

INCREASING FEMALE PARTICIPATION IN STEM

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Abstract

The significance of women's involvement in STEM cannot be underestimated. The center of gravity for technological development and advancement is STEM education. The rise in female population may contribute to new scientific and technological research of theories and techniques that will result in a sustainable development. Women's effective participation in STEM has been hampered by several problems, such as low school enrollment, gender discrimination, cultural and religious prejudice. Scholarships were suggested to get girls interested in science from an early age, and it was suggested that textbook authors utilize both men and women to illustrate masculine occupations and that laws be passed to remove discrimination against women in some professions.

Keywords: science, technology, engineering, mathematics, female participation

Introduction

Science, Technology, Engineering and Mathematics (STEM) education is very relevant in the 21st century in Nigeria, for effective knowledge, skills and attitude that will make her develop her full capacities and solve everyday life problems. It helps individuals to live autonomous lives in a scientific technological world (A⁺2012). STEM education is the pivot on which technological advancement and development revolves. It is the bedrock for sustainable development, and this will always lead to positive changes manifested in increased capacity of people to have control over material asset, intellectual resources, and ideology. Also, it helps to obtain physical necessities of life like good clothing, shelter, employment, participation in government politics and economic independence (Igbuzor, 2006). STEM education is regarded as an aspect of education that prepare students for STEM related careers (Eurostat, 2022 & Zilberman, 2021).

Science is the basis of Technology, Engineering and Mathematics and a panacea for effective

living in modern age. Equality and the future development of societies are dependent on providing a high-quality science education (Ekine and Abayi 2013). It is the cornerstone of industrial development and the link between technology and socio-economic development. A country's ability to have good health, fight diseases, protect the environment, produce food for its people and develop new industries all depends on scientific knowledge and skills of its citizens. The world is changing with different challenges such as food scarcity, new strains of diseases, change in climate, advanced communication gadgets, weapons of war etc. Scientists, technologists, engineers, and technicians work on discoveries everyday through STEM education. In Nigeria, these challenges range from ill health, illiteracy, poor public utilities, inadequate educational facilities, hunger, unemployment, insecurity, poor information, and communication infrastructure and, corruption amongst others. As the world is fast becoming a global village, STEM Education is helping to solve these problems through interconnectivity in the area of medicine,

engineering, new innovations in agriculture, welfare, transportation, communication, commerce, industrialization processes and architectural development.

The Federal government of Nigeria recognized the importance of STEM Education since 2004 in its National Policy on Education and set the following goals for secondary school students:

- Students should cultivate inquiry, knowing and rational minds for the conduct of a good life.
- Produce scientists for national development.
- Service studies in technology and technology breakthrough.
- Provide knowledge and understanding of the complexity of the physical world.

According to the policy, STEM education will encourage the following goals:

- Enhancement of the country's image.
- Expansion of Nigeria's technological framework.
- Reduction of poverty at local community level.
- Creation of wealth and employment opportunities.
- Generation of appreciable income for themselves and not depend on government for white-collar jobs.

However, most secondary schools teach science and technology primarily through the study of material rather than through the application of scientific facts and theories that pupils have learned from their textbooks. All students, regardless of gender, should achieve acceptable levels of scientific literacy as part of an effective STEM education that involves students in hands-on scientific activities.

Women's access to education in Nigeria has received attention at the policy and enrollment levels, but not at the level of children's learning or women's participation in various disciplines of science and technology education. Not many people recognize the need of gender equity in science education. The problem of the gender gap in science and the importance of women's participation in STEM demand a rethinking and full execution of all potential avenues for women's full involvement.

Basic Education In Nigeria: An Overview

During the introduction of formal education in Nigeria by the colonial government in, girls were discouraged from attending school. It was considered wasteful for girls who would eventually be married off to become housewives. At most, the girl's education was terminated at the primary school level. Even when female try to enroll in secondary school; they were withdrawn by their parents for marriage. This was very common in the country, because of this trend, the government made efforts to increase the population of girls by offering them scholarship and brought up laws forbidding early marriage, also bursary for both male and female students in higher institution was introduced. Although there has been a lot of transition in the education sector since independence. Nigeria began with a 6-5-2-3 educational system, which consists of a 6-year primary education, a 5-year secondary education, a 2-year higher school diploma program, and a 3-year university program. Later, it was changed to the 6-3-3-4 system, which consists of 6 years of elementary education, 3 years of junior high school, 3 years of senior high school, and 4 years of university education. Additionally, the 9-3-4 system is currently in place to support STEM education and the science, technology, and innovation agenda (FRN 2012). This makes the lowest qualification to be junior secondary school with the practical teaching of science for the first 9 years starting from the primary for the new basic science curriculum used in Nigeria, primary and junior secondary consisting of human and environmental sustainability subjects such as Basic Science, Basic Technology, Computer Science, while the upper basic deals with taking challenges making informed decisions, develop survival strategies and learn to live effectively within the diverse community in the 21st century (Nigeria Education Research and Development Council). A lot of STEM Education has been introduced to science students in the upper Basic Secondary School such as Physics, Chemistry, Biology, Health Science, Further Mathematics, Electronics, Food Science and Nutrition, Building Construction, Technical Drawing, Woodwork, Auto Mechanics, with Vocation subjects like, Photography, Carpentry, Garment making, Dyeing and bleaching, Catering, Fishery, etc. This is to facilitate gender equality in the society

(Ekine, 2013) and to cater for dynamic global changes. STEM education provides strong platform for Science, Technology, Engineering, and Mathematics with attitudes needed for success in the 21st century work force. These behaviors include engagement, inquiry, logical reasoning, collaboration, communication, investigation, and creativity (A⁺ educators 2012). In addition, National policy on education (FRN, 2013) also emphasized 70:30 admission ratio of Science to Business courses in the tertiary institution and 60 to 80 percent admission into conventional and technology universities to STEM oriented disciplines.

Challenges Of Female Participation In Stem Education

The problem of females started from birth. A female child is seen as a disappointment in many Nigerian cultures and as such a girl is treated as a second-class citizen. The society set up did not give her the opportunity to experiment, which is a prerequisite to science rather she was kept indoor to do housework while the male child is left to move about exploring the environment. When she is later exposed to school, her science textbook is boy-dominated with pictorial pictures, Although the Nation's Policy on Education (FRN2014) specified that every Nigerian should have a right to equal educational opportunities irrespective of disability, gender difference, some teachers still prefer males in science and technology class and enrolment in STEM careers and this shows a lot of disparity with females being underrepresented (Abe 2012, Salman, Olaoye and Yahaya 2011). In addition, UNESCO (2009) has reported that at the primary school level, enrolment of boys and girls is almost equal except in the north-east and north-west zone. However, the population changes as the progression through the education ladder increases (Danjuma 2010). There is a wide disparity in the enrolment and academic achievement of boys and girls in some STEM area of specialization (Alade 2012). Female students tend to drift or be guided towards area of studies regarded as feminine and shy away from scientific and technological fields (Nnaka and Anaekwe 2006).

Causes Of Female Non-Participation In Stem Education

In 2015, United Nation adopted the 2030 agenda for sustainable development goals with a blueprint of 17 goals and 169 targets (UNESCO, 2015). To achieve those goals, there should be room for creation, application and diffusion of scientific and technological knowledge which is not utilized fully especially in the aspects of girls and women's participation in the development of the society (Ekine, 2013). Low female participation in STEM fields has made it difficult for them to access positions in these fields, which pay higher salaries than jobs in non-STEM fields (Crawford and Cribbs, 2013).

There are many factors preventing females from participating fully in STEM education. These include;

Curricular pedagogic practices in classroom:

This hinders the access and retention of girls in Science and Technical education (Fegbesan, 2010). Some profession like carpentry, engineering, woodwork, metal work, plumbing, Automobile engineering are regarded as profession for men while nursing, catering, sales, and advertisement are profession for women (Orji, 2001). This makes females to lose interest in the so-called male profession.

Religious and Cultural belief: This has affected the role of women in the society. The culture learned directly or indirectly determines how a person thinks, feels, directs her actions and outlooks in life. Vindero (2006) has said that difference in brain structure, hormone production and maturation rate may account for differential performance in school related activities.

School factors: Udeani (2012) identified factors like instructional materials, illustrations, examples, and applications presented in resource materials are more familiar to the experience of males than that of females. Textbook writers are bias, using only males to represent engineering and technology profession. This is discouraging to the female students.

Gender discrimination: This is another critical factor facing female ineffective participation in every field of science and technology. The discrimination results from combinations of inbuilt biases that make them less likely to participate in mathematical, critical, and technical profession. Some teachers prefer to call only male

students to answer questions in class thereby making female students indifferent toward in science and technology related professions.

Large family size and poverty: Poor parents with low education background will not be able to encourage their female children to devote time to study science, striving to solve problems and bringing about innovation (Fegbesan 2010). Also, they may not go beyond secondary school due to lack of fund to take care of other members of the family. They do not have female mentors and role models to follow (Henry, 2013).

Stereotype: This another social barrier that can influence individual positively or negatively and in evaluating performance stereotype threat is one of the compelling that has hindered girls and women and it is a major reason why females remain underrepresented in science and technology. According to Master & Meltzoff (2014), gender stereotypes contribute to students' interest and motivation in STEM, the underrepresentation of girls and women in the STEM field is visible in gender social representations that suggest how girls are not appropriate or less than boys for STEM education and employment. Other factors that contribute to underrepresentation of women in STEM include social life and environment, bias and discrimination, negative attitude towards STEM, less family-friendly flexibility in the STEM field, lack of female role models in their vicinity that can be a source of encouragement to them and girl's low self esteem amongst others.

The Way Forward

The curriculum for early years should emphasize Mathematics, Science and Technology and Mathematics, this will enable more girls to have interest in science and open doors of opportunity to study science and technology related courses. They should be reinforced with praises and encouragement. Females should be encouraged to pursue courses in Science and Technology by granting brilliant students' scholarship from junior secondary school level to tertiary institution level. Guidance and counseling should be continuously carried out at secondary and tertiary education levels to prepare girls for the hard work and be protected from sexual harassment at all levels of education. Availability of equipment and resources should be of great importance. When

there are resources while their study in terms of well-stocked library, fully equipped science laboratories, access to the internet and a supportive personnel women will be encouraged to venture into STEM related course. Empowerment of women should be encouraged such that there is provision of financial support for the women and regular counsel on the need to venture into STEM related courses.

Support from family and the teachers, these two categories of people play a vital role in ensuring female are well represented in STEM related courses and careers, they can ensure the girl child see herself as capable as the boy child, they should let the girl child knows that they can also perform excellently like their male counterparts. Boys should not be allowed to dominate classroom discussion and teachers' attention, but instead encourage the girls to work hard in STEM education. Enforcing strictly 60:40 ratio of science and technology-based discipline to Art and Commercial with more emphasis on female students to encourage them to enroll in the universities.

Initiating and supporting continuing education program for female students by successful female Scientists, Engineers, Technologists, Doctors, Pharmacists amongst others to encourage female participation in STEM education.

Conclusion

Education can be used to control the country's wellbeing, as economic and productivity rises, maternal and infant mortality rate fall, wealth, and educational prospects of the next generation of girls will improve. Females should not be limited to being passive users of science and technology but active participant of science and technology in decision making and science development programmes (Rathyeber, 2009). Women are more than half of the world's population; they have huge influence at the family and society level when educated in STEM. The economic growth will be improved by provision of food, water, good health, and poverty is reduced. Also, to improve female participation in STEM, there should be women friendly policies, gender equality at all levels, female recognition, gender friendly environment, availability of scholarship, safety and security of females and proper pay for them in any STEM career they are into.

Recommendations

The following recommendations were suggested: Girls should be encouraged to go to school from primary to tertiary institution especially in the northern part of the country and to study science and technology related courses; Government should incorporate gender equity into teacher education and enhance partnership to promote girls' participation in science. Awareness should be created on the importance and need to encourage the female gender to participate in STEM related courses/careers; More women lecturers, engineers and technologists should be employed to teach girls and pay more attention to their problems. Mentorship programs and supportive leadership seminars/workshops should be organized regularly to expose the girl child to STEM education right from the onset of their early school years; Government should continue to enlighten the society on change of attitude to gender role using successful females as role models in science technology areas. This will encourage females to follow their footsteps. Textbook writers should be encouraged to use both males and females' characters in their pictures and not always presenting engineering as masculine profession; Building STEM initiatives in Nigeria schools to encourage girls to participate. This includes career days, Science fair and quiz, television competition, science clubs, award, and scholarship by successful women in engineering, nursing, medicine, architecture, technology amongst others.

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