion, 1(3).

[3] Afzal, M. (n.d.). Students' attitides towards mathematics: does classroom learning environment of single-gemder classes make any difference? Pakistan Journal of Education 30(1). https://doi.org/10.30971/pje.v30i1.94

[4] Amoah, K. (2021). Education and reform in Ghana.

[5] Arends, F., Rogers, S., Juan, A., Town, C., & Town, C. (2024). The South African perspective highlights from TIMSS, the South African perspective. 1–6.

[6] Asante, K. O. (2015). Secondary students attitudes towards mathematics. Ife Psychologia, 20(1).

[7] Bethell, G. (2016). Mathematics education in Sub-Saharan Africa: status, challenges, and opportunities. The World Bank.

[8] Chirume, S., & Chikasha, A. S. (2014). A critical analysis of the factors affecting achievement in secondary school mathematics in Zimbabwe: a case study of Gweru District. Merit Research Journal of Education and Review, 2(9), 194–202.

[9] Fletcher, J. (2018). Performance in mathematics and science in basic schools in Ghana. Academic Discourse: An International Journal, 10(1), 1–18.

[10] Fredua-kwarteng, E., & Ahia, F. (2003). Learning mathematics in english at basic schools in Ghana. European Journal of Educational Research, 4(3), 124–139. https://doi.org/10.12973/eu-jer.4.3.124

[11] Graven, M., & Venkat, H. (2023). Saarmste's role in building and connecting early grade mathematics research. African Journal of Research in Mathematics, Science and Technology Education 27(3), 255-272. https://doi.org/10.1080/18117295.2023.2223376

[12] Howie S. (1997). Mathematics and science performance in the middle school years in South Africa: a summary report on the performance of South African students in the third international mathematics and science study. Human Sciences Research Council.

[13] Iddrisu, A. K., Karadaar, I. B., Junior, J. G., Ansu, B., & Ernest, D. A. (2023). Mixed effects logistic regression analysis of blood pressure among Ghanaians and associated risk factors. Scientific Reports, 13, 1–13 https://doi.org/10.1038/s41598-023-34478-0

[14] Journal, A., Studies, E., & Vol, S. (2016). Students' performance on the Ghanaian junior high school mathematics national minimum standards in the Effutu Municipality. African Journal of Educational Studies in Mathematics and Sciences, 12, 25–34.

[15] Madu, T., Abimbola, Y., & Gbolahan, N. (2013). Factors influencing effective learning of mathematics at senior secondary schools within Gombe Metropolis, Gombe State. Journal of Education and Practice, 4(25), 61–67.

[16] Mata, M. D. L., Monteiro, V., & Peixoto, F. (2012). Attitudes towards mathematics: effects of individual, motivational, and social support factors. Child Development Research, 876028. https://doi.org/10.1155/2012/876028

[17] Meelissen, M., & Luyten, H. (2008). The Dutch gender gap in mathematics: small for achievement, substantial for beliefs and attitudes. Studies in Educational Evaluation, 34, 82–93. https://doi.org/10.1016/j.stueduc.2008.04.004

[18] Mereku, K. D. (1995). A comparison of the official primary in Ghana with mathematics curriculum in which it is implemented by teachers. The University of Leeds, School of Education.

[19] Okwara, M. O., & Raburu, P. (2015). Assessment of school factors related to academic achievement in mathematics among secondary school students of Masaba South Sub County, Kenya. Journal of Education and Practice, 6(12), 70–74.

[20] Poku, D. A., & Ampadu, E. (2020). Gender differences in attitudes and achievement in mathematics among Ghanaian JHS students. International Journal of Education, 12(3), 84–95. https://doi.org/10.5296/ije.v12i3.17136

[21] Recber, S., Isiksal, M., & Koç Y. (2018). Investigating self-efficacy, anxiety, attitudes and mathematics achievement regarding gender and school type. anales de psicolog á, 34, 41–51. http://dx.doi.org/10.6018/analesps.34.1.22957134

[22] States, D. (2019). Influence of teachers' qualifications in the teaching of technical drawing in technical colleges in Edo and Delta States, Nigeria. International Journal of Academic Research in Business and Social Sciences, 9(5), 518–527. https://doi.org/10.6007/IJARBSS/v9-i5/5902

[23] Third, T. H. E., Mathematics, I., & Realities, S. A. (2000). Middle school students' performance in mathematics in the third international mathematics and science study: South Africa realities. Studies in Educational Evaluation, 26, 61-77. https://doi.org/10.1016/S0191-491X(00)00006-7

[24] Thomson, S., Lokan, J., & Ainley, J. (2003). Lessons from the third international mathematics and science study. A study commissioned by the Australian Government Department of Education, Science and Training. Australian Council for Educational Research.