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Early-Career Women Scientists' Perception of the Challenges of Gender Inequality and Retention in Science and Technology

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Abstract: ***Two important gender issues in science, technology and mathematics (STM) education are issues of participation and retention of girls/early-career women scientists in science and science-based careers. Studies show that women are under-represented in all occupations dealing with STEM all over the world. This study therefore aims at finding out the early career women scientists' perception of the factors affecting girls/women participation in Science and Technology as well as determine the strategies they think could be adopted to increase their participation and retention in those areas. Two research questions guided the conduct of the study. A sample of 220 early-career female scientists from four universities in the South East Nigeria participated in the survey. A 17-item questionnaire was used to collect data from the respondents. The data were analyzed using mean and standard deviation. Prominent among the factors affecting female participation and retention in science-based careers are perceived difficult nature of science and technology courses and lack of interest in science and technology careers. The strategies to improve the situation include among others that successful women in the field should be made feasible to the young ones and interact with them, female scientist students should be exposed to the benefits of science careers early enough, teachers should avoid criticisms/comments that could deter girls. The study concludes that some of the challenges could be eliminated if the successful female scientists and technologists could serve as role models to the young ones by making themselves feasible to them and interact with them.***

Keywords: Early-career women scientists, gender inequality, retention

1. Introduction

Science is the bedrock of technology and technology promotes growth and development of a nation. It is in acknowledgement of this fact that the national policy on science and technology in Nigeria recognizes an encompassing need for massive basic education in science as well as a massive integration and popularization of science and technology (S&T) for growth and development (Uzoka, 2008). Thus, Basic education in science is meant to be given to all irrespective of gender.

Studies (Duyilemi, 2000; Njoku & Okeke, 2003) revealed that girls' enrollment, participation, achievement and retention in science, technology, engineering and mathematics (STEM) education is still very low and lags behind those of the boys. This is further supported by Schwedes (2001) in Uzoka (2008) who observed that empirical researches show that women are underrepresented in all occupations dealing with science, technology, engineering and mathematics (STEM) all over the world.

The awakening interest and concern to have women participate fully and achieve creditably in science and technology is a global issue. For instance, Elan (2012) maintained that the presence of women in the fields of science, technology and innovation remains significantly lower than for men, even in some of the world's wealthiest regions. However, Uzoka (2008) is of the opinion that in highly industrialized countries where tradition and customs hold less sway on the people, the problem of inadequate number of women in science and technology may be much less and the reverse seems to be the case in most developing countries of which Nigeria is one. Whatever is the case, it is still certain that gender inequality in science and technology is still a global issue which needs to be tackled.

Okebukola (2003) in Okoye and Onwuachu (2013) revealed that women consist of at least 50% of the Nigerian population but only 11% of women are in engineering and technology professions. Okoye and Onwuachu therefore argued that if science and technology are vital tools to national development, then there is need for more girls and women to be involved in science and technology education as this will greatly enhance national development.

2. Literature Survey

Much interest and effort has been geared towards adopting strategies that will promote and sustain girls/women's interest in science and technology. Government and non-governmental agencies/bodies have been making serious efforts to promote education of these girls in STEM. For instance, Galadima (2008) outlined some efforts made worldwide in a bid to promote girls/women participation in STEM. These include:

Girls Start: aimed at empowering girls to excel in mathematics science and technology. This programme engages, educates, and motivates girls to achieve the knowledge and confidence to participate in advance mathematics and science classes and future careers.

Operation SMART: (Science Mathematics and Relevant Technology) aimed at training girls between the ages of 6-18

to become engineers, auto-mechanics, micro surgeons and astronauts.

Techbridge: This is an after school programme aimed at encouraging girls to acquire skills and confidence in technology and addressing girls' needs and interests.

Sally Ride Science Club: Founded by the first American woman in space. It is aimed at providing support for girls who are, or might become interested in Science, Mathematics and Technology. This is a challenge to our women scientists, mathematicians, engineers, educationists etc.

Girls at the Centre: Aimed at encouraging family involvement in girls' science learning, women in technology – aimed at encouraging girls to stay and be interested in mathematics and science, so that they can pursue technology career options down the road.

Similarly in Nigeria, many gender-based organizations have also contributed so much in promoting girls/women participation in STM education and career. Uzoka (2008) mentioned some of these associations to include Nigeria Association of Women Scientists (NAWAS), Nigeria Association of Women in Science, Technology and Mathematics (NAWSTEM), Women in Colleges of Education (WICE), Forum for African Women Educationalists Nigeria (FAWEN). These organize conferences, seminars, workshops and make publications with the aim of addressing the problems of gender inequality in STM education. Uzoka also mentioned some professional associations like science teachers association of Nigeria (STAN), Nigeria Association of Technology Teachers (NATT), Chemical Society of Nigeria (CSN), Science Association of Nigeria (SAN) and the Mathematics Association of Nigeria (MAN). These Uzoka said have been making meaningful contributions in curriculum diversification in favour of girls and women. They also organize workshops and seminars for girls and women in order to improve their participation in STM.

3. Problem Definition

Despite all the efforts to give women greater access to education in science and technology in some countries, their retention in science-based careers still remains a challenge. This calls for more investigation into the factors that affect women's retention in these areas. Getting the information from the young career female scientists themselves might help to throw more light into the problems they encounter, so that appropriate solution can be proffered. It is against this background that this study sought to find out the views of early-career women scientists on the challenges of gender inequality and retention in science-based careers and strategies they think could be adopted to increase their participation in such careers.

Two research questions were posed to guide the conduct of the research.

1) What factors deter girls/women from participation and continued stay in science and science-related careers?
2) What strategies could be adopted to improve the girls/women participation and retention in science and science careers?

4. Method

The study was a survey involving 320 early-career female scientists from four universities in south east Nigeria. The female scientists were randomly sampled from selected Science and Mathematics departments in the universities used. They consist of graduate assistants and assistant lecturers with 1-3 years of working experience. A researcher-constructed seventeen-item questionnaire was used to collect information on factors that deter early-career women scientists from continued stay on their jobs and strategies to improve their retention in those careers. Data collected were analysed using mean and standard deviation.

5. Results and Discussion

Research Question One

What are the factors affecting female participation and retention in science and science-related careers?

Table 1: Mean Responses on Factors Affecting Female Participation and Retention in Science and Science-related Careers

S/NO	ITEMS	N	Mean	Std Dev.
1.	Perceived difficult nature of science and technology courses	120	3.71	1.18
2.	Attitude of teachers and guidance and counselors discourage girls from studying science and technology	120	2.82	1.35
3.	Paucity of female scientists in top positions discourages the young ones from aspiring higher	120	2.91	1.32
4.	Science and technology professions are not very lucrative	120	1.81	1.02
5.	Young career scientists may leave the job for fear of not getting married due to society bias	120	2.23	1.21
6.	STEM careers hardly give the females time to take care of their families	120	2.98	1.20
7.	Young career scientists are discouraged by their husbands from continuing with their job for fear that they may become arrogant	120	2.68	1.23
8.	Lack of interest in science and technology careers	120	3.48	1.20
9.	Lack of incentive on the job e.g. Hazard allowance, science allowance	120	3.15	1.35
10.	The early career scientists lack the competence and skill to continue in their profession	120	2.57	1.29
11.	Women who opt for STEM careers are viewed by the society as having male characteristics and so may not make good wives	120	2.22	1.04
12.	STEM careers are dominated by men and the few females are often intimidated and sexually harassed by their male colleagues.	120	2.51	1.23

Other Factors Identified by Respondents as Affecting Female Participation and Retention in Science and Science-related Career

Respondents were asked to identify other factors they think affect female participation and retention in science and science-related careers. Excerpts from their responses are shown in table 2.

Table 2: Analysis of Respondents Comments on Factors Affecting Female Participation and Retention in Science and Science-related Careers

S/NO	Excerpts from Respondents' Comments	N	%
1.	Girls have more domestic responsibilities than boys and therefore less time to study	1	7.7
2.	Most of the public schools are not well equipped with laboratory instruments and other materials that are used for practical	3	23.1
3.	Delay in getting jobs	2	15.4
4.	Young female scientists are sexually harassed by the top officials during recruitment with promise of offering them a job and this tends to discourage young female from their pursuit	1	7.7
5.	Most females believe or think that science is exclusive for males, so they are afraid of challenging the males	4	30.8
6.	Females are not exposed to the benefits of science careers at a tender age	1	7.7
7.	Discouragement from peers who put fear on others that science subject is very difficult	1	7.7
	Total	**13**	**100**

Research Question Two

What strategies can be used to foster female participation and retention in science and science-related careers?

Table 3: Mean Responses on Ways of Fostering Female Participation and Retention in Science and Science-related Careers

S/No	Items	N	Mean	Std Dev.
1.	Teachers should avoid criticisms which could affect girls' self image of perception of their capabilities to learn science	120	4.39	.81
2.	Teachers should adopt teaching methods that encourage collaboration among students than competitive individualized learning which are said not to favour girls	120	4.17	1.07
3.	Science and technology textbooks should be devoid of gender stereotyping	120	4.19	.89
4.	Governments should form projects that are aimed at promoting female participation	120	4.35	.75
5.	Government should organize vocational remedial courses for girls offering science and technology subjects	120	4.16	.94
6.	Science and technology career women should be adequately remunerated to boost their moral and increase their level of commitment and aspirations	120	4.29	.74
7.	Successful women in the field of science and technology should always interact with the younger ones so that they will aspire to be like them	120	4.48	.78
8.	Young female scientists should be exposed to the benefits of taking a bold step into science careers early enough	120	4.53	.63
9.	Achievements of successful female scientists should be highlighted in science textual materials at all levels	120	4.41	.73
10.	Successful women in the field of science and technology should be made feasible so that young girls can look up to them as role models	120	4.53	.72
11.	Provision of day-care centers to help young scientists who are nursing mothers ease off pressure	120	4.20	.93
12.	Periodic revision of curriculum materials from gender perspective	120	4.34	.65
13.	Making parents and young female scientists aware of opportunities that exist for work in science and technology-related careers	120	4.36	.62

Other Strategies Suggested for Fostering Female Participation and Retention in Science and Science-Related Careers

Table 4 shows the analysis of the suggestions made by respondents on the ways of improving female participation and retention in science and science-related careers

Table 4: Analysis of Respondents' Suggestions on Ways to Improve Female Participation and Retention in Science and Science-related Careers

S/No	Excerpts of Respondents' Suggestions	N	%
1.	Girls should be made to believe in themselves by the teachers and by the use of mass media.	9	37.5
2.	Girls should be encouraged to compete with the males in science matters, using words like: "Science is easy, you can do it".	1	4.2
3.	Prizes and awards or scholarships positions should be provided for women in science, these will encourage other girls.	2	8.3
4.	Considering more females for employment in science-based jobs	3	12.5
5.	Successful ones in the field of science can start early to advice the young	2	8.3
6.	Government should employ enough science teachers to carry on the learning	1	4.2
7.	Guidance counselors should start from junior secondary schools to tell the girls about how good and simple the science subjects are so that they will start early to develop interest in those areas	2	8.3
8.	Science competition should be organized yearly to encourage females and also inspire them on the need of becoming a good and well established scientist in the world	1	4.2
9.	Ensuring that female students' participate fully in the practical exercise	1	4.2
10.	Government recognition of female efforts in the career	1	4.2
11.	The stereotype about men dominance in science and technologically-related courses should be removed by prospective female science students	1	4.2
	Total	**24**	**100**

6. Discussion

Prominent among the factors that affect female participation and retention in science and science-based careers are the perceived difficult nature of science, lack of interest in science and technology, lack of incentive on the job as well as paucity of female scientists in top positions in science and technology careers (Table 1). These findings are in line with Duyilemi (2000) who had earlier affirmed that when females undertake careers in science, it is mainly in biology,

medicine and nursing but seldom in areas of engineering, physics and mathematics. In addition, the respondents also felt that lack of well equipped laboratory facilities in most secondary schools and the females' belief that science and technology are exclusive for the males are some of the factors that deter them from getting into science career (Table 2).

With regards to the strategies to enhance female participation and retention in science and science-based careers (Table 3), the participants believe that exposing them to the benefits of venturing into science early in their life will be of much help. Secondly, women who have made it in the field of science and technology should always make themselves available to the young females and create opportunities to interact with them. By so doing, the young ones will see them as role models and aspire to be like them. This is in line with Udeani (2012) in which female scientists indicated that their choice of career was influenced by their interaction with their parents, siblings, relatives and family friends who were female scientists. Other major suggestions made by the participants (Table 4) are that girls should be made to believe in themselves and encouraged to favourably compete with their male counterparts in science areas both by their teachers and through mass media. This agrees with Nasrin and Iftekhar (2014) who sated that teachers stand as role models for their students and as such should avoid criticisms that could affect girls' self-image or perception of their capabilities to learn science. The respondents in this study are also of the opinion that for employment in science-based jobs, girls should be given priority so as to increase their participation and give them opportunity to contribute their quota in nation building.

7. Conclusion

There are a lot of challenges to women participation and retention in science and science-based careers. Some of these include their perceived difficult nature of science and technology courses resulting to lack of interest in science and technology careers. These challenges can be eliminated if few successful female scientists and technologists make them-selves feasible to the young girls, interact with them and serve as role models. Increase in the number of the female scientists will no doubt, help to challenge gender stereotyping and create opportunities for their talents and expertise to be tapped in the interest of national development.

Science and technology are vital tools to national development. It is therefore necessary for more women scientists to take up science careers in order to increase their chances of contributing their quota to national sustainable development. They need all possible encouragement especially from the successful women career scientists who should interact with them and pass down the good legacy of hard work and love for science to them.

8. Future Scope

1) There is need to replicate this study in other parts of the country other than South-east Nigeria.
2) It might be of interest to carry out a similar study using Art-based career women to find out why they were not interested in science.

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