EVALUATION OF THE FACTORS AFFECTING FEMALE STUDENTS CREATIVITY IN SCIENCE EDUCATION IN NIGERIA

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Abstract

This study was designed to identify the factors that affect female students' creativity in science education. The study was undertaken in six purposely selected schools comprising of three co-educational schools and two single-sexed schools in Owerri education zone II. The population for the study comprised of 420 female Senior Secondary School Students from both private and public schools. The sample for the study consists of 100 Secondary School students. Cluster random sampling technique was used to select respondents for the study. Data were collected using 100 questionnaires administered to the SS3 students in the five schools. The questionnaire was validated by three experts so as to detect lack of clarity in the questions. The reliability coefficient was calculated using the Pearson correlation coefficient and the value obtained was 0.62.The findings showed that parental education influences the creativity of female students in science education as educated parents tends to involve their daughters in activities that will boost their interest in science. The traditional beliefs and culture of the society that female are mainly to play the roles of wives and mother affect female students' creativity in science. Based on the findings, it was recommended that government; organizations and institutions should

provide academic scholarships and bursaries aimed at encouraging girls to study science subjects.

Keywords: Evaluation, Female Students, Creativity, Science Education

Gender gap in Science, Technology, Engineering, Math (SETEM) field can be traced to the beginnings of the industries of science and technology in western society. A patriarchal scientific paradigm arose in parallel with the cultural stigma that males are more intelligent and capable in the fields of math, science, and technology, and women are not interested and competent in math, and science.

Parker and Rosenthal (2011) delineated the 1890s as the period when pedagogy for boys and girls diverged. During and after industrialization in the United States, male students were encouraged in the sciences of mining and engineering, which were seen as growing business fields. Female student were largely not offered science courses in secondary schools and were filtered into Latin, and the arts. Pressure to conform to societal gender roles discouraged women from pursuing careers in science at the cost of being stigmatized as lesbians. Males were similarly discouraged from fields that were not seen as masculine (Parker and Rosenthal, 2011). After the Second World War, boys were increasingly pushed into careers in woodworking and automobile repair, in order to increase global competition in technology and defense. Correspondingly, girls were required to take home economics classes during which they were taught how to use and consume a multitude of newly manufactured goods (Parker and Rosenthal, 2011) Powerful social stigmatization prevented individuals from entering careers that were typically assigned to the opposite gender. Female scientists who did make it through their education and conducted research during the early nineteenth century were often overshadowed and diminished in importance beside their male counterparts. By the 1920's there were thousands of women working in the sciences, a great step toward equal participation, however positions of leadership and power remained unobtainable for female scientists. In 2008 for example, women earned 59% of all bachelor degrees and 58% of all master's degree (Halpern, Aronson, Reimer, Simpkins, Star, and Wentzel, 2007), while women are attending undergraduate and graduate schools at rates meeting and exceeding the population of men in higher education, STEM fields remain underrepresented by women. Women represent half of the workforce, but only 26% of people working in science and engineering (Halpern, 2007).

However, secondary school teachers often lack training on science, and more generally, teachers at various levels of education tend to have little information on how to teach science and technology subjects in gender-sensitive ways. For instance, emphasizing the potential of science and technology innovations for improving people's everyday life may help engage girls. In addition, finding qualified science

and mathematics teachers can be difficult, particularly in view of the alternative employment opportunities with higher pay status and respect that existed outside schools. Exposing girls to successful female role models in mathematics and science is another way to reduce negative stereotypes and improve girls' performance and interest in science. There is a need to raise the number of women science and technology teachers, who play a significant role in enhancing girls' interest in scientific subjects. The variety of barriers to females' participation in science and technology education highlights the need for responses that not only focus on encouraging female students to enter science and technology fields, but also on changing institutions to make science and technology more attractive to female students.

Many factors influence a child's academic interest and achievement beyond a child's innate ability the neighborhoods children live in the qualities of the school, parents' occupations and economics status all have an effect. The level of parental education is a proven factor in predicting the academic achievement of their children. Parents also provide and encourage different recreational and learning activities that can support development of specific skills and interest. Additionally, parents are important role models. They communicate information about their own abilities and skills, and what is valued and important, through their choice of work and leisure activities. Parents influence not only affects children's choice of activities and achievement beliefs but also impacts children's career interest and choices. Parent beliefs about their children's abilities in mathematics in Grade 7 were to adolescents' science career efficacy 12 years later (Bleeker and Jacobs, 2004).

Instructional materials are in various classes, such as audio or aural, visual or audiovisual. Among the instructional materials the classroom teacher uses, the visuals out-numbered the combination of the audio and audio-visual. Isola, (2010) referred to them as object or devices, which help the teacher to make a lesson much clearer to the learner. Instructional materials are described as concrete or physical objects which provide sound, visual or both to the sense organs during teaching (Aginaobu, 2005). The place of instructional materials in the effective implementation of any education programme cannot be undermined. Instructional materials perform such functions as the extension of the range of experience available to learners, supplement and complement the teacher's verbal explanations thereby making learning experience richer and providing the teacher with interest into a wide variety of learning activities. Instructional materials supplement, clarify, vitalize, emphasize instruction and enhance learning in the process of transmitting knowledge, ideas, skills and attitude.

Students and especially girl's low interest in science and their relatively negative attitudes are at least partially attributed to the way relevant disciplines are taught at school. Science curricula, school textbooks, teachers and their teaching

practices are crucial factors considered to negatively affect students' attitudes towards an interest in science, since they tend to emphasize its academic, strongly intellectual and abstract character, and to present it in a decontextualised way, distanced from everyday life (Haussler and Hoffmann, 2002; Semela, 2010). At school, science teachers play an especially crucial role in the formation and reorganization of students' conceptions and attitudes towards science and scientists. In particular, teachers' conception and attitudes towards science and scientists establish a hidden curriculum' and determine to a large extent their teaching practices. Teachers' inadequate understanding of the nature of science may pose difficulties in introducing coherent and compelling teaching practices addressing their student's creativeness and experiences and perpetuate to implement traditional, teacher-centered instruction (Bianchini, Johnston, Oram, and Cavazos, 2003). Hence the teachers' views and attitudes towards science have an impact on the respective views and attitudes of their student. Science fields need to be occupied by a variety of voices and innovative thinkers. Female equal engagement in Science, Technology, Engineering and Math (STEM) fields is vital for the national economy and technological innovation.

The need to resolve the gap in determining the factors affecting female students creativeness in science education and engagement of women in STEM drives this research. Though a lot of related studies have been carried out in America (USA Dept. of Education 1997) and Israel, the findings cannot be transferred because of some cultural differences in the educational systems hence it becomes necessary to find out what the situation is in the Nigerian cultural setting. The study sought to examine the factors responsible for female student's creativeness in science education. The study intends to look into the factors which hinder girls' interest in science education, within the school and society. Specifically, the study will.

a. Investigate the effect of the family background on girls' interest in science.
b. Investigate the effect of the culture of the society in girls' interest in science.
c. Examine the extent of the influence of teachers' attitudes on girls' interest in science.
d. Investigate the effect of school type on the interest of girls in science.
e. Examine the influence of instructional materials on the motivation of girls' interest in science.

Research Questions

In order to effectively cover the issues raised in the study, the following research questions were raised;

1. What is the effect of family background on female students' creativeness in science?
2. What is the effect of culture of the society on female students' creativeness in science?

3. To what extent will the teachers' attitudes influence female students' creativeness in science?
4. What is the effect of the school type (co-educational or single-sexed school) on female students' creativeness in science education?
5. What is the effect of instructional material in motivating female students' creativeness in science education?

Research Hypotheses

1. The family background does not have significant effect on female students' creativeness in science education.
2. The culture of the society does not have significant effect on female students' creativeness in science.
3. The teachers' attitudes do not have significant influence on female students' creativeness in science.
4. The school type (co-educational or single-sexed school) does not have significant effect on the female students' creativeness in science.
5. The use of instructional material does not have significant effect in the motivation of female students' creativeness in science education.

Research Design

Survey research design was adopted for the study. The study area was in Owerri Education Zone II. The population for the study comprised of 420 female Senior Secondary School Students from both private and public schools in Owerri education zone II. The sample for the study consists of One Hundred Senior Secondary School students from six selected schools in Owerri education zone II (3 public schools and 3 private schools). Fifty female students were each selected from both public and private schools. The Cluster random sampling technique was used to select the subjects for the study. The instrument employed is a questionnaire, designed to assess students' attitude to science. There were 20 item questionnaires to which students were to respond by choosing one of the four scales; strongly Agreed (SA), Agreed (A), Disagree (D) and Strongly Disagree (SD). In addition students were to rate a list of careers as either male or female. The questionnaire was validated by three experts so as to detect lack of clarity in the phrasing of the questions and to enhance the comprehensibility of the items.

The reliability coefficient was calculated using the Pearson Correlation Coefficient. The reliability coefficient value of 0.62 was obtained. The questionnaires were distributed to the selected SS3 students and the students were supervised by both their class teachers and the investigators. Standardized instructions were provided with the survey and were read aloud to ensure that students understand how to fill out the questionnaire. The questionnaire was collected at the spot to prevent loss of the questionnaire. The data obtained from the questionnaire were coded and quantified,

and then recorded on data summary sheets, following the format required by the statistical package for the social sciences (SPSS) computer software.

Results

Result of data analyses concerning Research Questions

Table 1: Students' responses (by percentage) on effect of family background on female student's creativeness in science education.

S/N	Items	SD	D	A	SA	Total
Family						
1	I so much want to specialize in any of the science courses because my parents want me to do so.	24	17	26	33	100.0
2	Parents encourage learning activities to develop interest in science subjects	44	30	7	19	100.0
3	Parents prefer their male child in science class then their female child.	20	12	37	31	100.0
4	Parents are not disappointed when their female child has low performance in their science subjects.	17	6	41	36	100.0
	Total	**105**	**65**	**111**	**119**	**400.0**
	Percentage	**26.2**	**16.2**	**27.7**	**29.7**	**100.0**

From table 1 above, it was shown that 26.2 and 16.2 strongly disagree and disagree to the statement on family while 27.7 and 29.7 agree and strongly agree to the statement. This shows that 57.4% of the respondents agreed to the statement on the effect of the family background. Hence, family background has an effect on female students' creativeness in science education.

Table 2: Students' response (by %) on effect of culture of the society on female students' creativeness in science.

S/N	Items	SD	D	A	SA	Total
Society						
1	Companies prefer to employ male that studied science than female	23	32	27	18	100.0
2	I think there are more male scientists than female scientist in the society.	11	22	42	25	100.0
3	Girls who are actively involved in science are seen as being masculine	30	35	25	10	100.0
4	The society encourages girls who aspire to be creative	10	18	40	31	100.0
	Total	**74**	**107**	**134**	**84**	**400.00**
	Percentage	**18.5**	**26.7**	**33.5**	**21**	**100.00**

From table 2 above, it was shown that 26.7 and 18.8 strongly disagree and disagree to the statement on effect of the culture of the society while 33.5 and 21 agree and strongly agree to the statement. This shows that 54.6% of the respondents agreed to the statement on effect of the culture of the society. Hence, culture of the society has an effect on female students' creativeness in science.

Table 3: Students' responses (by %) on influence of teacher's attitude on female students' creativeness in science.

S/N	Items	SD	D	A	SA	Total
Teacher's Attitude						
1	My science teachers are so boring, so I don't want to take anymore science than I have to	28	6	38	28	100.0
2	My science teachers prefer the boys to answer difficult science questions in the class.	24	12	41	23	100.0
3	Science teachers prefer the boys to head laboratory practical.	11	15	37	26	100.0
4	My science teachers criticize the boys when a girl performs better in science subjects.	31	22	20	27	100.0
	Total	**105**	**55**	**136**	**104**	**400.00**
	Percentage	**26.2**	**13.7**	**34**	**26**	**100.00**

From table 3 above, it was shown that 26.2 and 13.7 strongly disagree and disagree to the statement on teacher's attitude while 34 and 26 agree and strongly agree to the statement. This shows that 60% of the respondents agreed to the statement on teachers' attitude. Hence teachers' attitude has an influence on female students' creativeness in science education.

Table 4: Students' responses (by %) on effect of school type on female students' creativeness in science education.

S/N	Items	SD	D	A	SA	Total
School Type						
1	I enjoy science more in a single-sexed school.	14	24	27	35	100.0
2	I enjoy science more in a co-educational school	11	29	33	27	100.0
3	I participate actively during group practical when it is single-sex grouping	10	21	45	24	100.0
4	I enjoyed practical work better when my team mates are girls.	18	18	39	25	100.0
	Total	**53**	**92**	**144**	**111**	**400.00**
	Percentage	**13.2**	**23**	**36**	**27.7**	**100.00**

From table 4 above, it was shown that 13.2 and 23 strongly disagree and disagree to the statement on school type while 36 and 27.7 agree and strongly agree to the statement. This shows that 63.7% of the respondents agreed to the statements on school type. Hence, the school type has an effect on female students' creativeness in science education.

Table 5: Students' responses (by %) on effect of instructional materials on female students' creativeness in science education.

S/N	Items	SD	D	A	SA	Total
Instructional Materials						
1	The use of instructional materials helps me understand science better and to be creative.	5	3	42	50	100.0
2	The illustrative pictures in science textbooks are masculine.	22	35	27	16	100.0
3	Science textbooks depicts scientist as only male.	35	34	16	15	100.0

4	Only the teacher makes use of the instructional materials for fear of the apparatus being damaged by the student.	35	20	29	16	100.0
	Total	**97**	**92**	**114**	**97**	**400.00**
	Percentage	**24.2**	**23**	**28.5**	**24.2**	**100.00**

From table 5 above, it was shown that 24.2 and 23 strongly disagree and disagree to the statement on instructional materials while 28.5 and 24.2 agree and strongly agree to the statement. This showed that more of the respondents of 52.7% agreed to the statement on instructional materials. This is a little above average. Hence, the use of instructional materials has an effect on female students' creativeness in science education.

Result of Data Analyses Concerning Hypotheses

Table 6: Descriptive statistics and different in family background and female students creativeness in science education using pear sample t-test.

Variables	Mean	SD	Df	t-cal	p-val	Remark
Family background	2.32	1.04				
Female creativeness in science	1.89	0.81	99	3.44	0.001	Sig.

P<0.01

Table 6 shows that t-cal of 3.44 is significant at p (0.001). Hence the null hypotheses was rejected, thus family background has a significant effect on female students creativeness in science education. This is even supported as it was in table 1 that 51% of the student were encouraged to learn by family members as against the 39% of the students that truly have an interest in science.

Table 7: Descriptive statistics and difference between culture of the society and female students' creativeness in science education.

Variables	Mean	SD	Df	t-cal	p-val	Remark
Culture and society	10.30	2.08				
Female creativeness in science	1.89	0.81	99	36.75	0.00	Sig.

P<0.01

Table 7 shows that t-cal of 36.75 is significant at p (0.00 <0.01). Hence the null hypothesis was rejected, thus culture of the society has a significant effect on female students creativeness in science education.

Table 8: Descriptive statistics and difference between teachers' attitude and female students' creativeness in science education.

Variables	Mean	SD	Df	t-cal	p-val	Remark
Teachers Attitude	8.7	2.26				
Female creativeness in science	1.89	0.81	99	29.30	0.00	Sig.

P<0.01

Table 8 above shows that t-cal of 29.30 is significant at p (0.00 <0.01). Hence the null hypotheses was rejected, this means that teachers' attitudes has a significant influence on female students creativeness in science education.

Table 9: Descriptive statistics and different between type of school and female students creativeness in science education.

Variables	Mean	SD	Df	t-cal	p-val	Remark
Type of School	11.13	2.43				
Female creativeness in science	1.89	0.81	99	37.97	0.00	Sig.

P<0.01

The table above shows that t-cal of 37.97 is significant at p (0.00<0.01). Hence the null hypotheses was rejected, thus type of school (co-educational or single-sexed school) has a significant effect on the female students creativeness in science.

Table 10: Descriptive statistics and difference between the use of instructional material and female student's creativeness in science education.

Variables	Mean	SD	Df	t-cal	p-val	Remark
Instructional Material	10.11	2.32				
Female creativeness in science	1.89	0.81	99	33.13	0.00	Sig.

P<0.01

Table 10 above shows that t-cal of 33.13 is significant at p (0.00<0.01). Hence the null hypotheses was rejected, thus use of instructional materials has a significant effect in the motivation of female students creativeness in science education.

Discussion

The result from hypothesis one shows that family background have a significant effect on female students' creativeness in science education. This result agrees with the article published by the London Review of Education in 2005 that parental education is a factor that affects girls' interest in science. Parents are important role models; they communicate information about their own abilities and skills, through their choices of work and leisure activities.

The result from hypothesis two shows that the culture of the society has a significant effect on female students' creativeness in science. This result is consistent with the research findings on African tradition and culture; women were expected to exclusively assume the role of mother and wives. Women were seen as less capable, physically, and mentally than men. Many community members also have the attitude that educating girl is a waste of time and money, as everything will end in the kitchen. As a result, parents do not encourage girls to take science subjects as it is considered to be masculine therefore 'unladylike'.

The result from hypothesis three shows that the teachers' attitude has a significant influence on female students' creativeness in science. This result agrees with the findings of (FInson, 2002; Hatzinikita, 2007; Hatzinikita, Christidou, and Bonoti, 2009), that many teachers have been found to adopt stereotypic images of scientist as male identical to those of students, which often go hand in hand with negative attitudes towards science. These teachers are expected to have a negative impact on the ways their students especially female conceive of science and scientists (Mosely and Norris, 1999; Quita,, 2003), as well as on the students' likelihood of selecting and pursuing school science courses and accordingly, of opting for a future career related to science (Finson, 2002; Quita, 2003). Teacher's behaviour in the classroom can play an important role in motivating and encouraging the students to continue to study science after the compulsory level (Labudde, 2000). He claimed that there is differential treatment of boys and girls in science lessons with teachers interacting more with boys than with girls, and that this has a crucial influence on students' subjects' choice.

The result from hypothesis four shows that the type of school (co-educational or single-sexed school) has a significant effect on the creativeness of female students in science. This result agrees with the findings of Parker and Rennie, (2002) that in single-sex classes, girls were observed to (and also perceived themselves to) participate more, be more extroverted, have more interaction with the teacher and receive less harassment from male students than in mixed-sex classes.

Finally, the result from hypothesis five shows that the use of instructional materials has a significant effect in the motivation of female students' creativeness in

science. This result is consistent with the findings of Hoffman-Barthes, (2000) that gender bias has been reported to be reinforced in science textbooks and curriculum materials; for example, depiction of masculine images of science, lack of gender-inclusive language and absence of female models in course content and images. These factors could be expected to particularly discourage female students from engaging in science.

Conclusions

The findings of the study led to the conclusion that family background especially educational level of parent has an effect in the interest of girls' in science. The attitude of teachers has an effect on girls' interest in science , teachers' attitude and perception toward science and scientists establish a hidden curriculum and determine to a large extent their teaching practices which in turn as an effect on girls' interest in science either positively or negatively.

The findings in the study also indicated that the culture of the society has an effect on girls' interest in science as parents and community attitude are mainly influenced by traditional beliefs regarding the ideal roles of women and girls in society. Traditionally, the only roles available to women were those of wives and mothers. Women were thus seen as nurturers and mainly as providing support for men who worked to provide for the family. It also becomes clear that girls prefer that their team mates are girls during practical's and a single-sexed classroom enhances active participation of girls more than in a co-educational classroom where the boys dominate class discussions.

Recommendations

Based on the findings, the following recommendations are put forward:

1. The government and other relevant organizations and institutions should provide academic scholarships and bursaries aimed at encouraging girls to study science subjects and careers should also be established.

2. Parents should be encouraged to become more involved in the academic activities of their children especially girls. Parents should be sensitized to the importance of their involvement, especially in the case of girls' involvement in science subjects.

3. Role models in the form of women who had succeeded in science based careers should be invited to schools to address and sensitize female students and parents on the importance of girls' education and their participation in science subjects.

4. The fact is that girls have the ability to perform well at science subjects and careers, but in order to do this they require, among other things, encouragement, motivation and material support from their parents and communities.

5. Curriculum materials should be developed to sensitize teachers on gender issues in science education and have examples of women acting as role models in the scientific and technological fields. Through workshops involving teachers, relevant ministries and NGO's, the issue of gender and science could be discussed and relevant programmes and projects could be initiated and implemented in schools.

6. Improved pedagogy and instructional materials should be introduced as it would contribute in a certain way to improve the scientific literacy of girls by enabling more girls to enroll for science courses and follow career paths in the scientific and technological fields and eventually participate as males in national development.

7. Sex-stereotyping in science textbooks should be removed, science textbooks should also include pictures of women as scientists, engineers, architects etc.

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