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PREVALENCE AND CAUSES OF GENDER IMBALANCE IN SCIENCE EDUCATION IN UNIVERSITIES IN ANAMBRA STATE, NIGERIA

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Abstract:
The study set out to ascertain the prevalence of gender imbalance in science education in universities in Anambra State. It adopted a descriptive survey. The population is made up of 700 male and 350 female students of science education from Universities in the study area. Simple random sampling technique was used in selecting 100 male and 100 female students. Thus, 200 respondents participated in the study. Two research questions and two null hypotheses guided the study. The instrument for data collection was a researcher developed questionnaire titled "Prevalence of Gender Imbalance in Science Education (PGISE)". The validity of the instrument was established by three experts: one in Measurement and Evaluation and the two experts in Science education, both in Chukwuemeka Odumegwu Ojukwu University, Anambra State. The instrument was trial tested and data obtained was used to determine the internal consistency reliability using Cronbach Alpha statistical method. A reliability index of 0.79 was obtained. Mean and standard deviation were used to answer the research questions while the null hypothesis was tested at .05 level of significance using t-test statistics. The findings revealed the causes of gender imbalance in science education in universities in Anambra State to include among others rigid sex-role stereotyping in science education curricular; masculine image of science education; cultural practices and scientific illiteracy among women. It also revealed among others that sex-role stereotyping in science curricula reduces female interest in leadership roles in science career and that rigid sex-role stereotyping reduces female participation in science curricular activities. It was recommended based on the findings that teachers should make their classrooms gender sensitive so as to reduce the prevalence of sex-role stereotyping in Nigerian universities.

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Keywords: gender, gender imbalance, science, science education, prevalence, cultural practices

1. Introduction

Education is the process of human learning by which knowledge is imparted, facilitated, trained and skills developed. It is a process of re-molding or re-arranging human experience; and learning that adds to previous experience, influencing the acquisition of future learning. It is the tool used to deliver entrepreneurship in educational institutions for national development (Obijiofor & Obiadazie, 2015). However, Onwuka (1981) pointed out that the functions of education are to change an individual in some desirable ways such as enabling them to perform skills which otherwise they would not perform; add to the knowledge they possess; develop certain understanding inside; and learn appreciation. Education serves the society in various ways which includes preserving, rediscovering, and transmitting knowledge. The entire benefits of education can only be enjoyed by any society when their members irrespective of the gender are encouraged to embrace education.

The nature of the concept of gender in any society determines the existence and ways of life of the members in the society. In order to achieve sustainable education therefore, there is need for both formal and informal education setting to appraise the causes of gender imbalance and address the issues that prevent either of the parties from being at their peak in the development race. Gender according to Okeke (2002) refers to many socially and/or culturally constructed characteristics, qualities, behaviours and roles which different societies ascribe to females and males. Prevalence according to Merriam-Webster's Unabridged Dictionary (2002) means the fact or condition of being prevalent; commonness, currency, widespread presence, universality, etc. It is the fact of something existing or happening often. It is the proportion of a population who have a specific characteristic in a given time period. Determining the prevalence of gender imbalance in science education is necessary to ensure sustainable development of students. Ogunjuyigbe, Ojofeitimi and Akinlo (2006), for instance, observed differences between enrolment of males and females in all levels of education in Nigeria. In addition, the drop-out rate of girls is higher than boys and participation in Science Technology Engineering, and Mathematics (STEM) classes are lower for girls than boys. Ojo (2002) found that the combined enrolment for primary, secondary and tertiary schools for females was 57% compared to 71% for males meaning that there are fewer women in certain economic fields as well. More so, Central Bank of Nigeria (CBN, 2000) noted that the gender gap in literacy rates at the rural level between boys and girls was 18.3% in favour of the boys overall and 3.9% in favour of boys in the age groups 6 – 9 years (primary school) indicating also a gender dimension to educational attainment and development in Nigeria. Furthermore, UNESCO in Morales, Avilla & Espinosa (2016) reported that in many countries, boys are more active, participative in classroom interactions and get more attention while girls in majority of the countries are better in literary skills than boys. Often times, more

men study and work in science fields than women, for instance, UNESCO reported in 2015 that only 28.4% of the workforce in STEM are women; others consist mainly of men. European Commission Ethics and Gender (2012) also noted that in other fields such as the humanities and education, employees are predominantly women. In the UK, women earn an average of 18% less than men. Science education helps students to achieve scientific literacy and also promotes the well-being and economic development of any nation. Agommuoh and Ndirika (2017) in support of this assertion stated that a country that educates its citizens (women as well as men) is bound to have great increase in its economic productivity, low maternal and infant mortality and improvement in health and educational sectors. There is need to enhance science education at all levels of education (primary, secondary and tertiary) because the output of both gender is required in the sustainable development of the nation to avoid partial use of the resources available. Science and technology education emphasized a purposeful study of science and its application to the social and economic life of the nation (Gbamanja, 1999) and thus has to be embraced by every citizen. There is need to ascertain the prevalence as well as the causes of gender imbalance in science education in universities in Anambra State to ensure sustainable education.

Exposing women in the field of science education to become experts or role models in science discipline according to Stout, Ito, Finkelstein & Pollock (2013) will positively influence their professional development. This also implies that the emergence of female professors in the classrooms will show clear benefits for female students. UNESCO (2010) stated that enabling policy environment and many initiatives have been implemented to promote women and girl's education in STEM subjects/discipline; yet, a number of social-cultural and institutional barriers has continued to prevent girls and young women from attending schools and universities; and also, from performing equally to their male counterparts. Nevertheless, parents' expectations of their daughters during childhood and adolescent, and masculine stereotypes make girls run away from STEM subjects. Moreover, most organizations have low skilled workers in ICT especially among girls and women showing that women are under-represented in most information technology (IT) career (Gurer 2002).
Gender equality in science education is necessary in fighting inequality everywhere. Although many women including men are being admitted in the universities today, fewer women still get selected in science-oriented courses like engineering and mathematics due to their inability to excel in STEM subjects (Agommuoh &Ndirika, 2017). With these indications, it is obvious that females in tertiary institutions have more flair for Arts and Education courses than science and engineering courses. Background initiation into what the society expected from females play hidden role in the choice of programme they make at the university level. Some hidden facts often times discourage females from science-oriented courses. Examples of them include questions like 'In which kind of establishment will I work?'; 'How can I combine my job and home demands?' and 'Which employer is ready to take female in a male dominated area in the establishment? This showed that the societal dogma of male preference actually made most female students to feel they are not capable or good enough in

science related career. Some researchers (Okeke,1996 & Enem, 2008) are pointing at some factors as the cause of gender imbalance in science education in universities.

However, Obiadazie and Obi (2015) opined that the impact of cultural prejudices, degradation and marginalization against women could be overcome through science education. In spite of the importance and popularity of science subjects among Nigerian students, there is still gender imbalance in science education. The desire to determine the prevalence and causes of gender imbalance in science education in universities in Anambra state is the focus of this research. With the current deterioration in students learning outcome in science subjects resulting in high rate of failure (Udoh, Ado & Udo, 2017), it is important to adopt science and technology as the bedrock of national development and so identify the causes of gender imbalance in science education for sustainable education. It is against this background that this study sought to determine the prevalence and causes of gender imbalance in science education in universities in Anambra State.

2. Objectives of the Study

Specifically this study is guided by the following objectives;

1) To examine the extent of prevalence of gender imbalance in the study of science education amongst university students in Anambra State
2) To determine the causes of gender imbalance in science education amongst university students in Anambra State

2.1 Research Question

1) To what extent is the prevalence of gender imbalance in the study of science education in universities in Anambra State?
2) What are the causes of gender imbalance in science education in universities in Anambra State?

2.2 Research Hypothesis

The following null hypothesis was tested at 0.05 level of significance

1) There is no significant difference between the mean–scores of male and female students with regards to the prevalence of gender imbalance in the study of science education in universities in Anambra State?
2) There is no significant difference between the mean–scores of male and female students with regards to the causes of gender imbalance in science education in universities in Anambra State?

3. Methodology

The study adopted a descriptive survey research design which sought information from respondents on the prevalence and causes of gender imbalance in science education in universities in Anambra State. The population was made up of 700 males and 350

female science education students from universities in Anambra State. Simple random sampling was used to select 100 males and 100 females from the population. A total of 200 students participated in the study. The instrument for data collection was a questionnaire developed by the researcher. The questionnaire was tagged "Prevalence and Causes of Gender Imbalance in University Science Education". The instrument has two Parts (1&2). Part 1 sought information on the demography of the respondents whereas Part 2 was on the issue of the study. Part 2 had two Sections (A&B). Section A sought information on the prevalence of gender imbalance in the study of science education in universities while section B sought information on the causes of gender imbalance in science education in universities in Anambra State. The structured pattern adopted was a four-point Likert-type scale of Strongly Agree (SA), Agree (A), Disagree (DA), and Strongly Disagree (SD). The responses were weighted as SA - 4; A - 3; DA - 2; SD - 1. The face validation of the instrument was established by three experts, one in Measurement and Evaluation and the two experts in Science Education all from Chukwuemeka Odumegwu Ojukwu University, Anambra State. Their comments and suggestions were included in the final draft of the instrument. The instrument was trial tested and the data obtained was used to determine the internal consistency reliability of the instrument using the Cronbach Alpha statistical method. A reliability index of 0.79 was obtained. The questionnaire was administered to the respondents and retrieved through the help of two research assistants. All the 200 questionnaires were returned. Mean and standard deviation were used to answer the research questions while t-test statistics was used to test the hypothesis at .05 level of significance. A mean of 2.50 and above indicated acceptance to the items in the questionnaire while a mean of 2.49 and below indicated non-acceptance to the items.

4. Results

Research Question 1: What is the prevalence of gender imbalance in the study of science education in universities in Anmabra State?

Table 1 revealed the mean ratings of items 1, 2, 3, 5, 6, 8, 7, 9, 10, 11, 12, 13, 16, 18 and 19 as the prevalence of gender imbalance in the study of science education in universities. They have mean above the interion mean of 2.50. However, items 4, 14, 15, 17 and 20 have mean scores below the interion mean of 2.50. These items were therefore not accepted as the prevalence of gender imbalance in the study of science education in universities in Anambra State.

Table 1: Mean and Standard Deviation Responses of the Respondents on the Prevalence of Gender Imbalance in the Study of Science Education in Universities in Anambra State

S/N	Item Description	Male		Decision	Female		Decision
		X	SD		X	SD	
1	Visuals in science education instructional materials	2.70	0.67	Accepted	3.08	0.70	Accepted
2	Language used in representing science resources	3.10	0.66	Accepted	2.94	0.83	Accepted
3	Online science education resources	3.05	0.65	Accepted	2.90	0.70	Accepted
4	Computer programs used in science education	2.07	0.70	Not accepted	2.30	0.65	Not accepted
5	Activities in science education resources	3.00	1.00	Accepted	2.77	0.80	Accepted
6	People used in science instructional resources	2.88	0.89	Accepted	3.20	0.73	Accepted
7	Context used in presenting science course contents	2.70	0.76	Accepted	2.72	0.64	Accepted
8	Teacher's attitudes towards learners	3.11	0.90	Accepted	2.80	0.77	Accepted
9	Assessment methods used in science education	3.27	0.66	Accepted	3.11	0.60	Accepted
10	Teaching methods used in science education	2.66	0.71	Accepted	2.76	0.70	Accepted
11	Roles students play in science teaching resources	3.31	0.60	Accepted	2.90	0.69	Accepted
12	Reading and writing done in science classroom	2.65	0.65	Accepted	2.79	0.80	Accepted
13	Classroom policies used in science education	3.25	0.70	Accepted	3.01	0.65	Accepted
14	Acclamations given to students in class exercises	2.15	0.99	Not accepted	2.29	0.84	Not accepted
15	Questions asked to students during class discussions	2.37	0.79	Not accepted	2.20	0.66	Not accepted
16	Groupings made during cooperative learning	3.48	0.65	Accepted	3.50	0.72	Accepted
17	Attentions and values given to teachers	2.43	0.81	Not accepted	2.36	0.88	Not accepted
18	Help and guidance given to students in the class	2.69	0.59	Accepted	2.78	0.71	Accepted
19	Access to science equipment granted to students	2.77	0.74	Accepted	2.69	0.63	Accepted
20	Theories and perspectives in science course content	2.33	0.68	Not accepted	2.44	0.70	Not accepted

Research Question 2: What are the causes of gender imbalance in science education in universities in Anambra State?

Table 2 revealed the mean ratings of items 1 – 13 as the main causes of gender imbalance in science education in universities in Anambra State. They have mean above the interion mean of 2.50. However, item 14 has mean score below the interion mean of 2.50. This item was therefore not accepted as one of the causes of gender imbalance in science education.

Table 2: Mean and Standard Deviation Responses of the Respondents on the Causes of Gender Imbalance in Science Education in Universities in Anambra State

S/N	Item Description	Male			Female		
		X	SD	Decision	X	SD	Decision
1	Sex-role stereotyping in science education curriculum materials	3.19	0.70	Accepted	3.17	0.63	Accepted
2	Masculine image of science education	3.40	0.73	Accepted	3.20	0.69	Accepted
3	Some cultural practices that promote ignorance among women	3.01	0.82	Accepted	2.98	0.83	Accepted
4	Early marriage among female students	2.98	0.77	Accepted	2.77	0.79	Accepted
5	Poor access to basic education	2.72	0.82	Accepted	3.00	0.88	Accepted
6	Poor access to basic scientific knowledge	2.66	0.58	Accepted	2.87	0.65	Accepted
7	Sexual harassment against women	3.11	0.90	Accepted	2.65	0.60	Accepted
8	Expected role of women in the home	2.52	0.67	Accepted	3.02	0.92	Accepted
9	Parents economic/financial status	2.85	0.70	Accepted	2.91	0.66	Accepted
10	Methods of teaching the students	3.05	0,65	Accepted	2.76	0.75	Accepted
11	Methods of assessing students learning	3.12	0.79	Accepted	2.68	0.78	Accepted
12	Language used in science instruction	3.22	0.83	Accepted	2.84	0.66	Accepted
13	Teachers attitude towards learners	2.85	0.75	Accepted	3.01	0.81	Accepted
14	Lack of proper education of the parents	2.22	0.64	Not accepted	2.19	1.00	Not Accepted

Hypothesis 1: There is no significant difference between the mean–scores of male and female students with regards to the prevalence of gender imbalance in the study of science education in universities in Anambra State?

Table 3: t-test statistics on the prevalence of gender imbalance in the study of science education in universities in Anambra State

Group	N	X	SD	DF	t-cal	t-crit	Decision
Male Students	100	2.80	0.74				
				198	0.563	1.960	Ho Accepted
Female Students	100	2.78	0.72				

The t-test statistics presented in table 3 revealed that the t-calculated value for the mean scores of male and female students is 0.563 at 198 degree of freedom and $p < 0.05$. The table value is 1.96. Since the t-cal is less than the t-crit, the null hypothesis is therefore not rejected. This indicates that there is no significant difference between the mean scores of male and female students of Nigerian Universities with regards to the prevalence of gender imbalance in the study of science education in universities in Anambra State.

Hypothesis 2: There is no significant difference between the mean–scores of male and female students with regards to the causes of gender imbalance in science education in universities in Anambra State?

Table 4: t-test statistics on the causes of gender imbalance in science education in universities in Anambra State

Group	N	X	SD	DF	t-cal	t-crit	Decision
Male Students	100	2.92	0.63				
				198	0.231	1.960	Ho Accepted
Female Students	100	2.86	0.76				

The t-test statistics presented in table 4 revealed that the t-calculated value for the mean scores of male and female students is 0.231 at 198 degree of freedom and $p < 0.05$. The table value is 1.96. Since the t-cal is less than the t-crit, the null hypothesis is therefore not rejected. This indicates that there is no significant difference between the mean scores of male and female students of Nigerian Universities with regards to the causes of gender imbalance in science education in universities in Anambra State

5. Discussion of Findings

The findings in table 1 revealed the prevalence of gender imbalance in the study of science education in universities in Anambra State. The respondents agreed gender imbalance are prevalent in visuals in science education instructional materials, language used in representing science resources, online science education resources, activities in science education resources, people used in science instructional resources, teacher's attitudes towards learners, assessment methods used in science education, teaching methods used in science education, roles students play in science teaching resources, classroom policies used in science education, groupings made during cooperative learning, help and guidance given to students in the class, access to science equipment granted to students. This affirmed the findings of studies (such as Carlone (2004); Warrington & Younger, 2000) who stated that gender bias in science education are prevalent in teaching, assessment methods as well as teacher's attitude. Kerkhoven, Russo, Land-Zandstra, Saxena and Rodenburg (2016) in line with this, also found that stereotypes might be visible in the use of visuals, language, activities, teaching methods, and teachers' attitudes. The stereotyping of men in science and women in teaching is, thus, already present at very early level of education. Moreover, Zittleman and Sadker in Kerkhoven et al (2016) studied teacher education methods and found that women were depicted as teachers twice as often as men in all textbooks they studied, including texts on science and mathematics; Moser and Hannover (2014) studied visuals and language in German language and mathematics books and found that there were more men portrayed than women. Additionally, in the mathematics books, there were also more boys than girls. Research studies such as Elgar (1999) and Elgar (2004) found that males were depicted in photographs more than four times as often as females in primary school books for science and science textbooks for secondary school. However, Whiteley (1996) studied Jamaican and British physics books for secondary school and also found that more men than women were depicted, but for children an approximately equal number of boys and girls was found. It seems that different

science textbooks show the same gender imbalance for adults but not for children. Ambady, Shih, Kim and Pittinsky (2001) noted that at least for girls aged 5 to 7, stereotypes already affect their math test results. In addition, researchers (such as Kerger, Martin, & Brunner, 2011; Sjoberg & Schreiner, 2010; Brotman & Moore, 2008) also observed that young girls are less interested in science and have fewer positive attitudes toward science than boys. This could be an effect of the prevalence of gender stereotypes (e.g., science is for men, not for women).

The findings in table 2 revealed the causes of gender imbalance in science education in universities in Anambra State. They respondents agreed the causes of gender imbalance in science education include sex-role stereotyping in science education curricular; masculine image of science education; some cultural practices that promote ignorance among women; early marriage among female students; poor access to basic education; poor access to basic scientific literacy; sexual harassment against women; expected role of women in the home, and parents financial status, methods of teaching the students, methods of assessing students learning, language used in instruction, and teachers attitudes towards learners. This is in line with the findings of Okeke (1996) who observed that factors such as sex-role stereotyping, socialization process, masculine image of science education, and the expected role of women in the home and individual communities are responsible for few women participations in science education in Nigeria. They play important role in determining student's choice of career. Moreover, Njoku (2000) in his gender analysis of science and technology curricula materials noted that gender bias exists against women but in favour of males and this is widespread in science and technology books used in Nigerian Primary, secondary and tertiary institutions. Aja-Okorie and Aja (2010) also noted that gender stereotyping exists in our homes and school system which affect both sexes education either positively or negatively. However, Udousoro (2011) opined that gender is a major factor that influences career choice of both males and females. It is particularly constraining for women because few occupations are perceived as being appropriate for women. In other words, there is strong indication that discrimination against females has created gender gaps in science and technology classrooms with the females lagging behind (Aniodo & Eze, 2014). The gender bias in science and technology books is believed to be as a result of the masculine image of science and technology whose root is in the sex-role stereotyping in the gender divided society. Thus, there is no equity for the sexes in the science and technology curricula (Njoku, 2007).

6. Conclusion

Gender imbalance are prevalent in online science education resources, teacher's attitudes towards learners, roles students play in science teaching resources, and groupings made during cooperative learning as well as in visuals, languages, activities, teaching methods, assessment methods, classroom policies. However, causes of gender imbalance include among others sex-role stereotyping in science education curricular; masculine image of science education; some cultural practices that promote ignorance

among women. Gender imbalance in science education need to be tackled to achieve sustainable education and produce students with modern scientific knowledge for problem solving.

6.1 Recommendations

Based on the above findings of this study the following recommendations were made:

1) Government should use anti-sexual harassment policies to empower school authorities to fight the menace of sexual harassment of females in the school.
2) Teachers should use classroom strategy that is gender inclusive to enhance active participation of both male and female students and also fight the problem of stereotyping in science instructional resources
3) Teachers should be allowed to attend professional development programmes to learn how to overcome obstacles inhibiting female interest, enrolment and academic performance in science education.
4) Science text book authors should device means of balancing language, illustrative diagrams, figures, pictures, models, activities and presentation of role models in science text materials so as to remove the gender bias in science curriculum materials.
5) Students should try as much as possible to imitate great achievers in science education as role models in order to be one tomorrow.

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