

**FEMALE STUDENTS' ATTITUDE TO SCIENCE AND TECHNOLOGY, ENGINEERING AND MATHEMATICS, AND CAREER CHOICE IN ENGINEERING AND MATHEMATICS IN SECONDARY SCHOOLS IN JOS, PLATEAU STATE, NIGERIA**

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**ABSTRACT**

*This study was prompted by the low participation of female students in Engineering and Mathematics in secondary schools in Jos North Local Government Area of Plateau State. The study therefore investigated female students' attitude to STEM and how it affects their career choices in Engineering and Mathematics. The study adopted the cross-sectional survey research design. The population of the study comprised of 817 SS II female secondary school students in twenty-two (22) public secondary schools in Jos North LGA of Plateau State and a sample of 260 female SS II students from nine public secondary schools were used. The sample size was determined using Krejcie and Morgan (1970) Table for Determining Sample Size and was drawn using simple random sampling technique. The instrument used for data collection was the "Female Students' Attitude to STEM and Career Choice in secondary schools Questionnaire (FSASTEMCCSSQ). The validity of the instrument was established using three experts; an expert in Gender and Women Studies, Research, Measurement and Evaluation Unit of the Faculty of Education and one expert in Science and Technology Education Department of the University of Jos while the reliability of the FSASTEMCCSSQ was computed using Cronbach Alpha and a reliability coefficient of 0.89 was obtained. Descriptive statistics of mean score and standard deviation were used in analyzing and answering the research questions asked in the study while Pearson Product Moment Correlation was used to test the hypotheses formulated in the study. The findings of the study were that female students had positive attitude towards Engineering and there is a significant positive relationship between female students' attitude to STEM and their career choice in Engineering. It was also discovered that female students had positive attitude towards Mathematics and there is a positive correlation between female students' attitude to STEM and career choice in Mathematics. Based on the findings of the study, it was recommended among others that teachers should encourage female students who are doing well in STEM subjects to pursue career paths in such areas. Also, parents, as stakeholders should motivate and support their female children who are doing well in STEM subjects by providing their educational needs to enable them study effectively in senior secondary schools which will in turn motivate them to choose careers in STEM. The study focuses on STEM but for the purpose of this article a subset of the STEM (Science and Technology) was considered.*

**KEY WORDS: Attitude, Science, Technology, Engineering, Mathematics, Career Choice.**

**INTRODUCTION**

Science, Technology, Engineering and Mathematics (STEM) is a system which integrates Science, Technology, Engineering and Mathematics into varied subject areas. STEM improves students' understanding of how things work, increases their use of ICT technologies, and exposes them to additional engineering courses throughout their pre-college education (Nimota, 2018). The significance of STEM implies that it is essential to a country's social and economic advancement. It

is essential to practically every aspect of human endeavor, including inventions, health, transportation, business, and industry. Students in secondary school get the opportunity to learn about global events and how STEM improves people's quality of life everywhere. According to Najdi (2017), the world's level of advancement and innovation during the last 20 years can be attributed exclusively to STEM. This suggests that it should be based on students' aptitude and personality rather than being a rule just for boys. In order to compete effectively in a world that is constantly evolving and innovating, students who take STEM courses have a better chance of understanding the connections between education, the community, and international businesses. It is impossible to overstate the value of STEM education in a country since it influences every aspect of society and propels economic progress.

STEM courses help students think more critically and develop their minds (Olasheinde & Olatoye, 2024). It is also imperative to acknowledge that STEM careers play an important role in global competitiveness and thus society advances through the progress in the four STEM fields considering their importance to the society (Olawale, 2024).

Ndewu (2022) found that female students at Nigerian tertiary institutions enroll in Engineering and Mathematics courses at a lower rate than male students, suggesting that there may be a gender gap despite the significance of Engineering and Mathematics to economic and societal growth. Supporting and promoting inclusive and equitable education and opportunities for lifelong learning for all is the fourth Sustainable Development Goal (SDG). The fourth Sustainable Development Goal aims to provide universal access to high-quality education by guaranteeing both male and female children equitable access to high-quality, reasonably priced education (Mutai, 2022). Enrolling more female students in Engineering and Mathematics courses will enhance a better nation where the nationals will have healthier lives, become more educated with improved empowerment which will in turn lead to a more productive country because to educate a girl-child is to educate a nation (Sawar & Amaz, 2023).

Choosing a career entails deciding on a course for one's professional life, which is frequently impacted by personal values, interests, and abilities. It's an important choice that affects success and pleasure in the long run. It entails evaluating oneself in terms of skills, interests, and the labor market—all of which are essential for making wise decisions.

According to UNESCO Institute of Statistics (2021), women make up less than 20% of the Engineering and Mathematics courses workforce in Sub-Saharan Africa, according to the. There is a significant gender disparity in women's participation in Engineering and Mathematics courses as compared to men worldwide. As observed by UNESCO (2021), women constitute more than half of the world's population, yet only a small proportion of them are participating in Engineering and Mathematics field. Nigeria as a developing nation should have more female scientists, technologists, engineers, and mathematicians in order to compete favourably with the developed nations. The need for females to be highly involved in Engineering and Mathematics fields should not be ignored because it is a major prerequisite for any nation to achieve meaningful development.

The noticeable gender disparity in enrolment in Engineering and Mathematics portends immediate and long-term danger to Nigeria's economic progress and sustainable development. Few studies (Fatoki, 2014; Ugo & Akpoghol 2016; Mtemeri, 2017 & Schug, Todd & Beery, 2022) have documented the effect of low school enrolment particularly among girls in developing countries. These effects include high poverty rate, high maternal and child mortality rate, high level of unemployment and low per capita income. Therefore, studies that have examined the challenges inherent in career path choices of girls are very minimal especially as it relates to Nigeria, hence there is paucity of literature in this research area thus creating a research gap to be filled. Female students' participation in Engineering and Mathematics in Nigeria remains relatively low despite the relevance of such courses to economic growth and development. The underrepresentation and limited participation of girls in Engineering and Mathematics education in secondary schools in Nigeria has become a major barrier to engendering inclusiveness and equality of opportunity.

Recent statistics (UNESCO Institute of Statistics, 2021) show that enrollment and completion rates for girls in key STEM subjects like Engineering and Mathematics has remained abysmally low in Africa and Nigeria in particular. This problem of low participation of the girl-child in Engineering and Mathematics stems from interlinked social, institutional, and economic factors. From a social standpoint, gender stereotypes and societal biases associated with the perceived capabilities and roles of girls serve to discourage many from pursuing interests in such right from basic education (Magnus, 2024).

Many public secondary schools lack the infrastructural facilities, teaching capacities and gender-sensitive pedagogical approaches required to make Engineering and Mathematics education more inclusive for girls. Economic barriers also exist, with the high costs of such education prohibiting girls from poorer backgrounds. The low participation of girls in Engineering and Mathematics related subjects in senior secondary schools effectively hinders inclusion and diversity in critical STEM professions. It also propagates gender discrepancies in opportunities for social mobility and economic participation. Addressing this multi-faceted problem requires firm commitment and concerted interventions from parents, schools, education administrators, government agencies and wider society (LeGrand, 2023).

Orunaboka (2021) lamented about the poor attitude portrayed by female students towards Engineering and Mathematics in secondary schools in Nigeria. Most female students perceived Engineering and Mathematics courses to be difficult, uninteresting, and challenging to them, therefore they tend to prefer other career choices in social sciences or art courses rather than such courses. This may be a testament to the low participation of female students in Engineering and Mathematics courses across tertiary institutions in Nigeria. It is in the light of the foregoing that this study was prompted to investigate senior secondary school female students' attitude to STEM and career choice in Engineering and Mathematics in senior secondary schools in Jos-North, Plateau State.

## **STATEMENT OF THE PROBLEM**

In Nigeria, the level of female students' enrolment and participation in STEM is abysmally low as compared to their male counterparts particularly in Engineering and Mathematics. Statistics from the research of Adesulu-Dahunsi (2024) revealed that only 25% of STEM graduates from Nigerian universities are females. This disparity depicts inequity and low participation between males and females. Female students' negative attitude towards Engineering and Mathematics could be linked to several factors such as peer influence, stereotypes, family background and school-related factors. Other factors responsible for negative attitude towards Engineering and Mathematics subjects could be the abstract nature of the courses which some female students perceived to be difficult. Engineering and Mathematics teachers have adopted several teaching strategies such as activity-based teaching and cooperative learning in attempt to change the perception of female students towards the subjects. However, despite all these efforts, the negative attitude of female students towards Engineering and Mathematics in secondary schools in Nigeria persists. Not addressing this problem could lead to consequences such as shortage of female students who could be captains in Engineering and Mathematics fields such as Electrical Engineering, Maritime Engineering, Mechanical Engineering and Statistics among others. This will make it difficult for Nigeria to ascend to its rightful position in the global economy. The problem of this study therefore lies in addressing the question; "what is the attitude of female students towards Science, Technology, Engineering, and Mathematics and its implication on their career choice in Engineering and Mathematics in senior secondary schools in Jos-North, Plateau State? This forms the rationale for the conduct of this research.

## **AIM AND OBJECTIVES**

The aim of this study was to investigate female students' attitude to Science, Technology, Engineering and Mathematics and career choice in Engineering and Mathematics in secondary schools in Jos North, Plateau State, Nigeria. The specific objectives of the study include to

1. ascertain the attitude of female students to Science, Technology, Engineering, and Mathematics (STEM) in Senior Secondary Schools in Jos North LGA.
2. find out how the attitude of female students towards STEM influence their choice of career in Engineering in Senior Secondary Schools in Jos North LGA.
3. investigate the extent to which female students' attitude towards STEM determine their choice of career in Mathematics in Senior Secondary Schools in Jos North LGA..

### RESEARCH QUESTIONS

- (1) What is the attitude of female students to Science, Technology, Engineering, and Mathematics (STEM) in Senior Secondary Schools in Jos North LGA?
- (2) What is the extent to which the attitude of female students towards STEM affects their choice of career in Engineering in Senior Secondary Schools in Jos North LGA?
- (3) What is the extent to which female students' attitude towards STEM determines their choice of career in Mathematics in Senior Secondary Schools in Jos North LGA?

### RESEARCH HYPOTHESES

The following hypotheses are formulated and tested at 0.05 level of significance:

1. Female students' choice of career in Engineering is not dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.
2. Female students' choice of career in Mathematics is not dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.

### METHODOLOGY

Cross-sectional survey research design was adopted in the study. Quantitative method was employed, and e-questionnaire was used to collect data from female students on their attitude to Science, Technology, Engineering and Mathematics and Career choice in senior secondary school in Jos North LGA of Plateau State. The population for this study comprised all the female secondary school students in Senior Secondary Two (SS 2) in public schools within Jos North LGA of Plateau State which is estimated to be eight hundred and seventeen (817). The sample size was determined using Krejcie and Morgan (1970) Table for Determining Sample Size. A sample of 260 female students, drawn from the population using the simple random sampling technique, was used.

The "Female Students' Attitude to STEM and Career Choice in Senior Secondary Questionnaire" (FSASTEMCCSSQ) was used. The instrument was designed using a five-point Likert scale of Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) and Strongly Disagree (SD). The respondents were required to show their level of agreement or disagreement with the items in the electronic questionnaire. The instrument was subjected to validation by three experts each from the Centre for Gender and Women's Studies, the Research, Measurement and Evaluation Unit, and the Department of Science and Technology Education, University of Jos. The instrument was evaluated by the experts in terms of appropriateness, clarity of expression, ease of comprehension, precision, and accuracy of the information provided. To guide their assessment, they were given the objectives of the study, the research questions, and the hypotheses, which enabled them to make relevant corrections, suggestions, and modifications where necessary. Construct validity of the instrument was further established through factor analysis, while Cronbach's Alpha method was employed to determine internal consistency. The reliability coefficient obtained was 0.89.

Descriptive statistics of mean score and standard deviation were used to analyse and answer the research questions asked in the study. A criterion mean of 3.00 was used in taking decision as to whether the response to an item was positive or negative. This implies that only items with mean

rating of 3.00 and above were accepted while those below 3.00 were rejected. The hypotheses formulated were tested using Pearson Product Moment Correlation.

### Research Question One:

What is the attitude of female students to Science, Technology, Engineering, and Mathematics (STEM) in Senior Secondary Schools in Jos North LGA?

**Table 1: Attitude of Female Students to Science, Technology, Engineering, and Mathematics (STEM)**

Attitude Direction	Attitude Scores	N	%
Negative	1-53	3	1
Neutral	54-106	73	28
Positive	107-160	184	71
Total		260	100

Table 1 shows the result on the attitude of female students to Science, Technology, Engineering, and Mathematics (STEM) in Senior Secondary Schools in Jos North LGA. Three students (1%) have a negative attitude, 73(28%) had neutral attitude towards STEM, while 184 (71%) students have positive attitude towards STEM. It implies that majority of the students have positive attitude towards STEM in Senior Secondary Schools in Jos North LGA.

**Research Question Two:** How does the attitude of female students towards STEM influence their choice of career in Engineering in Senior Secondary Schools in Jos North LGA?

**Table 2: Extent to which the Attitude of Female Students towards STEM Influence their Choice of Career in Engineering**

Career Choice in Engineering	N	Attitude Towards STEM Mean Score	Attitude Direction
Prosthetic engineering	11	117.27	Positive
Chemical engineering	5	111.60	Positive
Software engineering	26	110.46	Positive
Total/ Grand Mean	42	113.11	Positive

Table 2 presents the result on the extent to which the attitude of female students towards STEM influences their choice of career in Engineering in Senior Secondary Schools in Jos North LGA. From the table, majority of the students had a positive attitude towards STEM as 11 students who chose Prosthetic Engineering had a mean score of 117.27, 5 of the students who chose Chemical Engineering had a mean of 111.60, while 26 students who chose Software Engineering had a mean of 110.46. The grand mean was 113.11, which shows positive attitude towards STEM, indicating that only students with positive attitude towards STEM chose careers in Engineering, hence, positive attitude towards STEM determines students' choice of career in Engineering.

### Research Question Three

What is the extent to which female students' attitude towards STEM determines their choice of career in Mathematics in Senior Secondary Schools in Jos North LGA?

**Table 3: Extent to which the Attitude of Female Students towards STEM Determine their Choice of Career in Mathematics**

Career Choice in Mathematics	N	Attitude Towards STEM Mean Score	Attitude Direction
BSc Mathematics	9	123.00	Positive
Statistics	3	106.33	Positive
Total/ Grand Mean	12	114.67	Positive

Table 3 shows the result on the extent to which the attitude of female students towards STEM determines their choice of career in Mathematics in Senior Secondary Schools in Jos North LGA. From the table, 9 students chose Mathematics with an attitude mean score of 123.00, while 3 of them chose Statistics with a mean score of 106.33. The grand mean was 114.67, indicating that female students had a positive attitude towards STEM which influenced their choice of career in Mathematics in Senior Secondary Schools in Jos North LGA.

**Hypothesis One:** Female students' choice of career in Engineering is not dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.

**Table 4: Summary of Chi-Square result on Female Students Choice of Career in Engineering and Attitude towards STEM**

	Value	Df	P-value
Pearson Chi-Square	25.1 <sup>a</sup>	2	0.044
Likelihood Ratio	30.4	2	.859
Linear-by-Linear Association	13.9	1	.709
N of Valid Cases	42		

Table 4 shows the chi-square result on female students' choice of career in Engineering and their attitude towards STEM in Senior Secondary Schools in Jos North LGA. The result yielded  $\chi^2(1,2) = 25.1, P < 0.05$ . Since the p-value of 0.044 is less than the 0.05 level of significance, the null hypothesis was rejected. It was therefore concluded that female students' choice of career in Engineering is dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.

**Hypothesis Two:** Female students' choice of career in Mathematics is not dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.

**Table 5: Summary of Chi-Square result on Female Students Choice of Career in Mathematics and Attitude towards STEM**

	Value	Df	P-value
Pearson Chi-Square	13.227 <sup>a</sup>	2	.042
Likelihood Ratio	11.074	2	.300
Linear-by-Linear Association	12.934	1	.087
N of Valid Cases	12		

Table 5 indicates the chi-square result on Female students' choice of career in Mathematics and their attitude towards STEM in Senior Secondary Schools in Jos North LGA. The result yielded  $\chi^2(1,2) = 13.23, P < 0.05$ . Since the p-value of .042 is less than the 0.05 level of significance, the null hypothesis was rejected. It was concluded that female students' choice of career in Mathematics is dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.

## DISCUSSION

The findings on the attitude of female students to Science, Technology, Engineering, and Mathematics (STEM) in Senior Secondary Schools revealed that 71% of the students have positive attitude towards STEM. It implies that majority of the students have positive attitude towards STEM in Senior Secondary Schools in Jos North LGA.

The findings on how the attitude of female students towards STEM influence their choice of career in Engineering showed that only students with positive attitude towards STEM chose careers in Engineering, hence, positive attitude towards STEM determines students' choice of career in

Engineering. Hence female students' choice of career in Engineering is dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA.

The result on the extent to which female students' attitude towards STEM determines their choice of career in Mathematics revealed that female students have positive attitude towards STEM and it influences their choice of career in Mathematics in Senior Secondary Schools in Jos North LGA. It further revealed that female students' choice of career in Mathematics is dependent on their attitude towards STEM in Senior Secondary Schools in Jos North LGA. This result agrees with the findings of Nkhahle-Rapita and Moloi (2014) who studied the impact of attitude on students' career choices in Mathematics in secondary schools and found that attitude influences students' choice of career in Mathematics.

## CONCLUSION

From the analysis of data in this study, it can be concluded that female students in senior secondary schools in Jos North Local Government Area have positive attitude towards STEM and this influences their career choices in Engineering and Mathematics courses such as chemical engineering, software engineering, mechanical engineering, mathematics, statistics, and other related courses.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations were proffered:

1. All forms of stereotypes attributing STEM-courses to only male students should be discouraged.
2. Female students with positive inclination towards engineering should be encouraged to pursue career paths in such area.
3. Female students with positive attitude towards Mathematics should be encouraged to have career aspiration in such area.
4. Parents should motivate and support their female children who are doing well in STEM subjects by providing their educational needs to enable them study effectively in senior secondary schools which will in turn motivate them to choose careers in STEM fields.

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