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Exploring the Potential: Encouraging Girls to Study Engineering Discipline (A case study of Borno State)

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Abstract
Females are underrepresented in engineering cohorts in Nigeria. The underrepresentation of female participants in engineering fields has been a barrier for diversity and equality in both the industry and academic professions. This paper explores the underlying reasons for girls' hesitation to pursue engineering disciplines and discuss potential strategies to address these challenges. By promoting a supportive environment that encourages and empowers girls to engage in engineering education, we can work towards increasing female representation in this field and fostering a more diverse, innovative, and inclusive engineering workforce. The study found that some factors that influence girls under participation in engineering are Gender stereotype, quality of STEM education, lack of career guidance, self-efficacy, and lack of family supports. suggestion was made as follows: Challenging gender stereotypes, Improving the quality of STEM education in Borno State, building girls' self-efficacy in STEM, providing effective career guidance services, and promoting the visibility of female role models in engineering.
Keywords: Engineering, Discipline, Girls, Gender Gap, Academic Profession

Introduction

The gender gap in the engineering field has been a topic of concern and discussion for several decades. Despite efforts to increase female representation, women still face significant barriers when entering and advancing in engineering careers (Hill, Corbett, & St. Rose, 2010). As of 2019, women earned only 21% of all engineering bachelor's degrees in the United States (National Science Foundation, 2021). This disparity is particularly pronounced in certain engineering disciplines such as mechanical and electrical engineering.

For many decades, educators have been concerned about the relatively little number of students in general, and girls in particular, who choose science and technology in high-school and

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undergraduate programs (Holmegaard, Madsen & Ulriksen, 2012). Study has shown the reasons for the lack of girls in science, technology, engineering, and mathematics (STEM).

According to a report by UNESCO, in Nigeria, only 23% of students enrolled in engineering-related courses are women. While this statistic highlights the underrepresentation of women in engineering in Nigeria, it also indicates the potential for improvement through initiatives aimed at increasing girls' interest and participation in STEM fields. Many organizations and individuals in Nigeria are actively working to address the gender gap in engineering and other STEM fields by promoting gender equality, providing educational resources, and creating mentorship opportunities for young women.

Several factors contribute to girls' disinclination towards engineering studies, including societal stereotypes, inadequate career guidance, and educational barriers (Bix & Locks, 2018). Furthermore, young girls often lack role models and encouragement from family, peers, and teachers to pursue engineering as a viable career choice (Cheryan, Ziegler, Montoya, & Jiang, 2017).

Statement of the problem

Females are underrepresented in engineering cohorts in Nigeria. The underrepresentation of female participants in engineering fields has been a barrier for diversity and equality in both the industry and academic professions.

Significance of the Research

The research provided a clean reason to why our young girls don't want to pursue engineering discipline as a career, and the influence that affect their choice. It also provided a clear approach to mitigating this problem. If the provided factors plus the suggestion is look into with clear mind, it might help policy makers, government, private organization and the parent in mitigating this problem.

Theoretical Framework

With the push toward equal rights and equal employment opportunities, one would expect to see affair number of women entering predominantly male- dominated professions. Unfortunately, in science, technology, engineering, and mathematics (STEM) fields and careers, this is not the case. The number of girl's graduating from engineering programs is smaller than that of men (Damour2009), and there are fewer women (22%) in engineering jobs than men (78%) (Finken, 2004; U.S. Department of Labor, Bureau of Labor Statistics 2009).

Engineering continues to be a man's world. Women continue to be underrepresented in the profession de- spite the understanding that females are just as capable of achieving success in STEM careers as their male counterparts (Rosser and Taylor 2009). While jobs are no longer labeled as "men's jobs" or "women's jobs" according to Shaw (2009), occupational segregation is quite prevalent in today's workforce. For instance, of the 496 basic occupations, half of all women work in only 28 of the occupations and only 20 percent of these careers are nontraditional (Shaw 2009). Although girls have test scores in math and science classes' equivalent to boys' scores, the girls seem to lose interest in these subjects or develop a science and math aversion when entering high school or college (Slashinski 2004).

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Girls' participation in science can be influenced by the national culture of professions. Research has shown that in the U.S. and Europe students' job aspirations still reflect the traditional men and women employment patterns (Archer et al., 2012; Murphy & Whitelegg, 2006). In contrast, in a different culture in Kenya, girl students were very positive towards science and future STEM careers (Chetcuti & Kioko, 2012). Therefore, the discussion on STEM careers for women should take into account the national cultural context

Attitude that influences girl's participation in Engineering

Some of the factors that influence girl's participation in engineering discipline can be categories as follows: Nationality, Gender, Religious and community values.

Nationality: Research has shown that in the U.S. and Europe students' job aspirations still reflect the traditional men and women employment patterns (Archer et al., 2012; Murphy & Whitelegg, 2006). In summary, in a unique culture in Kenya, girl students were very positive towards science and future STEM careers (Chetcuti & Kioko, 2012). So, the discussion on STEM related careers for women should take into consideration the national culture.

Religious and cultural values

Religious believe also influence girl's decision to venture into STEM related discipline. In fact, there exist a dynamic relationship between religion and science. Stenmark (2004) defined four possible relations between science and religion: social (practitioners' social interactions), teleological (aims the practitioners have in mind), epistemological (theories, methods, and beliefs), and theoretical (subject matter and content).

Gender

Girls' involvement in STEM related course is highly influenced by their gender identity which is encouraged by the culture. Through middle-school age, students begin to link professions to gender identity (Fung, 2002). Physical science and engineering are perceived as masculine disciplines, in both boys' and girls' views (Farenga & Joyce, 1999).

The Structure of Engineering Workshops

Another study that identifies targeted feedback from middle school girls after participation in an engineering campus was highlighted by Quock, LaurenKovitz, and Bhattacharyya (2003). The authors enquire to determine the relevance of carrying out an annual Introduction of a Girl to Engineering Day. It was anticipated that the program would encourage middle school girls to learn more about the field of engineering. Also, the program provided female engineering mentors a means of reaching the community and expressing their enthusiasm and satisfaction for the career path they chose. McShannon and Derlin (2000) concluded that engineering faculty need to implement additional ways of communicating with their students. Managing class with traditional limited communication, such as the students alone (or "student-self"), does not provide guidance for minorities, women, and freshman.

Advantage of Engineering Workshops

Anderson and Gilbride (2007) carried out a study to examine if a high school workshop encouraging engineering has an impact on the interest of male and female students to consider

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engineering as a future career. This study examines beyond just awareness impressions of girls, as carried out by EWEP (2005), and found that engaging in the workshop did result in a significant increase in knowledge of engineering, with more girls wishing to pursue engineering as a career than indicated prior to the workshop

Role model and its influence on profession choice

Research has shown that people tend to choose a profession when they are familiar with a person, or at least are able to identify a role model in that field (Lent, Brown & Hackett, 1994; Zirkel, 2002). Hence, efforts are invested in finding ways of creating role model scientists in formal as well as informal settings. For instance, Leblebicioglu, Metin, Yardimci and Cetin (2011) studied the positive effect of informal and formal interactions between scientists, males and females, and children, boys and girls, at a science camp on their images of scientists.

Female role models can influence a profession, especially on women in the context of STEM occupation (Betz, 1994; Quimby & DeSantis, 2006). Therefore, positive images of women scientists and engineers can influence a girl student's commitment to a scientific career (Wyer, 2003). In summary, recent research conducted by Betz and Seikaquaptewa (2012) showed that exposing middle-school girl students to feminine STEM role models through articles reduced their interest in math, as well as their capability of dealing with math and their future plans for a STEM career.

Methodology

To gain a comprehensive understanding of the factors that affect girls' inclination towards engineering disciplines in Borno State, a mixed-methods approach was employed. This involved a combination of quantitative and qualitative methods to collect and analyze data from various sources.

Quantitative Data Collection and Analysis:

i. Survey: A structured questionnaire was designed and distributed to a sample of 500 secondary school girls in Borno State. The survey aimed to gather information on the participants' knowledge, perceptions, and attitudes towards engineering as a career choice. Data analysis involved the use of descriptive statistics and correlation analysis to identify trends and associations.

ii. Analysis of Secondary Data: Relevant statistical data was gathered from government agencies and international organizations, such as the National Bureau of Statistics (NBS), UNESCO, and the Nigerian Universities Commission (NUC), to provide a macro-level perspective on female enrollment in engineering programs.

Qualitative Data Collection and Analysis

i. Focus Group Discussions (FGDs): A series of focus group discussions were conducted with groups of girls (aged 14-18) from various secondary schools in Borno State. The purpose of the FGDs was to gain deeper insights into the participants' experiences, perceptions, and challenges related to pursuing engineering studies.

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ii. In-depth Interviews: Semi-structured interviews were conducted with key informants, including school administrators, teachers, parents, and representatives from NGOs working in the education sector. The interviews aimed to explore stakeholders' perspectives on the factors influencing girls' participation in engineering studies and potential interventions to address these challenges.

Data Analysis

Both quantitative and qualitative data were analyzed using appropriate techniques. Quantitative data were analyzed using descriptive statistics. This methods approach allowed for a comprehensive and nuanced understanding of the factors that influence girls' pursuit of engineering disciplines in Borno State. The findings from this study will contribute to the development of effective interventions to address the gender gap in engineering education and promote girls' participation in this field.

Results and Discussion

The study identified several key factors that influence girls' inclination towards engineering disciplines in Borno State. These factors can be broadly categorized into societal, educational, and personal factors.

Table 1. Showing Interest in pursuing engineering as a career

Response	Frequency	Percentage
Not all interested	150	30
slightly interested	100	20
somewhat interested	150	20
Quite interested	50	30
Extremely interested	50	10
Total	**500**	**100**

Source: field survey 2024

In this table above, 150 respondents were not at all interested in pursuing engineering as a career, while 50 respondents were quite interested. The highest percentage of respondents (30%) fell into the "somewhat interested" category

Table 2 showing Enjoyment of studying science subjects

Response	Frequency	Percentage
Not at all enjoyable	175	35%
Slightly enjoyable	50	10%
Somewhat enjoyable	25	5%
Quite enjoyable	200	40%

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Extremely enjoyable	50	10%
Total	**500**	**100%**

Source: field survey 2024

In this table, 175 respondents found studying science subjects not at all enjoyable, while 50 respondents found it extremely enjoyable. The highest percentage of respondents (40%) found studying science subjects quite enjoyable, and 35% found it somewhat enjoyable.

Table 3 showing teachers' support in pursuing engineering discipline

Response	Frequency	percentage
Not all supportive	25	5%
slightly supportive	50	10%
somewhat supportive	150	30%
quite supportive	200	40%
extremely supportive	75	15%
Total	**500**	**100%**

Source: field survey 2024

In this table, 25 respondents reported that their teachers were not at all supportive of them pursuing engineering, while 75 respondents reported that their teachers were extremely supportive. The highest percentage of respondents (40%) indicated that their teachers were quite supportive, and 30% found them somewhat supportive.

Table 4showing students' Confidence in mathematics abilities

Response	Frequency	Percentage
Not all confident	25	5%
slightly confident	50	10%
somewhat confident	150	30%
quite confident	200	40%
extremely confident	75	15%
Total	**500**	**100%**

Source: field survey 2024

In this table, 25 respondents reported being not at all confident in their mathematics abilities, while 75 reported being extremely confident. The highest percentage of respondents (40%) felt quite confident, and 30% felt somewhat confident.

Table 5 showing the Participation in STEM extracurricular activities or clubs

Response	Frequent	Percentage

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Never	100	20%
Occasionally	200	40%
Regularly	200	20%
Total	**500**	**100%**

Source: field survey 2024

In this table, 100 respondents reported never participating in STEM extracurricular activities or clubs, while 200 reported participating regularly. The highest percentage of respondents (40%) participated occasionally, and another 40% participated regularly.

Table 6 showing the Fields of engineering interest

Response	Frequency	Percentage
Agricultural Engineering	50	10%
Civil Engineering	150	30%
Mechanical Engineering	100	20%
Electrical Engineering	75	15%
Chemical Engineering	50	10%
Computer Engineering	75	15%

Source: field survey 2024

In this table, the highest percentage of respondents (30%) indicated an interest in Civil Engineering, followed by Mechanical Engineering (20%). Electrical Engineering, Computer Engineering, and the combined "Other" fields of engineering each received 15% of respondents' interest. Agricultural Engineering and Chemical Engineering was selected by 10% of respondents.

Table 7 showing Parental support for pursuing engineering

Response	Frequency	Percentage
Not all supportive	25	5%
Slightly supportive	50	10%
Somewhat supportive	150	30%
Quite supportive	200	40%
Extremely supportive	75	15%
Total	**500**	**100%**

Source: field survey 2024

In this table, the distribution of responses is the same as the tabulated sample provided earlier for teacher support. The highest percentage of respondents (40%) reported that their parents/guardians were quite supportive of them pursuing engineering, followed by 30% who reported somewhat supportive parents/guardians.

Table 8 showing the Influence of societal expectations and gender norms on career choices

Response	Frequency	Percentage

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Not all influential	25	5%
Slightly influential	50	10%
Somewhat influential	150	30%
Quite influential	200	40%
Extremely influential	75	15%
Total	**500**	**100%**

Source: field survey 2024

In the above table, the distribution of responses indicates that 40% of respondents found societal expectations and gender norms to be quite influential on their career choices, while 30% found them somewhat influential. Only 5% reported that these factors were not at all influential

Table 9 showing the Familiarity with engineering as a field of study

Response	Frequency	Percentage
Not all familiar	25	5%
Slightly familiar	50	10%
Somewhat familiar	150	30%
Quite familiar	200	40%
Extremely familiar	75	15%
Total	**500**	**100%**

Source: field survey 2024

In the table above, 40% of respondents reported being quite familiar with engineering as a field of study, while 30% reported being somewhat familiar. Only 5% of respondents reported being not at all familiar with engineering.

Table 10. Role of career guidance counselors in shaping career choices

Response	Frequency	Percentage
Not all helpful	25	5%
Slightly helpful	50	10%
Somewhat helpful	150	30%
Quite helpful	200	40%
Extremely helpful	75	15%
Total	**500**	**100%**

Source: field survey 2024

In the above table, the highest percentage of respondents (40%) reported that career guidance counselors were quite helpful in shaping their career choices, followed by 30% who found them somewhat helpful. Only 5% reported that career guidance counselors were not at all helpful.

Percentage analysis

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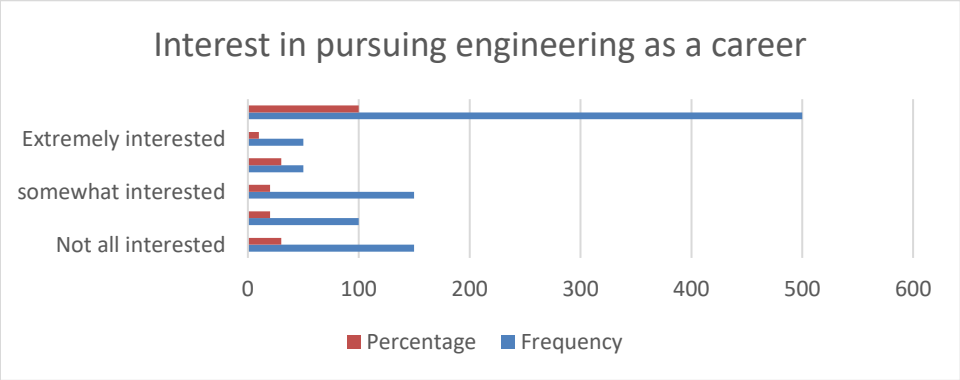


Fig. 1 above showing girls interest in pursuing engineering career

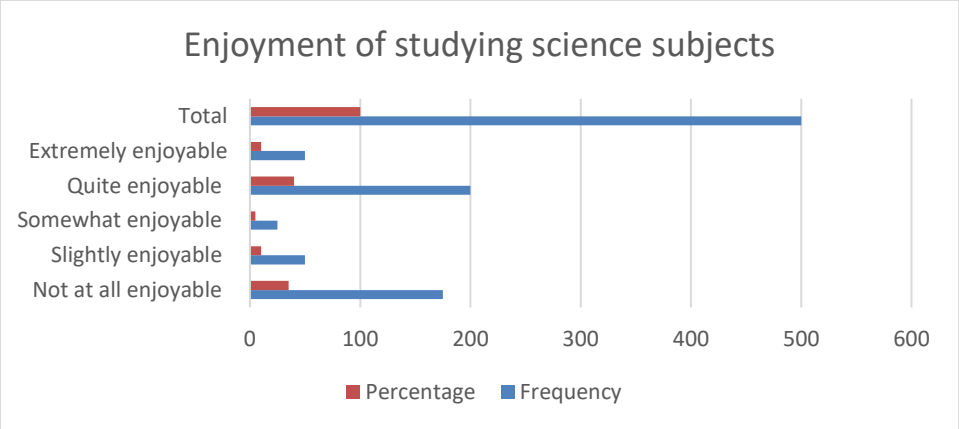
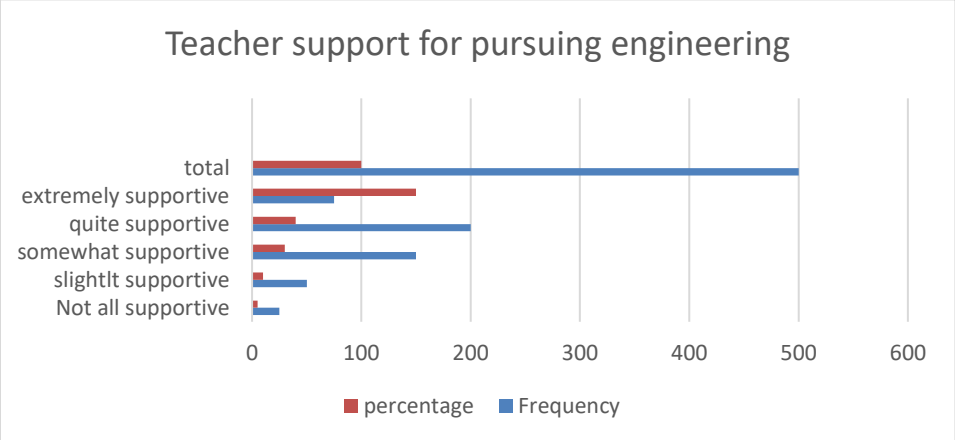


Fig. 2 above showing the girls enjoyment of studying STEM subject



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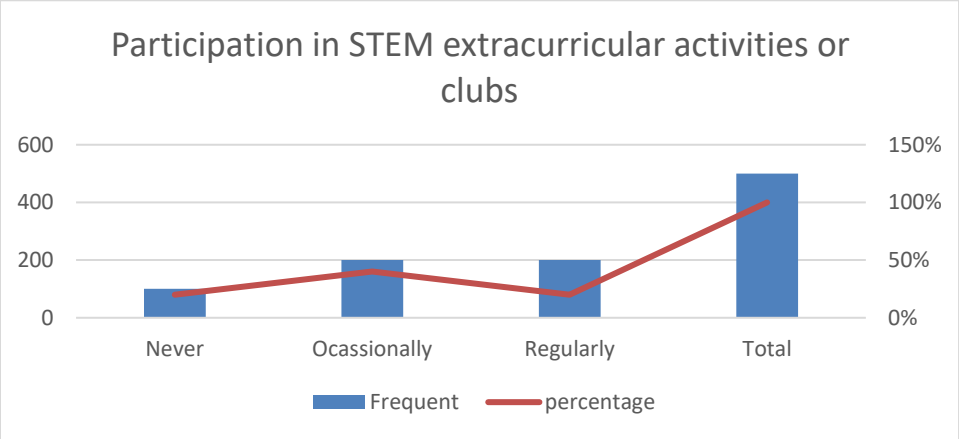

Fig 3 above showing girls participation in STEM extracurricular activities clubs

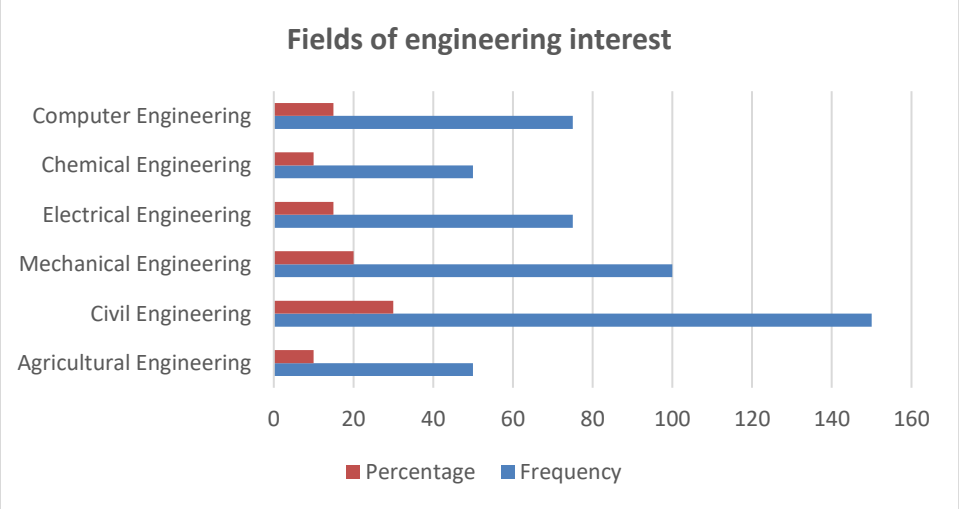

Fig. 4 above showing girls field og engineering interest

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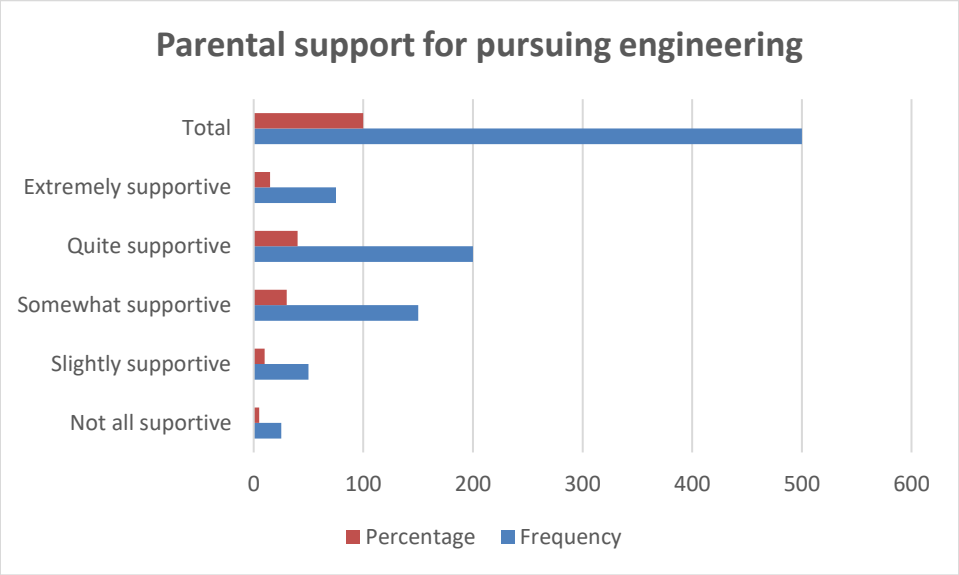

Fig 5 above showing girls parental support in pursuing engineering

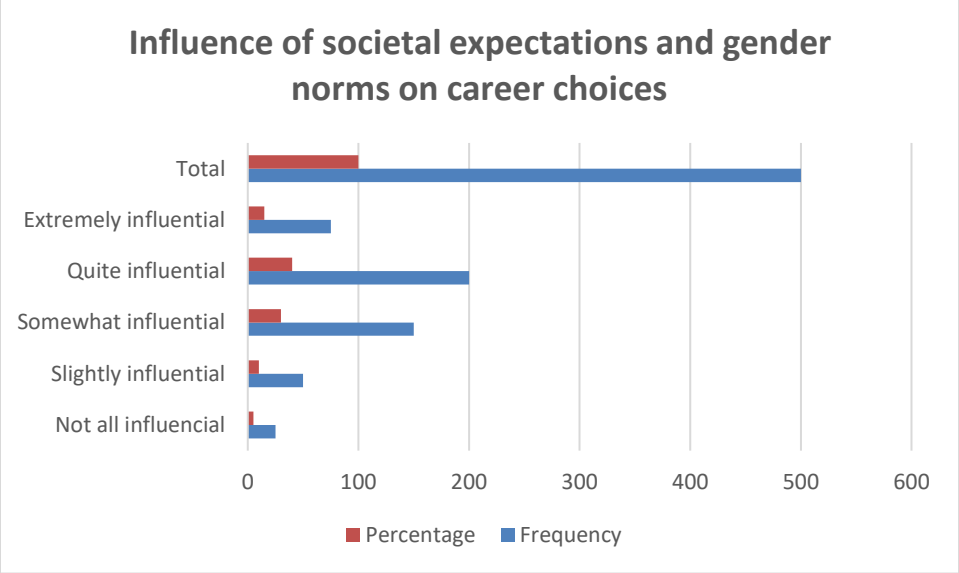

Fig. 6 above showing the influence of societal expectation and gender norms on carrer choices

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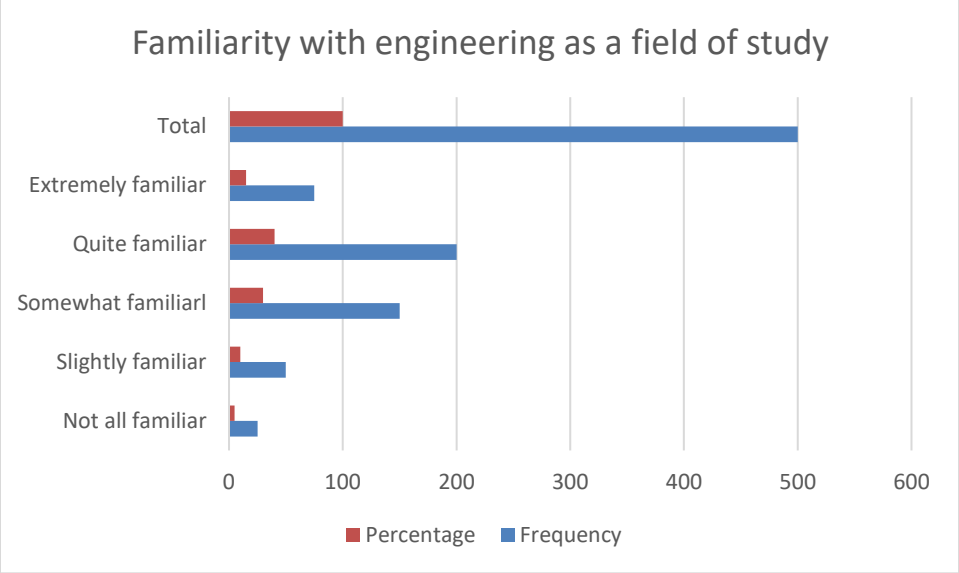

Fig.7 above showing girls familiarity with enginering as a field of study

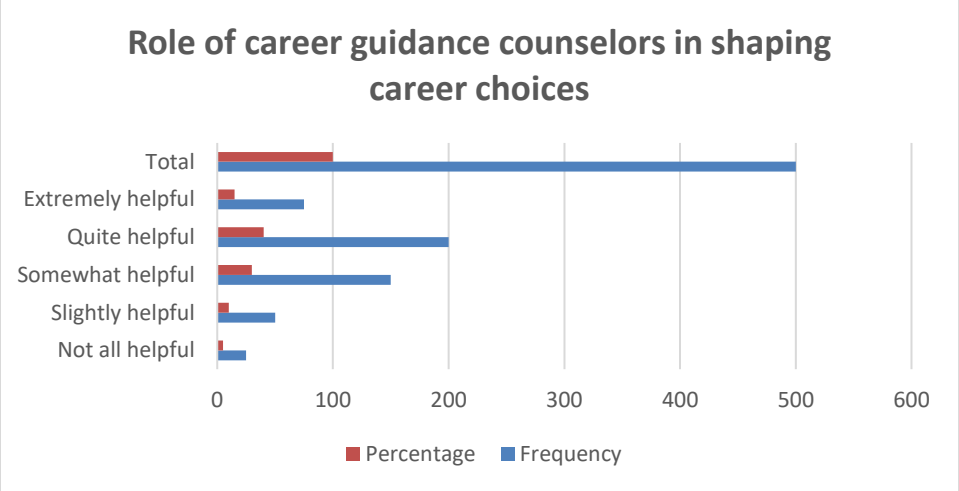

Fig. 8 above showing role of career guidiance coundelors in shaping career choices

Conclusion

After a careful study, with the application of the right tool, we were able to found that some factors influenced Factors that influence girls under participation in Engineering Discipline as follows:

Societal Factors:

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i. Gender stereotypes: Participants reported that societal norms and expectations regarding gender roles played a significant role in shaping girls' career choices. Engineering was often perceived as a male-dominated field, which discouraged girls from considering it as a viable career option.
ii. Family support: The level of family support, particularly from parents, emerged as a critical factor in girls' pursuit of engineering studies. Girls with supportive families were more likely to express interest in engineering disciplines.

Educational Factors:

i. Quality of STEM education: The study revealed that the quality of STEM education in Borno State schools influenced girls' attitudes towards engineering. Inadequate infrastructure, lack of qualified teachers, and outdated teaching methods were cited as barriers to girls' engagement in STEM subjects.
ii. Career guidance: Participants expressed a need for improved career guidance services in schools to provide accurate and comprehensive information about engineering disciplines and potential career paths.

Personal Factors:

i. Self-efficacy: Girls with higher self-efficacy in STEM subjects were more likely to pursue engineering studies. Building girls' confidence in their abilities to succeed in engineering emerged as a crucial factor in increasing their interest in these fields.
ii. Role models: The presence of female role models in engineering was found to positively influence girls' interest in pursuing engineering careers. Girls who had access to female engineers as mentors or role models expressed greater motivation to pursue engineering studies.

Suggestion

i. The findings from this study suggest that a multi-pronged approach is necessary to address the gender gap in engineering education in Borno State. This may include:
ii. Challenging gender stereotypes through public awareness campaigns and educational interventions that promote gender equality and STEM education for girls.
iii. Improving the quality of STEM education in Borno State schools through investments in infrastructure, teacher training, and modernizing teaching methods.
iv. Providing effective career guidance services in schools to help girls make informed decisions about their career paths and understand the potential of engineering as a viable option.
v. Building girls' self-efficacy in STEM subjects through targeted interventions, such as after-school programs, STEM clubs, and mentorship opportunities.
vi. Promoting the visibility of female role models in engineering to inspire and motivate girls to pursue engineering studies.

By addressing these factors, Borno State and Nigeria in particular can take significant steps towards increasing girls' interest and participation in engineering disciplines, thereby contributing to the overall development of the country and fostering gender equality in the engineering profession.

Dedication and Acknowledgement

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This research is dedicated to all our sister who are majoring in Engineering Discipline and the young girls who are willing to.

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