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SOCIO-CULTURAL AND INSTITUTIONAL DETERMINANTS OF FEMALE ENROLLMENT INTO MATHEMATICAL SCIENCES IN BORNO STATE

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ABSTRACT

Gender disparities in Science, Technology, Engineering and Mathematics (STEM) remain a critical challenge globally and with mathematics being among the most affected fields. In Borno state university, female enrollment in mathematical sciences is disproportionately low, despite various interventions such as scholarship programs aimed at improving gender equity. This study investigates the socio-cultural and institutional factors influencing female students' enrollment in mathematical sciences at Borno state university. A survey research design was adopted and data were collected from 120 female undergraduate students selected through stratified random sampling. A structured questionnaire with Likert-scale items was used to capture perceptions of socio-cultural norms, family support, institutional policies and learning environments. Data analysis involved descriptive statistics and binary logistic regression to determine the predictive influence of selected factors on enrollment. Results revealed that parental education, household income, access to scholarships, societal support and institutional safety significantly influenced female students' decisions to pursue mathematics. The model explained 92% of the variance in enrollment (Nagelkerke $R^2 = 0.920$), highlighting the critical role of both cultural expectations and institutional structures. The study recommends strengthening mentorship programs, increasing female role models in STEM, enhancing campus safety and expanding scholarship initiatives to bridge the gender gap in mathematical sciences.

Keywords: Gender disparity, STEM education, female enrollment, socio-cultural factors, institutional factors

Introduction

Gender disparities in science, technology, engineering and mathematics (STEM) disciplines remain a persistent global challenge, with mathematics being one of the most affected fields (Wang & Degol, 2017; Cheryan, 2025). In Nigeria, female enrollment in tertiary-level mathematics programs continues to lag significantly behind that of males, despite national and international efforts to promote gender equity in education (Adepoju, 2022; Laraba et al., 2023). This imbalance is particularly pronounced in northern regions such as Borno State, where socio-cultural norms, economic hardship, and the lingering effects of insurgency have disproportionately impacted girls' access to education (Adebayo & Yusuf, 2022).

Kashim Ibrahim university (formerly known as the Borno state university), established to expand access to higher education in the North East Nigeria offers a robust mathematics curriculum aimed at developing analytical and problem-solving skills. However, female participation remains low. Recent data from the Joint Admissions and Matriculation Board (JAMB) indicates that fewer than 2% of mathematics applicants in Borno State are female (JAMB, 2024). This underrepresentation reflects broader systemic issues, including gender stereotypes, limited career awareness and a lack of female role models in STEM fields (Okeke *et al.*, 2021).

In response, the Borno state government has introduced targeted interventions, such as full scholarships for female students who score 250 and above in the Unified Tertiary Matriculation Examination (UTME), with the aim of boosting female enrollment in STEM disciplines. While these initiatives signal progress, they raised critical questions: What barriers still deter female students from pursuing mathematics at BOSU? Are current policies sufficient to address the root causes of gender disparity? This study investigates the factors influencing female enrollment in mathematics at Borno state university to explore female students' perspectives.

Recent research continues to highlight the persistent gender gap in STEM education across Nigeria, particularly in mathematics at the tertiary level. Magaji and Abdullahi (2025) examined stakeholder perceptions at Abubakar Tafawa Balewa University and found that cultural and religious norms in Northern Nigeria significantly influence female enrollment in STEM disciplines. Similarly, Okeke *et al.*, (2021) identified systemic biases in curriculum design and teacher attitudes as major deterrents to female participation in STEM across Sub-Saharan Africa. In addition to structural and cultural barriers, socio-economic factors play a critical role in shaping female enrollment patterns. Adebayo and Yusuf (2022) demonstrated a strong correlation between parental education particularly maternal education and the likelihood of daughters pursuing STEM disciplines. Their findings suggest that family background and awareness significantly influence academic choices.

In the same vein, Ibrahim and Nwankwo (2023) evaluated the impact of mentorship programs in Nigerian universities and found that such initiatives substantially improve female students' confidence and interest in mathematics. These insights support the growing consensus that targeted interventions beyond financial incentives are essential to fostering gender equity in STEM. Eze and Bello (2024) explored how digital learning platforms can reduce barriers for female learners in conflict-affected regions, offering flexible and accessible alternatives to traditional classroom settings. These studies provide a multidimensional understanding of the factors affecting female participation in mathematics and offer a strong foundation for the present research focused on Kashim Ibrahim university.

Objectives of the Study

The objectives of the study are:

1. To assess the influence of socio-cultural factors on female students' enrolment into mathematics department in Kashim Ibrahim university.
2. To investigate the influence of institutional factors on female students' enrolment into mathematics department in Kashim Ibrahim university.

Research Questions

The following research questions were answered:

1. What are the socio-cultural factors affecting female students' enrolment into mathematics department in Kashim Ibrahim university?
2. What are the institutional factors affecting female students' enrolment into mathematics department in Kashim Ibrahim university?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance.

H_{01}: The combined effect of parental education, household income, scholarship access, and societal support does not significantly predict female students' enrollment into mathematics department in Kashim Ibrahim university.

Methodology

This study employed a survey research design using a structured questionnaire to investigate the influence of socio-cultural, economic and institutional factors on female students' enrollment in mathematics at Borno State University. The design was chosen to allow statistical analysis of relationships between multiple variables and the binary outcome of enrollment. The research focused on identifying predictors that significantly influence female participation in mathematical sciences, particularly in the northern Nigeria. The population for this study consisted of female undergraduate students across various faculties at Kashim Ibrahim university.

A total of 120 respondents were selected using stratified random sampling, ensuring representation across different academic levels and departments. This sampling method helped capture diverse experiences and perspectives, while maintaining statistical validity for regression analysis. Data were collected through a self-administered questionnaire, which included both closed-ended and open-ended responses. The instrument was divided into sections covering demographic information, socio-cultural perceptions, institutional support and academic background. Descriptive statistics were used to analyze the data, while binary logistic regression was employed to determine the predictive power of selected variables on female enrollment in mathematics.

The variables measured in the study included both dependent and independent variables. The dependent variable, enrollment was measured as a binary outcome coded as 1 for students enrolled in mathematical sciences and 0 for those not enrolled. Among the

independent variables, parental education was measured on an ordinal scale, ranging from 0 for no formal education, 1 for primary education, 2 for secondary education and 3 for tertiary education. Household income was treated as a continuous variable representing monthly earnings in Nigerian Naira. Scholarship access was measured as a binary variable, coded 1 for students who have a scholarship and 0 for those without. Societal support was assessed using a Likert scale ranging from 1 (very low) to 5 (very high), reflecting perceived community support for women in STEM. Finally, female role model availability was also measured as a binary variable, coded as 1 if the respondent had access to female faculty or mentors and 0 if no such access existed.

Results

Table 1: Demographic Information of the Respondents

Variable	Responses	Frequency	Percentage
Age Group	Below 20 years	78	30.71%
	20-25 years	105	41.34%
	26-30 years	43	16.93%
	above 30 years	28	11.02%
Marital Status	Marries	61	24.02%
	Single	193	75.98%
Level of Study	Part I	53	20.87%
	Part II	82	32.28%
	Part III	61	24.02%
	Part IV	43	16.93%
	Part V	15	5.91%
Parents Education	Non-Formal	36	14.17%
	Primary	22	8.66%
	Secondary	69	27.17%
	Tertiary	127	50.00%

Table 1 presented the demographic characteristics of the respondents. Results revealed that, majority of the respondents fall within the age bracket 20-25 with 105 students (41.34%), followed by 78 students (30.71%) who are below 20 years. A smaller proportion, 43 respondents (16.93%), are aged 26 to 30 years, while only 28 students (11.02%) are above 30 years, indicating that most participants are within the typical undergraduate age range. In terms of marital status, the data shows that a significant majority of the respondents are single, accounting for 193 individuals (75.98%), while 61 respondents (24.02%) are married. This suggests that most female students involved in the survey are unmarried, which may reflect broader trends in tertiary education demographics.

Regarding academic level, the highest concentration of respondents is in Part II, with 82 students (32.28%), followed by Part III with 61 students (24.02%) and Part I with 53 students (20.87%). Part IV students make up 43 respondents (16.93%), while Part V has

the smallest representation with 15 students (5.91%). This distribution indicates a relatively balanced sample across different stages of study. Parental education levels show a strong leaning toward formal education, with 127 respondents (50.00%) reporting that their parents attained tertiary education and 69 students (27.17%) indicating secondary education. A smaller group, 36 respondents (14.17%), reported non-formal education, while only 22 students (8.66%) cited primary education. This suggests that a significant portion of female students in the study come from families with relatively high educational backgrounds, which may influence their academic aspirations and access to resources.

Table 2: Influence of socio-cultural factors on female students' enrolment into Mathematics Department in Borno State University

S/N	STATEMENT	SD	DA	N	A	SA
1	In my community, mathematics is considered more suitable for males than females.	38 (31.93%)	42 (35. 29%)	8 (6.72%)	18 (15.13%)	13 (10.92%)
2	My family encourages girls to study mathematics and related sciences.	10 (8.40%)	22 (18.49%)	11 (9.24%)	44 (36.97%)	32 (26.89%)
3	Cultural expectations about women's roles discourage female students from studying mathematics.	24 (20.17%)	49 (41.18%)	13 (10.92%)	19 (15.97%)	14 (11.76%)
4	Female role models in mathematics are visible and accessible in my community.	6 (5.04%)	15 (12.61%)	10 (8.40%)	55 (46.22%)	33 (27.73%)
5	Peer pressure discourages girls from enrolling in Mathematical Sciences.	28 (23.53%)	37 (31.09%)	21 (17.65%)	22 (18.49%)	11 (9.24%)

Table 2 present the influence of socio-cultural factors on female enrolment into mathematical science. When asked whether mathematics is considered more suitable for males than females in their community, a significant proportion of respondents expressed agreement with this stereotype. Specifically, 38 students (31.93%) strongly disagreed, while 42 (35.29%) disagreed, suggesting that a majority reject this notion. However, 18 respondents (15.13%) agreed and 13 (10.92%) strongly agreed, indicating that gendered perceptions of mathematics still persist in some communities.

Family support also positively influences female enrolment with 44 respondents (36.97%) agreeing and 32 (26.89%) strongly agreeing that their families encourage girls to study mathematics and related sciences. Only 10 students (8.40%) strongly disagreed and 22 (18.49%) disagreed, while 11 (9.24%) remained neutral. This suggests that most families are supportive, although a notable minority still reflect hesitation or lack of encouragement. Cultural expectations about women's roles were also examined. A large portion of respondents; 49 students (41.18%) disagreed that such expectations discourage female students from studying mathematics and 24 (20.17%) strongly disagreed. However, 19 respondents (15.97%) agreed and 14 (11.76%) strongly agreed, indicating

that cultural norms continue to influence academic choices for some students. 13 students (10.92%) remained neutral on this issue.

Visibility of female role models in mathematics was viewed positively by most respondents. 55 students (46.22%) agreed and 33 (27.73%) strongly agreed that female role models are accessible in their communities. Only 6 respondents (5.04%) strongly disagreed and 15 (12.61%) disagreed, while 10 (8.40%) were neutral. This suggests that representation is improving and may be playing a role in motivating female students. Finally, peer pressure was identified as a potential barrier. While 28 respondents (23.53%) strongly disagreed and 37 (31.09%) disagreed that peer pressure discourages girls from enrolling in mathematical sciences, 22 students (18.49%) agreed and 11 (9.24%) strongly agreed. 21 respondents (17.65%) remained neutral, indicating that peer influence is a mixed factor discouraging for some, but not a dominant barrier overall.

Table 3: Influence of institutional factors on female students' enrolment into Mathematics Department in Borno State University.

S/N	STATEMENT	SD	DA	N	A	SA
1	The mathematics department provides clear information and encouragement to prospective female students.	6 (5.04%)	8 (6.72%)	24 (20.17%)	44 (36.97%)	37 (31.09%)
2	There are enough female academic staff in Mathematical Sciences to act as role models.	9 (7.56%)	17 (14.29%)	21 (17.65%)	41 (34.45%)	31 (26.05%)
3	Institutional policies favor male students over female students.	28 (23.53%)	50 (42.02%)	6 (5.04%)	22 (18.49%)	13 (10.92%)
4	Available facilities and classrooms are safe and accessible for female students.	28 (23.53%)	37 (31.09%)	14 (11.76%)	18 (15.13%)	22 (18.49%)
5	Harassment or gender-based discrimination discourages female students from enrolling in Mathematical Sciences.	11 (9.24%)	13 (10.92%)	24 (20.17%)	38 (31.93%)	33 (27.73%)

Institutional support plays a critical role in shaping female students' decisions to pursue mathematics. When asked whether the mathematics department provides clear information and encouragement to prospective female students, a majority responded positively. Specifically, 44 respondents (36.97%) agreed and 37 (31.09%) strongly agreed, indicating that institutional messaging is generally supportive. However, 24 students (20.17%) remained neutral, while a small minority 6 (5.04%) strongly disagreed and 8 (6.72%) disagreed suggested that communication could still be improved for some students.

Regarding the presence of female academic staff as role models, 41 respondents (34.45%) agreed and 31 (26.05%) strongly agreed that there are enough female lecturers in mathematical sciences to serve as mentors. Meanwhile, 21 students (17.65%) were neutral, and 17 (14.29%) disagreed, with 9 (7.56%) strongly disagreeing. This

distribution suggests that while many students perceive adequate representation, there remains room for improvement in staffing and visibility of female faculty. On the issue of institutional bias, a majority of respondents rejected the notion that policies favor male students. 50 students (42.02%) disagreed and 28 (23.53%) strongly disagreed with the statement, while 22 (18.49%) agreed and 13 (10.92%) strongly agreed. Only 6 respondents (5.04%) were neutral. These responses suggest that most students perceive the institutional environment as equitable, though a notable minority still feel disadvantaged.

Safety and accessibility of facilities also drew mixed responses. While 22 respondents (18.49%) strongly agreed and 18 (15.13%) agreed that classrooms are safe and accessible for female students, a larger portion expressed concern. 28 students (23.53%) strongly disagreed and 37 (31.09%) disagreed, with 14 (11.76%) remaining neutral. This indicates that infrastructural improvements may be necessary to ensure a more inclusive learning environment. Finally, when asked whether harassment or gender-based discrimination discourages female students from enrolling in mathematical sciences, the responses were notably split. 38 students (31.93%) agreed and 33 (27.73%) strongly agreed, suggesting that this issue is a significant barrier for many. However, 24 respondents (20.17%) were neutral, and 13 (10.92%) disagreed, with 11 (9.24%) strongly disagreeing. These findings highlight the need for stronger institutional safeguards and awareness campaigns to combat discrimination and foster a safer academic space.

Table 4: Omnibus Tests of Model Coefficients

S/N	Test Type	Chi-square	df	p-value
1	Step	166.355	6	0.000
2	Block	166.355	6	0.000
3	Model	166.355	6	0.000

-2log likelihood=0.00, Cox & Snell R^2=0.75, Nagelkerke R^2=0.920

The Omnibus Tests of Model Coefficients revealed that the overall model was statistically significant (Chi-square = 166.355, df = 6, $p < .001$), indicating that the predictors variables improved the ability of the model to explain female enrollment outcomes. The model summary showed a Cox & Snell R^2 of 0.750 and a Nagelkerke R^2 of 0.92, suggesting that the model explained 92% of the variance in the dependent variable.

Table 5: Variables Not in the Equation (Step 0 Score Statistics)

S/N	Variables	Score	Df	p-value
1	Parental Education	120.000	3	0.000
2	Parental Education(1)	40.000	1	0.000
3	Parental Education(2)	40.000	1	0.000
4	Parental Education(3)	40.000	1	0.000
5	Household Income	97.283	1	0.000
6	Scholarship Access(1)	120.000	1	0.000
7	Societal Support	120.000	4	0.000
8	Societal Support(1)	40.000	1	0.000
9	Societal Support(2)	40.000	1	0.000
10	Societal Support(3)	34.839	1	0.000
11	Societal Support(4)	21.176	1	0.000

Table 5 presents the score statistics for variables that were not yet included in the logistic regression model at Step 0. The results show that all variables listed are statistically significant, with p-values of 0.000, indicating a very strong likelihood that they influence female enrollment in mathematics at Borno State University. Parental Education yielded a total score of 120.000 across its three levels. This suggests that the educational background of parents plays a significant role in shaping female students' academic choices. The significance across all levels reinforces the importance of family education in promoting STEM participation.

Household Income is also a strong predictor, with a score of 97.283 and a p-value of 0.000, indicating that financial stability within the household significantly affects the likelihood of female enrollment in mathematics. This aligns with broader findings that economic empowerment is a key enabler of educational access and choice. Scholarship Access showed a score of 120.000, confirming its critical role in influencing enrollment. Societal Support, measured across five levels, also showed a total score of 120.000, with individual levels contributing scores ranging from 21.176 to 40.000. This indicates that perceptions of community encouragement or discouragement toward women in STEM have a measurable impact on enrollment decisions. Therefore, the Step 0 score statistics confirm that Parental Education, Household Income, Scholarship Access and Societal Support are all strong candidates for inclusion in the final regression model. Their statistical significance highlights the nature of barriers and enablers affecting female enrollment in mathematical science.

Discussion of Findings

The findings of the study revealed that, family support and the presence of female role models are major drivers of female enrollment in mathematics. Many respondents reported encouragement from their families and acknowledged that seeing women succeed in mathematics motivates them to pursue the field. This supports earlier findings by Adebayo and Yusuf (2022), who highlighted the role of parental education and Ibrahim and Nwankwo (2023), who found

mentorship programs to be effective in enhancing female confidence and interest in STEM. At the same time, cultural stereotypes about mathematics being more suitable for men still remain, aligning with Okeke et al. (2021), who identified gender bias as a barrier across Sub-Saharan Africa.

Institutional factors also play a major role. Respondents generally agreed that the mathematics department provides encouragement and that female lecturers serve as role models. This aligns with Adepoju (2022), who emphasized the importance of supportive institutional policies in bridging gender gaps. The regression analysis confirmed that parental education, household income, scholarship access and societal support are strong predictors of female enrollment, explaining 92% of the variation in outcomes. This supports the findings of Magaji and Abdullahi (2025), who noted that cultural norms and economic hardship strongly shape female participation in STEM. It also supports Eze and Bello (2024), who argued that innovative approaches such as digital learning platforms can help reduce barriers.

Conclusion

This study examined the socio-cultural and institutional determinants of female enrollment into mathematical sciences at Kashim Ibrahim university, Borno state. The findings revealed that parental education, household income, scholarship access, societal support and institutional safety significantly influence female students' decisions to pursue mathematics. Family encouragement and the presence of female role models emerged as strong enablers, while cultural stereotypes, peer pressure and gender-based discrimination remain barriers. The regression analysis confirmed that these factors collectively explain a very high proportion of enrollment outcomes.

Recommendations

Based on the findings, the following recommendations are proposed:

1. Government should expand scholarships for female students, including support for those from low-income families.
2. Government should run awareness campaigns to challenge stereotypes and promote girls' participation in mathematics.
3. School management should recruit more female lecturers and strengthen mentorship programs to inspire female students.
4. Parents should actively encourage and support their daughters to pursue mathematics or mathematics related courses.

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