Original Research Article

Enrollment Trends, Motivations, and Future Aspirations of Female Undergraduate Students in STEM Courses at Federal University Gusau - Nigeria

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Abstract: This study aimed to investigate the enrollment trends, motivations, and future aspirations of female undergraduate students in Science, Technology, Engineering, and Mathematics (STEM) courses at the Federal University Gusau in Nigeria. A survey design was employed, and a 36-item questionnaire was used to collect data from a sample of 350 female undergraduate students studying STEM courses at the university. The questionnaire had three sections focusing on demographic information, motivations and future career aspirations of the respondents in STEM fields. The questionnaire was validated and reliability coefficient of 0.72 was obtained using Cronbach alpha. The data collected were analyzed using mean and standard deviation. The results showed that female students' overall enrollment in STEM courses was relatively low. However, there were variations across disciplines, with some courses having as high as 50.70% (Biotechnology) and 49.43% (Microbiology), and as low as 8.36% (Physics), 9.06% (Geology) and 11.06% (Mathematics) of female enrollment. The overall enrollment rose from 23% in the 2014/2015 academic year to 31.4% in the 2019/2020. The study also found that personal interest, background knowledge, and academic success in STEM-related subjects were the key motivators for females to pursue STEM courses. On the other hand, lack of family and community support, lack of confidence in problem-solving, and the need for role models and mentors were significant barriers. It is recommended among others that, universities and policymakers provide more resources and support to female students in STEM fields, such as mentorship programmes, scholarships, and initiatives to promote gender equity.
Keywords: Career aspirations, Enrollment trend, Female students, Motivation, STEM fields, Undergraduate.

INTRODUCTION

The global conversation on gender equity in Science, Technology, Engineering, and Mathematics (STEM) education and careers has continue to linger. There has been increasing concern over the under-representation of women in STEM fields in Nigeria. This however, according to Ekine and Abay (1999), is widespread in many nations especially across the African continent. Abdullahi *et al.*, (2019) argued that, the disparity between males and females in STEM fields is very wide in Nigeria, with a significant lack of representation of women In this

regard, Ekine and Abay (1999) stressed that, it is crucial to address the gender gap in STEM fields, as failing to do so would result in a significant loss of human potential that could otherwise contribute to the country's development, and can also further perpetuate gender inequality within society.

According to Ekine and Abay (1999), Nigeria has been working towards ensuring equal access to education for all individuals. As part of this initiative, policies have been developed to address the issue of girls' access to education. Similarly Ajani and Ojetunde (2021) stated that, Nigeria has invested a considerable amount of effort towards enhancing the quality of education in the fields of STEM. However, with all these efforts directed towards improving STEM education, little attention has been given to promoting girls' participation in STEM fields. More so, Ekine and Abay (1999) argued that, while some regions of the country have shown some remarkable progress in achieving gender balance in enrollments others continue to fall behind. This situations are indicators that women are still encountering a multitude of challenges when it comes to pursuing STEM courses, which can impede their progress and negatively impact their career goals.

According to National Science Foundation [NSF], (2021), women remain underrepresented in STEM fields, both in terms of education and employment. This underrepresentation presents a concern for many countries, including Nigeria, where there has been a growing emphasis on increasing the number of students, particularly females, pursuing STEM degrees. Despite the increasing demand for workers in STEM fields, women continue to be underrepresented in these industries, particularly in leadership positions. Research has shown that women face unique barriers to entering and advancing in STEM careers, including bias, discrimination, and a lack of support and resources. This gender gap in STEM enrollment is particularly evident in Nigeria, where female students are often discouraged from pursuing STEM fields due to cultural and societal norms that prioritize male education and careers (Abdullahi *et al.*, 2019; Ekine & Abay, 1999; Jacob *et al.*, 2021). While efforts to promote STEM education among women have increased, research suggests that there are still significant barriers that discourage females from pursuing STEM degrees.

Previous studies have attempted to identify several factors that contribute to the underrepresentation of women in STEM fields. Some of the findings revealed lack of female role models and mentors in STEM fields (Omenihu, 2021), inadequate preparation in mathematics and sciences

at the secondary school level (Almukhambetova & Kuzhabekova, 2020; Wrigley-Asante *et al.*, 2022), limited access to resources and opportunities (Ajani & Ojetunde, 2021; Omenihu, 2021), societal expectation (Okorafor *et al.*, 2015), negative attitudes and biases towards women in STEM (Fisher *et al.*, 2021; Ndakogi, 2019; Ogundare & Abdullahi, 2021). In addition, female students face a range of social and cultural challenges that may discourage them from pursuing STEM fields, such as traditional gender roles and expectations, limited family support, and societal pressures to prioritize marriage and motherhood over education and career goals. Some studies have found that societal and cultural norms may also discourage girls from pursuing STEM education and careers (Ekine & Abay, 1999). Likewise, lack of female role models in STEM fields, can make it more difficult for women to envision themselves in these careers. Similarly, a study by Shapiro *et al.*, (2017) found that women in STEM fields face various challenges, such as bias and a lack of supportive work environments, which also impact their career trajectories.

Notwithstanding these challenges, some studies have shown that women who persist in STEM fields tend to have high levels of motivation and a strong desire to make a positive impact in their respective fields. For example, a study by Okwelle and Alalibo (2017) and Richard et al. (2018) revealed that, female students who persisted in STEM majors had higher levels of intrinsic motivation, self-efficacy, and a strong desire to contribute to society through their work. While interest in the subject matter is a common motivator for both male and female, another important motivation for females is the desire to contribute to the development of Nigeria's economy through innovation and technology (Appiah-Castel *et al.*, 2020). Female students in STEM fields often see themselves as pioneers and role models, breaking gender stereotypes and inspiring other girls to pursue similar paths (Oluwatayo & Ayodele, 2018). Additionally, some female students are motivated by the career prospects and financial benefits associated with STEM professions (Okwelle & Alalibo, 2017).

Another study conducted by Iji (2019) found that parental influence, career prospects, and personal skills were important motivators for female students, but to a lesser extent than interest in the subject. Peer support was not found to be a significant motivator for female students in this study. Another study that examined the motivations of both male and female undergraduate students in Nigeria to pursue STEM fields found that female students were more likely than male students to be motivated by a desire to contribute to society and

make a difference in the world (Adeleke *et al.,* 2017). This finding suggests that female students may have different goals and aspirations in pursuing STEM fields than male students, which could have implications for how STEM education is designed and delivered to better meet the needs and interests of female students.

On the factors that influences female students' career choices and aspirations, Oyekan and Akinsola (2020) found that the majority of female students aspired to careers in academia, followed by research and development, and industry. Another study by Adeyemo and Adeyinka (2019) investigated the career aspirations of female students in STEM fields in Nigeria, focusing specifically on computer science students. The study found that the majority of female students aspired to careers in software development and programming, followed by careers in data analysis and information security. The study also identified several factors that influenced female students' career aspirations, including parental influence, self-efficacy, and exposure to technology. Another study by Azikiwe *et al.,* (2019) found that female students who had mentors in STEM fields were more likely to aspire to careers in STEM and had higher self-efficacy in STEM than those without mentors. Furthermore, a study by Iji (2019) found that the main factors that influenced career aspirations were interest in the field, self-efficacy, and job availability. Also, the study found that female students in STEM fields were less likely to aspire to leadership positions than male students. A study conducted by Wrigley-Asante *et al.,* (2022) found no significant difference in the career aspirations of male and female students in STEM. However, the study established that females were more influenced by external motivation factors such as encouragement and motivation from role models.

In Nigeria, the participation of female in STEM course is still not encouraging, despite the country's efforts to address the situation. The Federal University Gusau, being among the recently established institutions of higher learning in Nigeria, has been demonstrating a commitment by increasing the enrollment of female students in STEM courses, as evidenced by their emphasis in prioritizing female students during admission process. This effort is to complement government's stride in light of the crucial role that women can assume in propelling economic growth and development in the nation. Drawing on this contextual foundation, the present aims to examine the enrollment trends, motivations, and future aspirations of female undergraduate students in STEM fields at Federal University Gusau, Nigeria, to contribute to the global conversation on gender equity in STEM education and careers for policy and practice.

Research Objectives
The objectives of the study are to;
1. Determine the enrollment trends of female students studying STEM courses compared to their male counterparts at the Federal University Gusau.
2. Identify the factors that motivate female undergraduate students to choose STEM courses.
3. Explore the career aspirations of female undergraduate students studying STEM fields for their future.

Research Questions
The following research questions were raised to guide the study:
1. What is the enrollment trends of female students studying STEM courses compared to their male counterparts at the Federal University Gusau?
2. What factors motivate female undergraduate students to choose STEM courses?
3. What are the career aspirations of female undergraduate students studying STEM courses?

METHODOLOGY
The methodology used in this study was a survey design. The purpose of this research was to gain insights into the enrollment trends, motivations, and future aspirations of female undergraduate students in STEM fields at the Federal University Gusau. The target population consisted of all the female undergraduate students enrolled in different STEM courses at the Federal University Gusau in Nigeria. Sample size of 246 was determined using Research Advisor and used for the study. The sample were drawn from the population using a stratified random sampling technique. Each department running STEM course served as strata.

Secondary data (i.e. undergraduate STEM students' enrollments of 2014/2015 through 2019/2020 academic years) were obtained from the record office of ICT Center, Federal University Gusau. A 36-item questionnaire with three sections focusing on motivations, challenges, and future career aspirations of the female students in STEM fields was used as instrument for data collection. The questionnaire was structured on a 5-point modified Likert-type scale. The researchers validated the questionnaire by obtaining feedback from two experts in science education and one expert in measurement and evaluation. The experts' suggestions were incorporated into the final

questionnaire. To test the reliability of the questionnaire, the instrument was trial tested on twenty female students offering STEM courses at Zamfara College of Arts and Science, and a reliability coefficient of 0.72 was obtained using Cronbach alpha. The researchers administered the questionnaire to the respondents and retrieved on the spot, ensuring a 100% return rate. Mean and standard deviation were used to analyze the date collected in order to answer the research questions raised. A mean of 2.50 and above indicated agreement with the item on the questionnaire, while a mean of 2.49 and below indicated disagreement.

The mean is a measure of central tendency that indicates the average score of the respondents for each item on the questionnaire, while the standard deviation measures the amount of variability or dispersion of the responses.

RESULTS

Research Question 1: What is the enrollment trends of female students studying STEM courses compared to their male counterparts at the Federal University Gusau?

Table 1: Female students enrolment in STEM courses at Federal University Gusau from 2014/2015 to 2019/2020 academic sessions

	2014/2015		2015/2016		2016/2017		2017/2018		2018/2019		2019/2020		% of Female
	M	F	M	F	M	F	M	F	M	F	M	F	
B.Sc. Biochemistry	44	20	70	31	142	81	194	126	236	159	289	209	39.11
B.Sc. Chemistry	52	06	71	12	135	33	178	54	221	84	240	121	25.69
B.Sc. Computer Sci.	48	11	80	19	157	38	223	44	276	58	333	67	17.50
B.Sc. Geology	60	03	89	09	158	11	215	22	257	32	306	31	9.06
B.Sc. Mathematics	26	01	48	03	102	18	130	19	156	21	157	20	11.06
B.Sc. Microbiology	41	35	66	54	126	114	162	163	190	218	224	208	49.43
B.Sc. Physics	66	04	97	06	134	15	167	17	200	19	191	17	8.36
B.Sc. Plant Science & Biotechnology	45	34	61	50	88	90	118	119	149	152	159	190	50.70
B.Sc. Zoology	23	07	25	14	61	32	70	39	91	50	98	50	34.29
Total	**405**	**121**	**607**	**198**	**1103**	**432**	**1457**	**603**	**1776**	**793**	**1997**	**913**	29.39

Source: ICT Unit, Federal University Gusau, 2023.

Table 1 presents the enrolment rate of female students and their male counterparts in STEM courses available at the Federal University Gusau from the 2014/2015 to the 2019/2020 academic session. The data shows that the overall enrolment of female students in STEM courses was lower than that of males in the six-year period under review. Specifically, a total of 3060 female students enrolled in STEM courses compared to 7345 male students. Moreover, the enrolment rates of female students in STEM courses varied profoundly across the different disciplines. For example, female students constituted slightly more than half of those studying Plant Science & Biotechnology (50.70%) and close to the half of male that enrolled in

Microbiology (49.43%), with a percentage gap of 25% in the 2014/2015 academic session, and this gap decreased to 1% in the 2019/2020 academic session. The overall trend in this two courses shows an increase in female students over the years. In contrast, there were few female students enrolled in the Physics course (8.36%), Geology (9.06%) and Mathematics (11.06). with a percentage gap of 93% in the 2014/2015 academic session, and this gap decreased to 8% in the 2019/2020 academic session. However, female students overall enrolment in STEM courses fell in the average of 38.39%, which is substantially below that of their male counterparts.
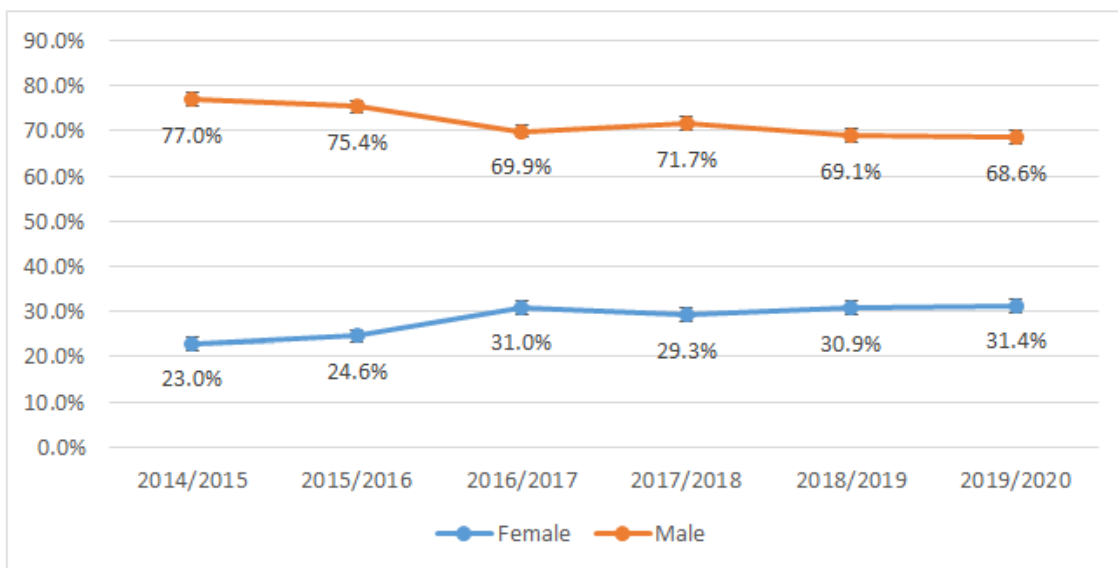
Figure 1: Trends in the enrolment of students into STEM courses over the period of 6 years

In general, Figure 1 showed that female students' enrolment increased from 23% in 2014/2015 academic session to 31.4% in 2019/2020 academic session. Surprisingly, while the females' enrolment in STEM courses is increasing slowly, that of male is declining in the like manner (Figure 1).

Research Question 2: What factors motivate female undergraduate students to choose STEM courses?

Table 2: Mean and standard deviation on factors influencing females in studying a STEM course

Items	$\bar{X}$	SD
Personal Factors		
I am interested in the subject matter of STEM fields	3.11	0.68
I have a sound background in mathematics and science subjects	3.06	0.58
I passed my O' level mathematics and science subjects examinations	3.59	0.79
Studying a STEM related course will earn me a good salary	2.63	0.49
I would really like to further my education in STEM related field	3.06	0.92
I want to be successful in life	3.25	0.68
I have confidence in my personal ability	2.82	0.93
Grand Mean	**3.07**	
Environmental Factors	$\bar{X}$	SD
My school offers sufficient resources and support for STEM courses	2.72	0.67
I have access to mentors and role models in STEM fields.	2.64	1.10
My friends and peers encourage me to pursue STEM fields.	3.17	0.38
My family and community support my pursuit of STEM fields.	2.35	1.08
I have been exposed to STEM fields through extracurricular activities	2.76	1.36
There is a need for more female representation in STEM fields	1.67	0.67
I was not given a chance to choose my preferred course except this	1.96	1.05
Due to low number of women who pursue careers STEM related fields	3.00	0.75
Grand Mean	**2.53**	
Behavioural Factors	$\bar{X}$	SD
I challenged myself to prove women's capability to excel in STEM	3.06	0.92
I feel confident in my ability to solve problems relating to calculation	1.73	0.47
I seek out mentors/role models in STEM fields for guidance and support	1.87	0.65
I prioritize and invest time in studying STEM subjects than others	1.71	0.69
STEM courses can empower women to make a positive impact on society	2.72	0.67
I believe that persistence and resilience are essential for STEM success.	2.59	0.49
I set career goals in STEM and actively work towards achieving them	1.53	0.56
Grand Mean	**2.17**	

Table 2 revealed that, for Personal Factors, the mean scores are generally high, ranging from 2.63 to 3.59, indicating that the respondents agreed that these factors are important in studying a STEM course. It can be inferred that female students' motivation to enroll in STEM courses is influenced by factors such as personal interest, prior knowledge, and academic achievement in STEM-related subjects. For Environmental Factors, the mean scores are mixed, ranging from 1.67 to 3.17. This indicates that although there may be certain environmental factors that encourage females to pursue STEM courses, such as peer support and

school resources, there are also significant challenges such as lack of family and community support. For Behavioural Factors, the mean scores are generally low, ranging from 1.53 to 3.06. This suggests that there are significant behavioural barriers to females pursuing STEM courses, such as lack of confidence in problem-solving and the need for role models and mentors.

Research Question 3: What are the career aspirations of female undergraduate students studying STEM courses?

Table 2: Mean and standard deviation on career aspirations of female STEM students

Career Aspirations	$\bar{X}$	SD
I aspire to become an employer and create job opportunities in STEM fields	1.77	0.75
I am considering establishing a non-STEM business.	2.05	0.91
I will strive to secure a full-time position in a respected STEM company.	1.76	0.43
Work part-time from home for a STEM-related company	2.92	0.99
Work for a government organization in a STEM-related field.	2.75	0.78
Look for roles within NGOs that focus on supporting women in STEM fields	2.11	1.11
Do a job that promotes gender equity in STEM.	2.82	0.98
Balance being a full-time parent and working in a STEM-related field.	2.65	0.97
Pursue further education (master's, Ph.D.) in a STEM-related field	2.35	1.08
I will aim toward achieving greater social status and recognition through contributions to STEM.	2.35	1.08
Grand Mean	**2.33**	

The grand mean of 2.33 suggests that, on average, the respondents were somewhat positive about their career aspirations in STEM fields. Six out of the ten items had means above 2.50, indicating agreement with those items. These items were "Work part-time from home for a STEM-related company," "Work for a government organization in a STEM-related field," "Do a job that promotes gender equity in STEM," "Balance being a full-time parent and working in a STEM-related field," "Pursue further education (master's, Ph.D.) in a STEM-related field," and "I will aim toward achieving greater social status and recognition through contributions to STEM."

The remaining four items had means below 2.50, indicating some level of disagreement with those items. These items were "I aspire to become an employer and create job opportunities in STEM fields," "I am considering establishing a non-STEM business," "I will strive to secure a full-time position in a respected STEM company," and "Look for roles within NGOs that focus on supporting women in STEM fields."

DISCUSSION OF FINDINGS

The finding of the study revealed that, female students had lower enrollment rates (29.39%) in STEM courses compared to male

students. This is consistent with the findings of Onyekwelu (2019), Ogundare and Abdullahi (2021) and Onile-ere *et al.*, (2021) that reported underrepresentation of female students in STEM degrees in Nigeria. However, the enrollment of 29.39% found in this study is much higher than the 14% reported by Ogundare and Abdullahi (2021) at Federal University of Kashere in STEM related disciplines. This further supported the argument of Ekine and Abay (1999) that, while certain regions in Nigeria have made notable strides towards achieving gender equality in enrollment, others are still lagging behind. Also, Tandrayen-ragoobur and Gokulsing (2021) revealed an existence of gender disparity in STEM-related degrees tertiary enrollment in Mauritius, with female student having lower probability of enrolling in such degrees than male student. In a comparative empirical analysis conducted by Onyekwelu (2019) on female university enrollment in STEM courses revealed that, although university enrollment in Nigeria is increasing, there is still a significant gender gap in enrollment, with more males than females being enrolled in STEM fields. The study revealed that, female enrollment seems to be higher in commercial and arts courses compared to the STEM. According to NSF (2018), the gender gap in STEM enrollment begins as early as high school and persists through college and into the workforce. This suggests the

existence of systemic barriers to female participation in STEM education, calling for targeted efforts to promote gender equality in STEM fields.

The finding of this study also revealed that, female students' motivation to enroll in STEM courses is influenced by personal factors such as personal interest, prior knowledge, and academic achievement, while environmental factors such as peer support and school resources could encourage them, but challenges such as lack of family and community support remain, and there are substantial behavioural barriers such as lack of confidence in problem-solving and the need for role models and mentors. This is in line with the study conducted by Ogundare and Abdullahi (2021) who revealed a lack of female role models in schools that could serve as a source of inspiration and motivation for girls and women pursuing professional careers in STEM. The absence of female role models in STEM fields that would act as professional motivation, serves as a discouraging factor for women who aspire to pursue careers in STEM disciplines. The finding that personal factors such as interest and academic success in STEM-related subjects at secondary school are key motivators is consistent with the finding of Okwelle and Alalibo (2017), Tandrayen-ragoobur and Gokulsing (2021), and Wrigley-Asante *et al.*, (2022) who also found that personal interest and academic performance in STEM subjects also play a significant role in enrolment in STEM degrees at university. The present study also revealed that female students are more likely to pursue STEM fields if they have access to supportive environments that provide resources such as mentorship, networking opportunities, and access to STEM-related activities. This finding is consistent with Ekine & Abay's (1999) assertion and Tandrayen-ragoobur and Gokulsing's (2021) finding that, if females receive support from their family, school, and teachers, they are more inclined to choose STEM degrees. This shows that, encouraging females to pursue STEM careers could be achieved by addressing the identified factors and creating supportive environments, according to the study's findings.

The finding of this study also revealed that, on average, female students had a somewhat positive attitude towards their career aspirations in STEM fields, with six out of ten items indicating agreement. They showed agreement towards items such as working part-time from home, pursuing further education in STEM, promoting gender equity in STEM, achieving social status through STEM, among others. This finding supported that of Almukhambetova and Kuzhabekova (2020) and Wrigley-Asante *et al.*, (2022) who found significant level of interest among females who expressed a

desire to pursue careers in STEM fields. However, the finding of this study also indicated some level of disagreement on aspirations by female students in STEM fields such as becoming an employer in STEM areas, securing a full-time position in a respected STEM company among others. This finding supported the study of Ojwala *et al.*, (2022), that females exhibited a greater tendency relative to their male counterparts to assume non-tenure track appointments. This result suggest a need for further exploration of the reasons for the lower mean scores on these items and addressing the underlying factors that may be influencing females' attitudes towards them.

CONCLUSION

This study focused on female undergraduate students studying STEM courses at the Federal University Gusau in Nigeria. The data collected revealed that female enrollment in STEM courses was relatively low, although the gap keep decreasing slowly over the years under review. Personal factors such as interest and academic success were identified as key motivators for females to pursue STEM courses, while environmental and behavioural factors present significant challenges. It was found that, female undergraduate students had positive career aspirations in STEM fields, with a focus on achieving greater social status and recognition through contributions to STEM, promoting gender equity, and pursuing further education.

RECOMMENDATIONS

The study recommended that;

1. There is need to encourage and support more females to enroll in STEM courses by addressing the environmental and behavioural factors that hinder their participation.
2. Targeted outreach programmes should be initiated to encourage female students to pursue STEM fields, as well as providing mentoring and role models to help them develop necessary skills and confidence.
3. A supportive environment should be created for female students, including access to resources and support systems.
4. Gender equity should be promoted in STEM fields through opportunities for female students in leadership and research programmes.
5. Collaborations between academia and industry should be fostered to provide female students with internships and job opportunities in STEM-related industries.

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