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Gender Equality in Science, Technology, Engineering and Mathematics in Taraba State, Nigeria

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ABSTRACT

Long acknowledged as the foundation for a country's growth and prosperity are four disciplines- science, technology, engineering, and mathematics (STEM). Education in these four fields has several advantages for women in terms of long-term social and economic advancement. By 2030, the fifth sustainable development target (SDG 5) is to enable women and girls to realise their full potential. One of the criteria to determine SDG 5 is measuring gender equality in science, technology, engineering, and mathematics (STEM). In Taraba State, Nigeria, this study investigated into gender equality in STEM fields. The study sample consists of 14,548 STEM-majoring students from 100 secondary schools and 6 post-secondary institutions in Taraba State, with 8,354 male and 6,194 female participants. Data on enrollment in STEM-related courses as well as information from a standardised survey were collected. The findings show that enrollment data at the secondary school level is equal for both sexes. Nonetheless, more male students chose chemistry and physics, while more female students chose biology and technical drawing. According to the tertiary institutions' findings, men predominate in STEM fields. The study comes to the conclusion that there is significant gender inequality in STEM education in Taraba State, Nigeria, and suggests that efforts should be taken to bridge the gap in order to meet SDG 5. The findings of this study add to the existing body of knowledge that provides a baseline report that there is gender discrepancy in STEM education in Taraba State, Nigeria, and an indication that if efforts are not taken, the female gender might be disadvantaged in the efforts to achieve SDG 5 by 2030.

Keywords: *Gender Equality; Science; Technology; Engineering; Mathematics; SDG 5*

INTRODUCTION

Any nation's economic success is correlated with how effectively it uses and manages science and technology. This demonstrates the significance of professional human resources in Nigeria's fields of science, mathematics, and technology. STEM fields—science, technology, engineering, and mathematics—have long been acknowledged as essential to a country's growth

and prosperity. STEM is crucial for the growth of any country's economy since it serves as the foundation for the various developing technologies that are now the backbone of global operations (Akinsowon, & Osisanwo, 2014). Despite the fact that providing girls with an education in science and mathematics has been demonstrated to be beneficial for sustained social and economic development in some significant regions of the world, Asimeng-Boahene (2007) discovered that Africa lags behind other continents in this area. Statistics in Sub-Saharan African (SSA) nations have indicated that women in general and in the study of science, mathematics, and technology (SMT) in particular lag behind men in education (Masanja, 2010). In Sub-Saharan African nations, the gender gap in education in science, technology, engineering, and mathematics at all levels and therefore in jobs has remained relatively large.

Gender equality might have a significant effect on economic growth and productivity. Women who are employed in developing nations provide a multiplier effect because they are more likely than men to reinvest their earnings in their families and communities, which promotes social and economic advancement. Generations to come will clearly benefit from gender equality as mothers become role models for their daughters and their sons support women.

According to a review of the Global Employment Trends for Women report by the International Labor Organization (2012), the gender disparity in the employment-to-population ratio remained significant at 24.5 points. According to a World Bank (2012) analysis, gender differences persist to a particularly great extent among groups when geographic distance, racial diversity, and additional characteristics like disability or sexual orientation further exacerbate gender inequality. The World Bank analysis demonstrates that women have fewer options for employment across industries. They (women) are leaving agricultural jobs in emerging countries as well as leaving industries and services. According to the World Bank Report (2012), women make up 40% of the global labour force but own just 1% of its wealth.

Global and national efforts have been made by countries to eliminate gender disparities in education and occupations since the Universal Declaration on Human Rights was adopted in 1948, which recognises education as a fundamental human right. Such initiatives to combat gender inequality in employment and education gave rise to the Millennium Development Goal 3 (MDG 3) and Sustainable Development Goal 5. (SDG 5). While MDG 3 sought to advance gender equality and women's empowerment by eradicating gender disparity at the basic and secondary levels of education by 2005 and at all educational levels by 2015

(www.un.org/documents), SDG 5 seeks to enable women and girls to realise their full potential by eradicating all forms of violence and discrimination against them, including harmful practices, by 2030.

According to the MDGs' performance evaluation (e.g., Durokifa & Abdul-Wasi, 2016), MDG 3 may not have been able to fully meet its objectives. There are variations in equal access to education, according to the Nigeria MDG Report (2016). There are stark differences in the statistics on the education of girls between the northern and southern regions of Nigeria, and the North-East has a big population that is not attending school due to instability, insurgency, and cultural traditions (Nigeria MDG Report, 2015).

The United Nations framework for achieving "integrated and indivisible" goals and targets across the three defining pillars of sustainable development—social, environmental, and economic—the 2030 Agenda for Sustainable Development—became operational in January 2016. The achievement of gender equality and the empowerment of all women and girls is a stand-alone goal (SDG 5) of the sustainable development agenda. A framework that is specific to the setting will be needed due to variations in the nation's situations. Every level of government will be expected to benchmark and evaluate progress on this independent objective for it to be successful (SDG 5).

The MDGs set 2015 as the deadline for all children to complete their elementary education. In order to assure the successful advancement of MDG 2 and MDG 3, the Nigerian government implemented several education programmes, which improved the school net enrolment rate from 60% in 1995 to 84% in 2004, 87.6% in 2006, and 88.8% in 2008 (MDG Report, 2013). However, the country's insurgency and security issues in some areas caused the net enrolment rate to decline to 59% in 2011 and moderate to 68.7% in 2014. (OSSAP-MDGs, 2016). In secondary education, gender parity was attained in 2015 in the Caucasus and Central Asia, Eastern Asia, Northern Africa, South-Eastern Asia, and Southern Asia, but girls continue to face disadvantages in sub-Saharan Africa and Western Asia, according to the MDG Report (2015). The report also demonstrates that postsecondary education has the highest gender gaps in enrollment ratios, with sub-Saharan Africa and Southern Asia having the most severe disadvantages against women.

According to the Nigeria MDG Report (OSSAP-MDGs, 2016), as of 2015, progress had been made in reducing the gender gap in primary education. However, because the majority of females who attend primary schools do not enrol for secondary education, the report revealed a

low rate of enrollment of girls in secondary schools. Additionally, fewer female candidates than male candidates in Nigeria earn five credits in the secondary school certificate examinations, which are necessary for admission to institutions. The same report highlights stark sub-national and geopolitical differences in access to education in Nigeria, with notable differences in the data on girl education between northern and southern Nigeria due to the presence or lack of cultural traditions that limit girl enrollment in school. In terms of girls' education, there are also conflicting circumstances between the South-East, the North-West and North-East geopolitical zones. The report further revealed that whereas the Northeast has a high percentage of school dropouts among girls, the South East has a high dropout rate among boys. From the foregoing, it is pertinent to note that gender disparity still exists in the Nigerian education system, in spite of all efforts to close the gap. Thus, this study was therefore commissioned to assess the gender gap in STEM education in Taraba State.

Within its fifteen-year lifespan, the sustainable development agenda is already in its seventh year. The standards for monitoring the SDGs were derived from an analysis of the MDG monitoring framework's implementation. The MDG and SDG frameworks are based on tangible, quantifiable indicators that allowed many developing nations to increase their national capability for statistical monitoring. The monitoring of gender equity in the teaching of science, technology, engineering, and mathematics appears to lack any framework, nevertheless. In order to provide cogent, effective, and efficient support for achieving nationally agreed-upon sustainable development goals and to help assess overall progress by enhancing national data to monitor SDG 5 in Nigeria, a framework for evaluating gender equity in STEM fields must be developed. This is because interdependent goals and aims that should be jointly pursued are cut through by gender equality. Because of this, research is being conducted to determine the degree of gender equality in STEM fields in Taraba State, Nigeria, with the goal of achieving SDG 5.

When placed side-by-side with extensive and detailed statistical analysis of achievements and limitations of lifelong learning, social interaction, and culture, human development indices have revealed enormous obstacles that must be overcome, especially when gender issues of equity and equality are discussed. Reorientation becomes necessary and appealing. Therefore, the liberal feminism theory (Tong, 1992), which emphasises women's capacity to uphold their equality via their actions and choices, serves as the theoretical foundation for this study. The idea contends that discrimination against women in the workplace, public discourse, and the

marketplace results from society's mistaken belief that women are inherently less intelligent and physically capable than men. In accordance with this view, Agassi (1989) suggested that chances for lifelong learning and the complete removal of gender segregation in all social positions are necessary for gender equality (and equity) in contemporary society. This theory's use of the notions of equal opportunity, socialisation, sex roles, and discrimination, as well as applying techniques to change socialisation practices, change attitudes, and use pertinent laws, justifies its adoption as the theoretical foundation for this research.

In order to provide equal educational opportunities for men and women, the Federal Government of Nigeria has adopted a number of actions, such as offering Universal Free Primary Education (UPE) in 1976 and Universal Basic Education in the present (UBE). The social and economic standing of women in the country is greatly impacted by the fact that the female gender is still falling behind in the study of science, technology, and mathematics. The necessity for gender equity to be mainstreamed in Nigerian policy after seven years of the SDGs makes this study critical. How much gender equity has been achieved in Taraba State, Nigeria's STEM-related education is the problem of this study.

The goal of this study is to assess gender parity in Taraba State, Nigeria, in the fields of science, technology, engineering, and mathematics education. The study specifically determined:

1. The percentage of secondary school students in Taraba State, Nigeria, who are pursuing science subjects, both male and female
2. The percentage of male and female students who are enrolled in STEM-related courses at tertiary institutions in Taraba State

METHOD

Taraba State, Nigeria, was the site of the study. There are 16 local government areas in Taraba State. The selection of Taraba State is based on its sociocultural and religious differences in education as well as the State's long history of insecurity and banditry, all of which may have hampered the achievement of the MDG 3 and maybe the SDG 5, with a focus on STEM.

This study provides the actual data on gender equity levels in Taraba State’s education system for science, technology, engineering, and mathematics. The results of this study have highlighted the gender gap in STEM fields while also providing the Taraba State government and other educational stakeholders with baseline information to use as they work toward

achieving the objectives of gender equality programmes, including those outlined in the SDGs, UNICEF gender equality programmes, Nigeria's Gender Equality Policy, CEDAW, and ECOWAS Gender Policy, among others.

The survey and document analysis designs were used in the investigation. In these designs, data on school enrollment in STEM-based subjects and courses were gathered from 100 secondary schools and 6 post-secondary schools using checklists, questionnaires, and interview schedules. At the senior secondary school level, STEM subjects include technical drawing, biology, chemistry, mathematics, and physics. Additionally, it involved gathering data through comprehensive literature research, expert opinions, and expert consultations. Experts in the field of education validated the instruments (checklists, questionnaires, and interview proforma) for construct, face, and content validity. The researchers personally gathered data from secondary schools and tertiary institutions with the aid of Research Assistants. 14,548 students from 100 secondary schools, two universities, two polytechnics, and two colleges of education in Taraba State, Nigeria, make up the study's sample. There are 6,194 female students and 8,354 male students overall. The investigation took 16 months. Histograms and percentages are used to display the results.

RESULTS & DISCUSSION

Result

The results of the data analysis are presented in bar charts, using percentages to explain enrolment figures.

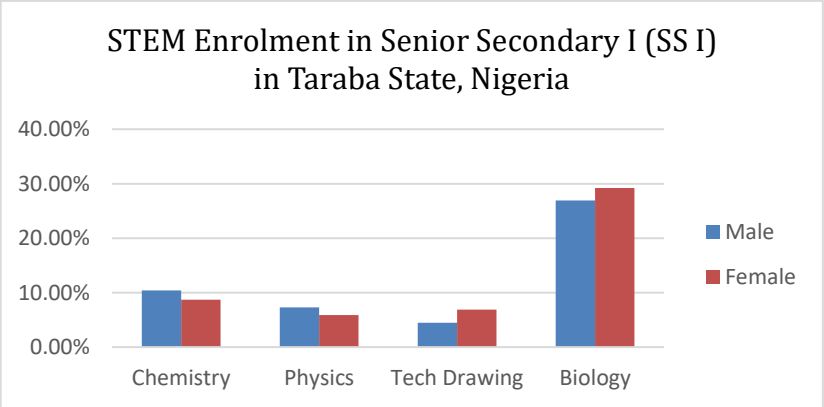

Figure 1. STEM Enrolment in Senior Secondary I (SS I) in Taraba State, Nigeria

Figure 1 displays the number of students enrolled in STEM subjects at the senior secondary level I (SS I). It can be noted that just 8.70% of the female students at this level are taking chemistry, compared to 10.4% of the male students. The percentage of female students majoring in physics is 5.9%, compared to 7.3% of male students. 6.9% of female students are majoring in technical drawing, compared to 4.5% of male students. According to statistics, 26.9% of male students study biology, compared to 29.20% of female students. According to the graph, male students outweigh female students in chemistry and physics, while female students exceed male students in technical drawing and biology.

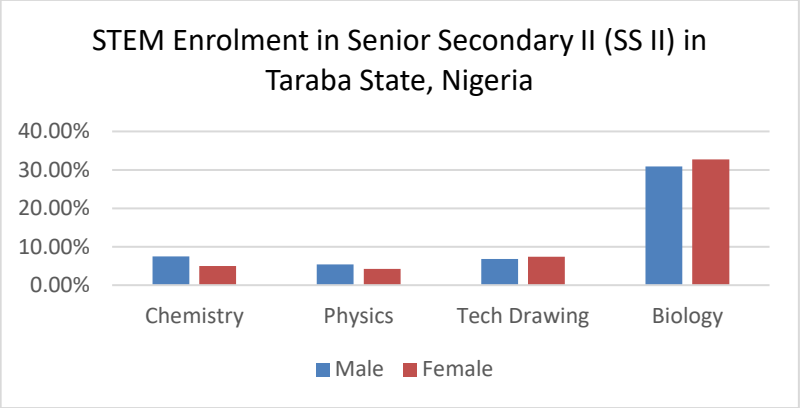

Figure 2. STEM Enrolment in Senior Secondary II (SS II) in Taraba State, Nigeria

The enrollment of students in SS II is shown in Figure 2, and it reveals that while chemistry is taken by 7.5% of the male students at this level, only 5.0% of female students do the same. Here, 5.4% of the male students are enrolled in physics, compared to 4.2% of the female students. 6.8% of male students are studying technical drawing, compared to 7.40% of female students. 30.9% of male students study biology, compared to 32.70 % of female students. Figure 2 demonstrated that while there are more male students than female students in chemistry and physics, there are more female students than male students in technical drawing and biology.

Results in Figure 3 show students in SS III that are taking STEM subjects. According to the results, 9.7% of the male students at this level are taking chemistry, compared to 8.8% of the male students overall. Here, 13.6% of the male students are enrolled in physics, compared to 9.9% of the female students. In a contrast to 6.1% of male students, 6.6% of female students are studying technical drawing. 24.1% of male students and 22.1% of female students are

studying biology, respectively. The results reveal that while male students beat female students in physics and biology, female students beat male students in chemistry and technical drawing.

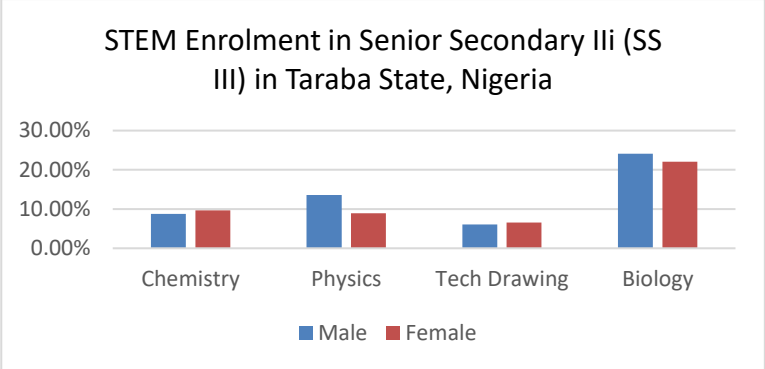

Figure 3. STEM Enrolment in Senior Secondary III (SS III) in Taraba State, Nigeria

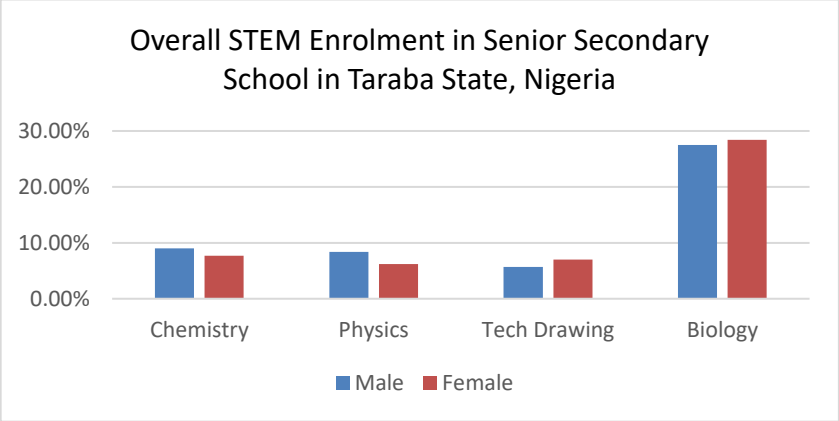

Figure 4. Overall STEM Enrolment in Senior Secondary School in Taraba State, Nigeria

According to Figure 4, which shows the overall enrollment of students in STEM disciplines at secondary schools in Taraba State, 7.7% of female students are enrolled in chemistry, compared to 9.0% of male students. 7.7% of male students are majoring in physics, as opposed to 6.2% of female students. 5.7% of female students are majoring in technical drawing, versus 7.0% of male students. Male students studying biology make up 27.5% of the student body, while female students make up 28.4%. The overall enrollment in STEM subjects revealed that male students outweigh female students in chemistry and physics, whereas male students outnumber female students in technical drawing and biology.

The distribution of STEM course enrollment among students at tertiary institutions is depicted in Figure 5. In Taraba State's tertiary institutions, the distribution of students enrolled in science programmes reveals that 20.2% of them are women and 40.3% of them are men. Only 5.3% of students studying technology are female, compared to 10.2% of students who are

male. 1.2% of engineering students are female, with 16.06% being men. Only 5% of the students studying mathematics at tertiary institutions are men, while only 1.1% are women. Overall, male students make up 72.9% of STEM course participants, while female students make up 29.1%. This shows that there is still a gender gap in the enrollment of men and women in Courses in Taraba State, Nigeria.

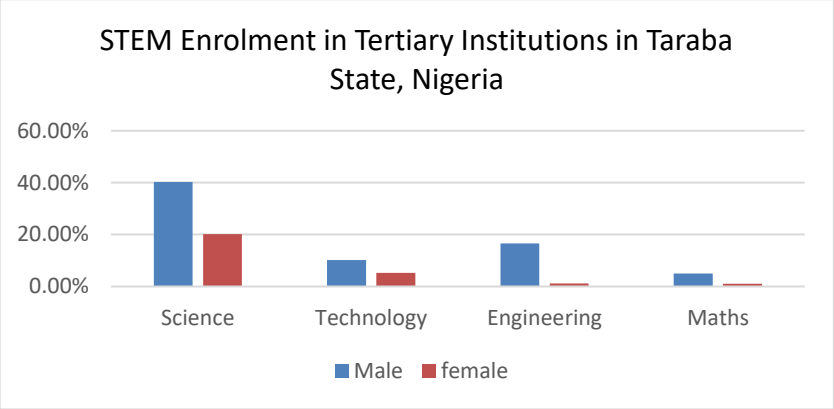

Figure 5. STEM Enrolment in Tertiary Institutions in Taraba State, Nigeria

Discussion

By examining gender equity in STEM (science, technology, engineering, and mathematics) school courses, this study adds to the body of research on gender inequities in education. It offers knowledge based on evidence regarding secondary school students' selection of STEM courses and enrollment in a STEM course in postsecondary education. Regardless of whether they are studying STEM or non-STEM topics in secondary school, all students are required to take mathematics. Additionally, some biology students are not necessarily science majors, and students can enrol in any STEM course they choose (biology, chemistry, physics, mathematics and technical drawing). A student can enrol in mathematics, biology, chemistry, and technical drawing without enrolling in physics. It depends on the STEM-related subject the student plans to enrol in at the university.

The results of this study show that there are no appreciable differences between male and female students' enrollment in STEM subjects in SS I. For instance, the between male and female students' enrolment in physics and chemistry is 1.4% and 1.7%, respectively. In technical drawing, there is a 2.4% difference between male and female enrollment, whereas, in biology, there is a 2.3% difference. Male students benefit from the disparities in chemistry and

physics, while female students benefit from the differences in technical drawing and biology. In senior secondary school II, there is a gap that favours male pupils by 2.5% in chemistry and 1.2% in physics. In technical drawing, the gap favours female students by 0.6%, whereas in biology, it favours them by 1.8%. In senior secondary III, there is a 0.9% difference in enrollment between male and female students in chemistry, a 4.7% difference in physics, a 0.5% difference in technical drawing, and a 2.0% difference in biology. Male students benefit from differences in physics and biology in SS III, while female students benefit from disparities in chemistry and physics. These discrepancies show that male and female students' enrollment in all in-STEM subjects at each level (SS I to SS III) is no different. The irony is why more female students than male enrolled in chemistry in SS III compared to SS I and SS II. The fact that more male students than females are enrolled in biology in SS III is also surprising. The trend in secondary school enrollment in STEM topics is mirrored in the enrollment in SS I and SS II. The overall enrollment difference in chemistry is 1.3%, in physics it is 2.2%, in technical drawing it is 1.3%, and in biology, it is 0.9%. In chemistry and physics, the differences in overall enrollment favoured male students, whereas the inequalities in technical drawing and biology favoured female students.

The findings of this study showed that male students were more likely to enrol in STEM courses at tertiary institutions. Male and female enrollment in science courses differs by 20.10%; in technology courses, it differs by 5.2%; in engineering courses, it differs by 15.4%; and in mathematics, it differs by 3.9%. According to the report, STEM course enrollment in tertiary institutions in Taraba State differs significantly from that seen in secondary schools.

Gender parity in secondary education in Taraba State, Nigeria has not yet been attained, according to the study's findings. This finding conforms with the MDG Report (2015), which stated that gender parity was yet to be attained in Sub-Saharan Africa. The results of this study, which showed that there were more male students enrolled in SS I, SS II, and secondary school overall, support Makarova, Aeschlimann, and Herzog's (2019) assertion that physics and chemistry are more generally associated with men. Although this study only looked at STEM courses, its findings support the MDG Report's assertion that there is a significant gender gap in tertiary enrollment.

There are numerous consequences for these findings. The first is that Taraba State, Nigeria has been involved in SDG projects for seven years, but has yet to meet MDG 3 and Target 3 (eliminating gender disparity in primary and secondary education, ideally by 2005,

and at all educational levels, no later than 2015) in STEM-related subjects, in secondary schools, and in tertiary institutions. Thus, there is a real concern that SDG 5 may not be accomplished in STEM-related courses and disciplines in secondary schools and tertiary institutions. How will women develop the necessary abilities for utilising and managing science and technology if SDG 5 is not met in STEM topics in secondary schools and higher institutions?

CONCLUSION

This study serves as an example of the significant gender discrepancy in Taraba State's STEM education. Taraba State is located in Nigeria. Therefore, it is clear that there is still more work to be done to close the gaps. In the state (Taraba State, Nigeria), the female gender will be disadvantaged in the effort to achieve SDG 5 by 2030 if this issue is not addressed. With the advent of new technology, will also have an impact on how effectively women can contribute to Nigeria's growth. This information is timely, and all interested parties should put their hands on the deck to change the situation, notably the government, STEM educators, and other interested parties.

Previous research of this kind has only been able to provide baseline information on gender equity in general. However, this investigation has produced baseline data that will help Taraba State, Nigeria, mainstream gender in STEM education.

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