INVESTIGATING THE INTERPLAY OF GENDER AND SCHOOL LOCATION IN SHAPING ATTITUDES TOWARD ALGEBRA AMONG SENIOR SECONDARY STUDENTS

[1]Ganiyu Adisa IROKO & [2]Omolola Aina LADELE
[1]Osun State University, Osogbo
ganiyu.iroko@uniosun.edu.ng
ORCID: 0009-0005-7076-9952
[2]Lagos State University of Education, Oto/Ijanikin
ladeleoa@lasued.edu.ng
ORCID: 0000-0003-1264-739X

Abstract

This study investigates the interplay of gender and school location in shaping attitudes towards Algebra among senior secondary students in Ogun State, Nigeria. The main objective is to understand how these factors influence students' attitudes towards Algebra, a fundamental subject in Mathematics education. A quasi-experimental pretest, post-test nonequivalent control group 2x2 factorial design was employed, involving 356 SS 2 students from eight public senior secondary schools, with four schools each from urban and rural areas. A mathematical attitudinal questionnaire with a reliability index of 0.78 was administered before and after a 12-week treatment period. Data were analysed using Mean, Standard Deviation, and Analysis of Covariance (ANCOVA) at a significance level of 0.05. The results indicate no significant difference in attitudes towards Algebra between male and female students ($F(1,354) = 2.142$; $p > .05$). However, there was a significant main effect of school location, with urban students displaying more positive attitudes than their rural counterparts ($F(1,354) = 12.188$; $p < .05$). Additionally, a significant interaction effect was found between gender and school location ($F(1,354) = 5.080$; $p < .05$). These findings highlight the importance of considering both gender and school location in educational interventions and policy-making to enhance students' attitudes and performance in Algebra. The study provides valuable insights for educators and policymakers to develop targeted strategies that address the specific needs of different student groups, ultimately promoting a more inclusive and effective learning environment.

Keywords: Algebra, Attitudes, Gender, School Location, Secondary Mathematics.

Introduction

Algebra is a foundational aspect of Mathematics that plays a crucial role in developing logical reasoning, problem-solving skills, and abstract thinking. These skills are essential not only for academic success but also for various professional and personal endeavours, and are often required for higher education and many career paths, making Algebra vital for students' future success. Algebra is one of the branches of Mathematics that uses letters rather than numbers (Iroko & Olaoye, 2021). Algebra is a critical component of the Mathematics curriculum, serving as a bridge between basic arithmetic and more advanced mathematical concepts. It is a cornerstone of Mathematics, essential for developing the abstract thinking and problem-solving skills required for higher education and careers in science, technology, and engineering (Stylianides et al., 2017). Despite its importance, many senior secondary students exhibit

negative attitudes towards Algebra, which significantly hinders their engagement and academic achievement. Understanding the factors that shape these attitudes is therefore critical for improving educational outcomes.

A student's attitude towards mathematics is a stable, evaluative disposition that encompasses their beliefs, feelings, and behaviours related to the subject (Hwang & Son, 2021). A subfield of affective research, attitude, is distinct from emotion since it is steadier and more cognitive (Goldin et al., 2016). This attitude is a powerful predictor of performance, making its study a priority for teachers (Adetayo & Otiegede, 2020), as teachers have focused a lot of attention on students' attitudes towards mathematics (Chen et al., 2018). Mathematical attitude is therefore seen as a necessary precondition for success in today's world. Among the many factors influencing attitude, gender and school location are two significant, yet complex variables.

Gender has been a significant area of research in the field of Mathematics education. Unlike sex, gender is a socially determined characteristic of males and females in a particular culture (Iroko, 2024) and a significant factor in the educational system (Akissani & Ahmed, 2019). Research on gender and Mathematics has produced conflicting findings. Some studies indicate that male students often display greater confidence and more positive attitudes, potentially due to societal norms and encouragement (Else-Quest et al., 2010). However, other meta-analyses suggest this gender gap is small and declining (Hyde et al., 2008), indicating a nuanced relationship. Similarly, school location, whether a school is in an urban or rural area, creates starkly different learning environments. School location refers to a place in relation to other areas in the physical environment (rural or urban) where the school is located (Nbiti & Edoho, 2017). Urban schools typically have superior resources, infrastructure, and teachers, which can foster positive attitudes (Kane & Mertz, 2012). In contrast, rural schools often face resource limitations and the additional challenge of teaching Mathematics in English, a language not always widely spoken in these communities, which can negatively impact student attitudes and performance (Song, 2023).

Crucially, the interaction between gender and school location has been largely overlooked. The effect of a school's location may not be the same for male and female students. For example, urban resources might be particularly empowering for female students, while the supportive environment of a rural school might be more beneficial for males (Wilkins & Ma, 2003).

This study is guided by Social Constructivism, which posits that learning is shaped by social and cultural contexts (Akpan et al., 2020). Social Constructivism Theory, which asserts that learning happens when students actively develop or construct fundamental knowledge on their own through research and discovery (Saleem et al., 2021). From this perspective, students' attitudes towards Algebra are not formed in a vacuum but are actively constructed through their gendered experiences within the specific social environment of their school, whether urban or rural. Therefore, this study aims to investigate the interplay of gender and school location in shaping senior secondary students' attitudes towards Algebra. The research will provide valuable insights for creating targeted interventions to improve attitudes and learning outcomes for diverse student groups by exploring this gap.

Objectives of the Study

The main objective of this study was to investigate the interplay of gender and school location in shaping attitudes toward Algebra among senior secondary students.
Specifically, the study sought to:

1. determine the differences in students' attitude towards learning of Algebra based on gender.
2. examine the effect of school location on students' attitude towards Algebra
3. investigate whether interaction exist between gender and school location on students' attitude towards Algebra

Research Questions

1. Is there a difference between male and female students' attitudes toward Algebra?
2. Does school location have effect on students' attitudes toward Algebra?

Hypotheses

Ho1: There is no significant difference in attitudes toward Algebra between male and female students.

Ho2: School location does not have a significant effect on students' attitudes toward Algebra.

Ho3: There is no significant interaction effect between gender and school location on students' attitudes toward Algebra.

Methodology

This study employed a quasi-experimental design with a pretest post-test non-equivalent control group approach, utilising a 2x2 factorial framework. The two factors were gender (male and female) and school location (urban and rural). The population included all SS 2 students in 333 public senior secondary schools across Ogun State. From this population, eight schools were randomly selected; four from urban areas and four from rural areas. The sample consisted of eight intact classes comprising a total of 356 SS2 students.

A mathematical attitudinal questionnaire containing 20 items was used to measure students' attitudes toward Algebra. The questionnaire is made up of two sections A and B. Section A collected information on school name, school location and Gender while section B comprised 20 items (positive and Negative statements) developed basically on three components (Cognitive, Affective and Behavioural) of attitude, requested students to indicate their attitude toward the learning of Algebra based on four point modified Likert scale of Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1) for positive statements; negative statements were reversed. The instrument demonstrated good reliability using Cronbach's Alpha with r-value of 0.78. It was administered as pretest to the intact classes before the intervention of using the contemporary instructional strategies to teach selected Algebra topics for 12 weeks. The topics selected under Algebra for the study were as a result of students' weaknesses as reported by the WAEC chief examiner, their fundamental importance in the learning of Algebra and their relationship as a bridging gap between the topics in Mathematics.

The questionnaire was also administered as a posttest after the intervention. The data collected were analysed using Mean, Standard Deviation, and Analysis of Covariance (ANCOVA), with a 0.05 significance level.

Results

Research Question 1: Is there a difference between male and female students' attitudes toward Algebra?

Table 1: Table of gender attitudes towards Algebra

Gender	Mean	Std. Deviation	N
Male	57.7574	7.98326	169
Female	57.1176	7.54107	187
Total	57.4213	7.74975	356

Results presented in Table 1 indicate that male students scored slightly higher (Mean = 57.76, SD = 7.98) on the posttest of the Algebraic Attitudinal Questionnaire compared to female students (Mean = 57.12, SD = 7.54). This suggests that, overall, male students exhibited a more positive attitude toward Algebra than their female counterparts. To determine whether this observed difference was statistically significant, hypothesis one was tested.

H_{o1}: There is no significant difference in attitudes toward Algebra between male and female students.

Table 2: Table of Analysis of Covariance for Algebra Attitudinal Questionnaire

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5429.552[b]	17	319.385	6.793	.000
Intercept	10828.624	1	10828.624	230.320	.000
Pre-Attitude	735.170	1	735.170	15.637	.000
Gender	100.707'.	1	100.707	2.142	.144
School Location	573.031	1	573.031	12.188	.001
Gender * School Location	238.832	1	238.832	5.080	.025
Error	15891.246	338	47.016		
Total	1195128.000	356			
Corrected Total	21320.798	355			

a. R Squared = .255 (Adjusted R Squared = .217)

It was found in Table 2 that the pretest F-value ($F = 15.64$; $\alpha = 0.05$ $p < .05$) was significant. This indicates that prior to the intervention, there were significant differences in the students' attitude toward Algebra. Hypothesis one was tested, and the results are displayed in Table 2. The analysis showed no significant difference between male and female students' attitudes toward Algebra [$F(1,354) = 2.142$; $p > .05$]. Therefore, the hypothesis that there is no significant difference in attitudes toward Algebra between male and female students is not rejected. Although male students appeared to have slightly better attitudes than females, this difference was not statistically significant, indicating that gender does not have a meaningful impact on students' attitudes toward Algebra.

Research Question 2: Does school location have effect on students' attitudes toward Algebra?
Table 3: Table of school location attitudinal questionnaire

School Location	Mean	Std. Deviation	N
Urban	58.7441	6.75496	211
Rural	55.4966	8.67317	145
Total	57.4213	7.74975	356

Table 3 indicates that students in urban schools exhibited a higher attitude toward Algebra (Mean = 58.74, SD = 6.75) compared to students in rural schools (Mean = 55.49, SD = 8.67) in the post-test of the Algebraic Attitudinal Questionnaire. This suggests that urban students generally had more positive attitudes toward Algebra than their rural counterparts. To determine whether this difference was statistically significant, hypothesis two was tested

H_{o2}: School location does not have significant main effect on students' attitudes towards Algebra.

The hypothesis was tested, and the results are presented in Table 2. The analysis revealed significant main effect of school location on students' attitudes towards Algebra [$F(1,354) = 12.188$; $p < .05$]. This indicates that students in urban schools had significantly more positive attitudes than those in rural schools. Consequently, the hypothesis stating that school location does not have a significant main effect on students' attitudes towards Algebra is rejected, supporting the observation that school environment influences students' attitudes towards Algebra.

$H_{o3:}$ There is no significant interaction effect between gender and school location on students' attitudes toward Algebra.

The hypothesis regarding the interaction between school location and gender was also tested. The results showed a significant interaction effect [$F(1,354) = 5.080$; $p < .05$], suggesting that the combined influence of gender and school location affects students' attitudes toward Algebra. Therefore, the hypothesis that there is no significant interaction effect between gender and school location on students' attitudes toward Algebra is rejected, highlighting the complex interplay of these factors in shaping attitudes.

Discussion of Findings

The results of this study indicate that while male students had slightly higher mean scores on the Algebra attitudinal questionnaire compared to female students, the difference was not statistically significant. This finding aligns with some previous research that found no significant gender differences in attitudes towards Mathematics (Else-Quest, Hyde, & Linn, 2010). The findings of Adetayo and Otiegede (2020); Olosunde, et al (2020) also showed that the there are no significant differences in the learning attitude adopted by male and female senior secondary school students towards the learning of mathematics. The lack of a significant difference suggests that gender alone may not be a strong predictor of attitudes towards Algebra among senior secondary students. In contrast, Lin, Tseng and Chiang (2017) study indicated significant gender differences in attitudes toward Mathematics. Also, Efai and Fripong (2023) found significant difference in students' attitude towards Mathematics in favour of female students while Amatobi and Amatobi (2020) found that boys displayed better attitude than girls in Mathematics.

The school location of students plays a vital role in their attitude. Environmental influence has the capacity to serve as a trigger mechanism for students in showcasing their right attitude to learning and Mathematics in particular. Beyond this, students' environmental influence also has the capacity to crystallize and demystify the misconceptions in Mathematics. The study was able to prove beyond a reasonable doubt that students schooling in urban areas tend to develop an undismayed attitude toward learning of Algebra

The significant main effect of school location on students' attitudes towards Algebra is consistent with previous research that has highlighted the importance of school resources and environment (Kane & Mertz, 2012). Corroborating this finding is Alordiah et al (2015), who found that the students in urban schools did better than their counterparts in rural schools. Students in urban schools, which typically have more resources and better infrastructure, displayed more positive attitudes towards Algebra compared to their rural counterparts. This finding underscores the need for policymakers to address resource disparities between urban and rural schools to improve students' attitudes and academic outcomes.

The significant interaction effect of gender and school location on students' attitudes towards Algebra is a critical finding of this study. The intersection of gender and school location further complicates the societal divide. For example, girls in rural areas may face unique challenges due to traditional gender roles and limited access to educational opportunities compared to boys in urban settings. Similarly, boys in urban areas may encounter socioeconomic pressures and academic expectations that differ from those in rural communities. Understanding these intersectional dynamics is crucial for addressing the complex factors contributing to educational disparities. This suggests that the impact of school location on attitudes may differ between males and females. For instance, the positive influence of urban schools on attitudes may be more pronounced for female students, while the supportive community environment in rural schools may benefit male students. This interaction highlights the importance of considering both gender and school location in the development of educational interventions.

Conclusion

This study provides valuable insights into the interplay of gender and school location in shaping attitudes towards Algebra among senior secondary students. While gender alone did not significantly influence attitudes, school location emerged as a significant factor, with urban students displaying more positive attitudes. The significant interaction effect further emphasises the complex nature of these relationships and the need for targeted interventions that consider both gender and school location.

Recommendations

i. Policymakers should focus on reducing resource disparities between urban and rural schools to ensure that all students have access to high-quality educational materials and facilities.
ii. Educational programmes should be designed to address the specific needs of both male and female students, particularly in rural areas. For example, providing role models and mentors can help improve female students' attitudes towards Algebra.
iii. Teachers should receive training on gender-sensitive teaching methods and the importance of creating a supportive learning environment, especially in rural schools.
iv. Engaging the community in educational initiatives can help create a supportive environment for students, particularly in rural areas where resources may be limited.

v. Future research should explore the underlying mechanisms that contribute to the interaction effect of gender and school location on attitudes towards Algebra, as well as the long-term impact of these attitudes on students' academic performance and career choices.

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