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Abstract

Science, Technology and Mathematics (STM) have been identified as the bed rock or foundation of wealth and consequently an imperative for national development. It has also been argued that in this era of globalization only persons with appreciable knowledge, skills and abilities in STM are required in the job market. Female gender discrimination is also said to be evident in the school system of many developing countries. This study was design to investigate the perception of undergraduates of Nigerian females' participation in STM. The study focused on subjects' awareness of the problem of under representation of females in STM, expected career choice for females, predisposing factors of females to STM education and strategies for change. Students in the university constituted the population for the study. Simple random sampling was used to select the subjects for the study. 438 subjects were selected from two universities in Benin City, Edo state of Nigeria. The instrument for data collection was a questionnaire having four sections to reflect the four areas of focus of the study. Data collected were analysed with the use of descriptive statistics. Based on the findings of the study recommendations were made for enhanced participation of Nigerian females in STM.

Key Words: National Development, Gender Discrimination, Science, Technology & Mathematics (STM).

Introduction

Mathematics is about the oldest subject in existence. It originated from man's quest for a language or means of counting, measuring and recording his possessions. It is a subject whose knowledge is useful in every aspect of life. This is why it occupies a significant position in the Nigerian school curriculum. It is a compulsory subject at the primary and secondary school levels, and a credit pass in ordinary level mathematics is required for admission to study the majority of the courses at the tertiary level. Today, mathematics has been generally accepted as

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the bedrock of science and technology, a language which scientists use to express scientific findings.

Audu (2005) stressed that "mathematics is the foundation for any meaningful scientific endeavour and any nation that must develop in science and technology must have a strong mathematical foundation for its youths" (p. 197). According to him, mathematics is frequently encountered in association and interaction with astronomy, physics, and other branches of natural sciences, and it also has deep-rooted affinities to the humanities. He concluded that mathematics is an indispensable medium by which and within which science expresses, formulates, continues and communicates itself.

Science, Technology and Mathematics (STM) can be seen as a cord of three strings which are interwoven and interdependent. Advances in one field result in/from development in the other. STM have been identified as the bedrock or foundation of wealth and consequently an imperative for national development. It has also been argued that in this era of globalization only persons with appreciable knowledge, skills and abilities in STM are required in the job market. Any country that has not embraced or made significant efforts to advance STM education is said to be on the wrong or negative side of the international digital divide.

Despite the relevance and utilitarian purpose of STM, it has been observed that participation of females in the field is low. Badekale (2003) reported that women in Africa are greatly underrepresented in science and technology related courses/occupations. In the same vein, the international conference organized by UNESCO in Bamako, Mali in July 2009 assessed the participation of girls and women in science and technology in Africa to be the lowest of all the regions of the world (Nnaka, 2009). Alutu and Eraikhuemen (2004) investigated the involvement of females in mathematics in south western Nigerian universities. The study shows that the ratio of male to female lecturers was approximately 16:1, and the ratio of males to females enrolled at the undergraduate levels was 2:1, while at the post graduate levels, the ratio of male to female on roll was 6:1.

Nwelih, Igene & Igene (2013) investigated gender studies in computing at the University of Benin. The results show that females are disadvantaged or less involved in the technical and logical aspects of computer use. They concluded "that something definitive has to be done to improve the statistics in computing in favour of females; else we risk having a population teeming with females inadequately prepared to face the future; a future in which computers, information and technology hold sway" (p. 177-178).

The work of Imogie & Eraikhuemen (2008) on sex differentiation in admission and academic performance at the University of Benin yielded similar findings. Their data analysis revealed wild gaps in favour of males in the enrolment and graduation figures of males and females. They opined that the observed gaps are basically a result of the society's perception of the roles of males and females, especially as it is generally believed that arts and education disciplines are for females, while engineering, medicine and social science disciplines are for males.

Gender disparity in enrolment into education physics as a course of study in the university has also been reported (Eraikhuemen & Eraikhuemen, 2010). This study shows that more males than females enrol into education physics.

This trend is worrisome. If females are not participating in STM, how can they contribute their quota to national development? Non participation in STM will eventually culminate in being a misfit for the job market and consequently in economic disempowerment. This must not

be. All hands must be on deck to develop and implement strategies to improve participation of females in STM.

Statement of Problem

STM has been identified as the foundation of wealth creation and an imperative for national development. Any person who wants to be relevant in this regard must be STM compliant. It has been established that the participation of females in STM, particularly in Africa (Nigeria inclusive), has been very low. Are undergraduates aware of this problem of under representation of females in STM? What are their expected career choices for females? In their opinion, what are the predisposing factors of females to STM education? What are the strategies for enhancing Nigerian females' participation in STM? These constitute the problem of this study.

Research Questions

This study is designed to provide answers to the following questions:

1. What percentage of subjects is aware of the problem of under representation of females in STM?
2. What are the expected career choices for females?
3. What are the factors predisposing females to STM?
4. What are the strategies for enhanced female participation in STM?

Method of the Study

This study adopted the survey research design. The data used for this study was generated by the use of a questionnaire adapted from Nnaka (2008).

The questionnaire had four sections and a total of 37 items: eight items on subjects' awareness of the problem of under representation of females in STM, eight items on expected career choice for females, 16 items on subjects' perception of predisposing factors of females to STM and a request for five strategies that can be used to enhance the participation of females in STM. The population for the study consisted of undergraduate students of two universities (one federal and one private).

A sample of 438 students was selected from 14 faculties of the two universities. The selection was across disciplines and levels. Data collected were analysed using descriptive statistics. The analysis of research question 1 made use of mean and percentages, and research questions 2 and 3 were analysed using item by item analyses, while qualitative data analysis was done for research question 4.

Results and Discussion

The research questions were analysed one after the other as follows:

Research Question 1: What percentage of subjects is aware of the problem of under representation of females in STM?

Table 1: Subjects' Awareness of the Problem

Score on the scale	No of responses	Percentage
4 and Above	157	35.84
Below 4	281	64.16
Total	438	100

Table 1 above shows subjects' awareness of the problem of under representation of females in STM. The scale that measured awareness had eight items with three response options, agree (A), not sure (NS) and disagree (D). The response options had assigned scores of 1, 0, -1 for positively worded items and -1, 0, 1 for negatively worded items. The maximum possible score in the scale is 8. 4, being the midpoint of the scale, is taken as the minimum acceptable score for perceived awareness. As shown in table 1, one can say in response to research question 1 that only about 36% of the subjects are aware of the problem of under representation of females in STM.

Research Question 2: What are the expected career choices for females?

Table 2: Expected Career for Females

S/No	Statements	Responses (%)		
		A	NS	D
1	Females should go into STM career.	84.0	9.8	6.2
2	Females should go into career outside STM.	36	32.2	30.8
3.	Females should be stopped from having anything to do with STM.	6.2	5.5	8.4
4.	Females should be encouraged to pursue their choice of career whether or not in STM.	90.6	4.6	4.8
5.	Females should be encouraged to pursue career in the fields of Arts and Humanities.	58.2	19.2	22.6
6	Females should be encouraged to pursue career in Home Management/Family life.	61.6	14.6	23.7
7	Females should withdraw from all STM training programmes.	3.7	5.9	90.4
8	It is better for females not to be involved in any career.	3.7	3.9	92.5

Table 2 shows subjects' expected career choice for females. There is 84% agreement among subjects that females should go into STM career, females should be encouraged to pursue their choice of career whether or not in STM (90.6%), females should be encouraged to pursue career in the fields of Art and Humanities (58.2%) and in Home Management/Family life (61.6%). In response to research question 2, one can say that the most popular opinion is that females should be encouraged to pursue their choice of career whether or not in STM.

Research Question 3: What are the factors predisposing females to STM?

Table 3: Predisposing Factors of Females to STM Education

Statements		Responses (%)		
		A	NS	D
1	Females possess low intellect and cannot grasp abstract Science concepts as we have in STM.	19.2	9.36	71.5
2	They lack creative abilities and original thinking.	15.9	8.5	75.6
3.	Females avoid competition with males.	18.7	18.7	62.6
4.	Socialization of girls from childhood leads them to develop personality traits (e.g. dependence) which do not go with STM females.	26.0	41.5	32.4
5.	Socializing females into accepting subjects and jobs said to be "fit for females" is bad for STM.	29.7	30.4	39.9
6.	School experiences give Science, Technology and Mathematics masculine image.	39.3	23.5	53.2
7.	Females are deliberately counselled out of STM Jobs.	29.9	24.2	43.6
8.	Females normally have reduced marriage opportunities if they go for STM careers.	38.1	19.4	42.5
9.	Females see no relevance of Science, Technology and Mathematics.	19.2	17.8	63.0
10.	Females go along with societal values and expectations in all their endeavours.	33.3	41.6	25.1
11.	There are not many female role models to influence girls' choice of careers in STM.	46.8	22.2	31.1
12.	Females in Science, Technology and Mathematics usually experience prejudices and antagonisms from male colleagues and subordinates.	36.8	27.6	35.6
13.	Females are not favourably considered when it comes to employment.	27.6	26.3	46.1
14.	Females do not like long periods of training which characterize most STM jobs.	33.1	32.6	34.3
15.	Females are afraid of coping with the demands of STM career as married women and mothers.	34.3	23.3	43.2
16.	Religious beliefs and practices about women affect female aspirations and ambitions.	25.6	17.8	56.6

Table 3 shows subjects' perceived factors predisposing females to STM. One significant outcome is the fact that the subjects are of the view that there are not many female role models to influence girls' choice of careers in STM (47%).

Research Question 4: What are the strategies for enhancing female participation in STM?

Qualitative Analysis of Data

The content analysis of the information generated through section D of the research instrument is presented under seven themes.

Theme 1: Strategies for improvement to be adopted by women scientists

1. Females should be encouraged to study STM courses through awareness programmes, role modelling in primary and secondary schools, science projects and competitions.
2. Rewards or incentives should be given to females studying STM Courses in tertiary institutions.
3. Females should not be stereotyped into certain courses. Females should be made to understand that anybody can read any course, whether male or female.
4. Women scientists should encourage younger females to enrol into STM courses or careers.

Theme 2: Strategies for improvement to be adopted by government

1. Female graduates of STM should not be discriminated against in employment, equal opportunities should be given to both sexes, and government should enact laws to sanction any establishment or persons that reject females in STM in their recruitment exercise.
2. Government should provide the necessary books, infrastructures and facilities for the studying of STM subjects or courses at the different levels of education.
3. Free education for females in the field of STM and automatic employment at graduation should be put in place by government.
4. The societal impression that STM is for males should be erased, and there should be public enlightenment and change of attitude.
5. Research grants should be given to female scientists to motivate younger females studying STM courses.
6. Scrap all religious or cultural beliefs that negate females studying STM courses.
7. Give awards to female students who excel in STM.

Theme 3: Strategies for improvement to be adopted by science based associations

1. Rewards or incentives should be given to females studying STM courses.
2. The saying that women's education ends in the kitchen should be campaigned against strongly.
3. Females should not be stereotyped into certain courses. Females should be made to understand that anybody can read any course, whether male or female. Science based associations should be in the forefront of this campaign.
4. Research grants for females scientists to motivate younger females studying STM courses.
5. Give awards to female students who excel in STM.

Theme 4: Strategies for improvement to be adopted by primary and secondary school science teachers

1. Teachers in primary and secondary schools should encourage healthy competition between males and females in STM subjects.
2. Females should not be stereotyped into certain courses. Females should be made to understand that anybody can read any course, whether male or female.
3. Mathematics and science teachers should make their subjects interesting to learn.

Theme 5: Strategies for improvement to be adopted by parents

1. Parents should not hinder but encourage their females to study STM careers.
2. Mothers should encourage their daughters from childhood to study STM courses. They should be nurtured from childhood on how to cope with the demands of STM disciplines.

Theme 6: Strategies for improvement to be adopted by females

1. Females intending to go into STM should encourage themselves to disregard what people will say against their career. They should be focused and determined.

Theme 7: Strategies for improvement to be adopted by males

1. Males should not refuse to marry females who are in the field of STM, like female nurses, doctors, engineers, mathematicians, et cetera.

Conclusion and Recommendations

It has been established that there is low female representation in the field of science, technology and mathematics. This study revealed that only about 36% of the research subjects are aware of this problem. This study also revealed that a major factor predisposing females to STM is that there are not many female role models to influence girls' choice of careers in STM. But there is a popular opinion that females should be encouraged to pursue their choice of career whether or not in STM.

A careful analysis of these findings points to the fact that concrete steps need to be taken by stakeholders to change the status quo. There is a need to develop and implement strategies that will result in desirable level of participation of females in STM. Based on the findings and conclusions reached in this study, the following recommendations are made.

1. Females should be encouraged into STM through awareness campaign, role modelling and mathematics and science competitions.
2. Rewards and incentives should be given to females in the field of STM.
3. All forms of discrimination against females in STM should stop.
4. The necessary facilities and infrastructures for the study of STM subjects/courses should be provided at the different levels of education.
5. Mathematics and science teachers should make their subject interesting to learn, and they should encourage healthy competition between males and females in STM subjects/courses.
6. Parents should socialize their daughters in such a way that they will opt for STM courses/careers.

7. Males should not refuse to marry females who are in the field of STM.
8. Females in the field or intending to go into the field of STM must encourage themselves to disregard what people will say against their career. They should be focused and determined.

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