

# Assessing School-Based Factors Inhibiting Females' Participation in Elective Science: A Case Study in Ghanaian Senior High Schools

<sup>1</sup>Assafuah-Drokow Anthony, <sup>2</sup>Ansah Emmanuel

<sup>1</sup>Tutor, <sup>2</sup>Lecturer

<sup>1</sup>Science Education Department; Foso College of Education; Box 87; Assin Foso; C/R; Ghana

<sup>2</sup>University for Development Studies; Department of Basic Education; Tamale, N/R; Ghana

**Abstract:** *The study sought to assess school-based factors inhibiting senior high schools (SHS) female students' participation in science and identify strategies that could be used to improve females' participation, interests and performance in science. A descriptive survey was the research design used for the study. A total sample size of 60 respondents made up of 20 SHS science teachers and 40 SHS elective science female students drawn from 4 SHS in the Central and the Ashanti Regions of Ghana. A purposive sampling procedure was used to select the respondents for the study. Questionnaire and interview were the 2 instruments used for the study. Data were analyzed using both quantitative and qualitative methods. Statistical package for Social Sciences (SPSS) version 16.0 for windows was used for analysis and Microsoft excel program was used to present the data graphically into tables. It was revealed that there were several factors that inhibit SHS female students' participation in science. Again, all the 60 respondents representing 100% indicated that female students' lack of self-confidence and low-esteem in solving scientific problems; lack of motivation, encouragement and support to female students; and inappropriate and uninspiring teaching strategies used by science teachers were some of the factors that inhibit female students' participation in science. It was also observed that using eclectic approach in teaching science; adoption of gender-inclusive classroom strategies during science instructions and adoption of peer teaching as well as cooperative learning were some of the school-based strategies that could be used to improve females' participation, interests and performance in science. It was recommended that science teachers and other stakeholders in science education should guide and counsel female students to develop their self-confidence in solving scientific problems. Also, science teachers should use inspiring teaching strategies during science instructions so as to improve females' participation, interests and performance in science.*

**Keywords:** Factors, inhibiting, females, participation, science, strategies, performance, interests.

## I. INTRODUCTION

Indeed, it is an acceptable fact over the entire world that no nation can progress without embracing scientific education. Science is regarded as the cornerstone of industrial development and the link between technology and socio-economic development (UNESCO, 2010).

In a study, Croxford (2002) imputed that a country's ability to secure good health, fight diseases, protect the environment, produce food for its citizenry and develop new industries is dependent on the scientific knowledge, attitudes, interests and skills of its people.

However, despite efforts made to promote girls in science education over the past three (3) decades, there is worldwide low participation (under-representation) and under-achievement of females in science subjects in schools specifically junior and senior high schools, college and university science programmes and many scientific careers (Njoku, 2006; Baker, 2014).

The low participation of females in scientific studies has stimulated widespread concern from multilateral organizations such as the UN agencies and academia in developed and developing countries calling for solutions and what can be done to reverse the trend. The former UNESCO Director Koichiro Matsuura described the low participation or representation of females in sciences as unacceptable in various spheres of societal life (UNESCO, 2011).

However, the low participation, interest, attitudes, performance and career choice varies across the regions of the world (Croxford, 2002; UNESCO 2010; Baker, 2014). According to Okeke (2000) the low participation or representation of females is stronger in the developing countries particularly in Sub-Saharan Africa and Ghana is of no exception.

Professor Arvid Pardo of the University of Southern California, in the 1986 Balfour Lectures, declared that for effective development, a nation requires at least a scientific population of about two percent (2%) (Dadson, 1988). Thus, Ghana with an estimated population of 30 million will require a scientific population of 600,000.

According to 2010 housing and census report, the women currently constitute about 51% (Ghana Statistical Service, 2012). By computation of 51% requirement of the scientific population of 600,000; it implies that Ghana will require a female scientific population of 306,000 as against male scientific population of 294,000. Studies by (UNESCO 2010; Ghana Statistical Service, 2012) opined that Ghana is in need of 12,000 engineers and 48,000 technicians for science and technology to take off.

In view of the great importance of science education coupled with low female scientific population, Ghana through the various strategies has sought to increase females' participation, performance and sustain the interests among females or girls who are lagging behind at the secondary and tertiary levels of education.

To increase female students' participation in science in Ghana (Eshun & Krampa, 1997; Eminah, 2006) and elsewhere in the world (Obianyo, 2000; Croxford, 2002; Njoku, 2006) researchers have indicated that it is important to first delineate and understand the factors that inhibit female students' low participation in sciences; so as to adopt innovative strategies to improve female students' participation, interests and performance in sciences.

It is against this background that this study was undertaken to assess the causes of female students' poor participation in science and also identify strategies that could be used to improve females' participation, interests and performance in science.

### Statement of the Problem

The issue of low participation or low representation of SHS female students in elective sciences seems to have been neglected and is a grey area as far as research into educational issues in Ghana is concerned.

In Ghana, the required elective science class size for SHS education per Ghana Education Service Standard is 45 students per class in both gender mixed or single sex classes. However, this is not the reality on the ground in schools upon series of observations made in most of the science classes.

Observations made by the researchers in some of the randomly selected SHS and also studies by (Send Ghana, 2018) revealed that the number of students per science class ranged between 45 to 70 students per class. In each of these science classes, the ratio of male students to that of females is not encouraging. A typical assessment of four (4) randomly selected mixed SHS in the Central and Ashanti Regions (2 SHS from each region) revealed horrible and shocking statistics as shown in Table 1 below:

**Table 1: Number of Females Offering Elective Science Compared To Males in 4 Ghanaian SHS**

School	Total number of science classes	Number of students offering elective science	Number of male students offering elective science	Number of females students offering elective science
A	4	210	158	52
B	3	197	137	60
C	4	211	146	65
D	3	204	153	51

Source (Field work, 2017)

Data in Table 1 shows that in all the four (4) SHS sampled, the number of male students out-numbered that of the females in the ratio of males and females ranging between 1:2 to 1:4. In one (1) of the science classes, it was observed that the number of females were only 4 whereas their male counterpart were 38 students. The data in Table 1 shows that there might be low participation of female students in sciences in some of the Ghanaian SHS.

In confirmation to this observation, studies by (Eshun & Krampa, 1997) revealed that there was under-representation of girls in some selected secondary schools (now SHS) in the Central regions of Ghana. Other studies by (Okeke, 2000; Njoku, 2006) posited that the low participation of female students in the sciences are historical and have been brought about by several inter-related socio-cultural and interacting social factors which acts singly or jointly to depress female interest, enrolment, participation and achievement in science subjects at various levels of education system.

At the school level, studies by (Okeke, 1990; Obianyo, 2000) opined that female students experience a lot of discouraging conditions that deter them from participating, enjoying and achieving well in science subjects. The study concluded that these school-based factors are responsible for the observed low participation, low interest, and under-achievement of females in sciences.

Since low participation of female students in science subjects are caused by school-based factors; it is imperative to assess these factors so as to adopt innovative strategies to address the situation. It is in the light of this that this study was undertaken to assess school-based factors that inhibit of female students' participation in science and also identify strategies to improve females' participation, interests and performance in science.

### Purpose of the Study

The study sought to assess school-based factors inhibiting Ghanaian SHS female students' participation in elective science and also identify effective school-based strategies that could be used to improve females' participation, interests and performance in science. Specifically, the study intends:

1. To identify school-based factors inhibiting SHS elective science female students' participation in science.
2. To assess effective school-based strategies that could be used to improve female students' participation, interests and performance in science.

### Research Questions

The following two (2) investigative questions directed research activity in the study:

1. What are the school-based factors that inhibit SHS elective science female students' participation in science?
2. What are the effective school-based strategies that could be used to improve female students' participation, interests and performance in science?

## II. REVIEW OF RELATED LITERATURE

This aspect of the study seeks to review related literature associated with this study. The review was done under sub-themes:- factors that inhibit female students' participation in science and strategies to improve female students' participation, interests and performance in science.

### Factors That Inhibit Female Students' Participation in Science

Several pioneer studies by (Erinosho, 1997; Obianyo, 2000; Roger & Duffield, 2000; Njoku, 2006) have asserted that there are a number of factors that inhibit female students' participation in science subjects in schools.

Studies by (Erinosho, 1997; Njoku, 2006) attributed poor female participation in science to gender-bias curriculum materials used in primary and secondary schools. In a study, Njoku (2006) stated that teacher expectation that science are for males rather than females; and that teachers do not expect females to participate and perform well in physical sciences. On their part, Good and Brophy (1973) indicated that lack of motivation, encouragement and support by the teachers to female students were some of the factors that inhibit female participation in science.

Studies by (Heidy, Walter, Hilk & Rennate, 1986; Roger & Duffield, 2000; Obianyo, 2000) stated that science teacher's discrimination against females as the factor that inhibits female participation in science. Obianyo (2000) attributed low participation of female students to the teachers giving male students leadership positions, more challenging tasks, interact more with boys and engage them actively in learning than their female counterparts.

On his part, Okeke (1996) mentioned inappropriate guidance and counselling services to girls in science disciplines as an inhibiting factor of females' participation in science. Okebukola (1985) attributed the low participation of females to unconducive science teaching strategies used by science teachers. Eminah (2006) and Bricheno and Thornton (2007) attributed the low female participation in science to lack of female role models in the communities.

On their part, Tadafferua, Ogundare, Obe and Njoku (1989) attributed the poor participation of females in science to sexual harassment of females. The study revealed that the few females who participate in science are often intimidated and sexually harassed by males and teachers.

According to Croxford (2002), females' lack of self-confidence in their ability to solve science problems is a major factor that inhibits females' participation in science. Nwagbo (2001) stated that inappropriate and uninspiring teaching methods used by science teachers are inimical to female performance and low participation in science subjects at the secondary school level.

### Strategies to Improve Females' Participation, Interests and Performance in Science

Studies by (Simpson & Oliver, 1990; Njoku, 2006; Lynda, 2014) have outlined various strategies that could be used to develop females' or girls' participation, interests and performance in science. Lynda (2014) mentioned that eclectic approach can be used to develop girls' interests in science. The study revealed that eclectic approach of teaching takes care of the diverse learners with different background settings; thus, making the teaching and learning of science more interesting.

Simpson and Oliver (1990) stated that girls' attitudes and interests could be developed through active engagement of females in practical and hands-on activities. Okebukola (1985) posited that science teachers should engage female students in peer teaching and cooperative learning approaches. The study concluded that these approaches enhance female students' interests, participation and achievement in science subjects. Eminah (2006) and Bricheno and Thornton (2007) also mentioned motivation and the use of role models as some of the strategies used to develop girls' interests and participation.

Obianyo (2000) indicated that giving female students leadership positions, more challenging tasks, and engaging them actively in science learning could be used to develop girls' interests in science. Also, teachers should involve females in discussions, question-and-answer sessions, practical activities, and field trips. Good and Brophy (1973) stated that science teachers should motivate, encourage and support females during science instructions so as to increase their participation and interest in sciences.

Njoku (2006) stated that creation of awareness among science teachers about gender issues in science education; adoption of gender-inclusive classroom strategies; de-sexing science curricula and teaching learning resources; adoption of gender-inclusive guidance and counselling; elimination of sexual harassment of females; and placing emphasis on the relevance of science education to learners through effective teaching were some of the strategies that could be used to improve females' participation and performance in science.

## III. METHODOLOGY

### Research Design

The descriptive survey was the design used for the study. This design was appropriate because the study used the views of different peoples sampled in the target population in a non-experimental design on school-based factors inhibiting SHS female students' participation in science and also identify strategies that could be used to improve female students' participation, interests and performance in science.

### Sample and Sampling Procedure

A total sample size of 60 respondents made up of 20 SHS science teachers and 40 SHS elective science female students drawn from 4 SHS in the Central and Ashanti Regions of Ghana. A purposive sampling procedure was used to select the respondents for the study.

### Research Instruments

The study used a combination of quantitative and qualitative data-gathering instruments. Questionnaire and interview were the two (2) instruments used to collect data from the respondents. The questionnaire constituted the quantitative part while the interview constituted the qualitative part of the instruments.

### Data Collection Procedure

Permission was sought from the teachers and female students selected for the study. In all, two (2) weeks were used to collect the data. The questionnaire was administered to the selected respondents to answer in our presence. This ensured 100% retrieval rate of the questionnaire from the respondents.

After, the administration of the questionnaire, a focus-group interactive interview sessions were organised for only 30 of the respondents (10 teachers and 20 SHS females) in their respective schools.

### Data Analysis Method

The study employed both quantitative and qualitative methods of data analysis. Data from the questionnaire were analysed quantitatively using descriptive statistics mainly frequency and percentage. Data from the interview sessions were analysed qualitatively and summarised thematically.

## IV. RESULTS AND DISCUSSION

### Analysis of the Results

The analyses of the results were done to answer the 2 research questions that guided the study.

### Research Question 1: What are the school-based factors that inhibit SHS elective science female students' participation in science?

In answering research question 1, science teachers' and female students' responses to questions (1-15) were analysed quantitatively using frequency and percentage and are presented in Table 2 below;

**Table 2: Factors That Inhibit SHS Science Females Participation In Science**

No.	Causes of girls' learning difficulties in science	Frequency	Percentage
1.	Females' lack self-confidence and low-esteem in solving scientific problems.	60	100.0
2.	Ineffective use of instructional materials in teaching science.	25	41.7
3.	Science teacher's expectations of female science students.	45	75.0
4.	Sexual harassment of female students in science by teachers and male students.	55	91.7
5.	Teacher's belief that boys are academically superior to girls in intellectual capacity.	58	96.7
6.	Female students perceived science as a western enterprise and full of hard facts.	52	86.7
7.	Female students perceived science as a masculine subject.	50	83.3
8.	Sex role stereotype during science lessons.	15	25.0
9.	Lack of female scientists as role model in the community.	59	98.3
10.	Inappropriate teaching strategies used by science teachers.	60	100.0
11.	Lack of motivation, encouragement and support to female students by science teachers and male counterparts.	60	100.0
13.	Gender bias curriculum and science textbooks.	50	83.3
14.	Theoretical and abstract nature of some science concepts.	20	33.3
15.	Inappropriate science teacher's behaviours exhibit during science lessons.	60	100.0
	<b>Total</b>	<b>60</b>	<b>100</b>

Source: (Field work, 2017)

Responses in Table 2 show that, several factors inhibit science females' participation in science. From Table 2, some of the identified factors include sexual harassment of female students in science by teachers and male students; teacher's belief that boys are academically superior to girls in intellectual capacity; lack of female scientists as role model and gender bias curriculum and science textbooks.

From Table 2, the four (4) most serious identified factors that inhibit females' participation in science were female students' lack self-confidence and low-esteem in solving scientific problems; inappropriate and uninspiring teaching strategies used by science teachers; lack of motivation, encouragement and support to female students; and inappropriate science teacher's behaviours exhibited during science lessons; while sex role stereotype during science lessons the least inhibiting factor. This is because, all the 60 respondents representing 100% agreed to these four (4) identified factors whereas only 15 respondents representing 25.0% indicated sex role stereotype.

### Research Question 2: What are the effective school-based strategies that can be used to improve female students' participation, interests and performance in science?

In answering research question 2, science teachers' and female students' responses on effective school-based strategies that could be used to improve females' participation, interests and performance in science were analysed qualitatively and are presented in Table 3 below:

**Table 3: Strategies to Improve Females' Participation, Interests and Performance in Science**

No.	School-based to Effective strategies to improve females' participation.
1.	Using varied teaching methods (eclectic approach) in teaching science.
2.	Adoption of gender-inclusive classroom strategies during science instructions.
3.	Embarking on excursions (field trips) to female domineering industries and institutions.
4.	Elimination of sexual harassment of female students by teachers and male students.
5.	Attachment of female students to female scientists as role models.
6.	Provision of science corners in the classrooms to enhance science learning after school.
7.	Provision of appropriate non-gender bias curriculum and science textbooks.
8.	Invitation and the use of female scientists as resource persons during science lessons.
9.	Use of motivational and encouraging strategies during science instructions.
10.	Using appropriate instructional material and real objects in science teaching.
11.	Active engagement of female students in practical and hands-on activities.
12.	Adoption of peer teaching and cooperative learning.

Source: (Field work, 2017)

Data in Table 3 shows that there are several effective school-based strategies that could be used to improve females' participation, interests and performance in science. Some of the identified effective school-based strategies include using eclectic approach (varied teaching methods) in teaching science; adoption of gender-inclusive classroom strategies during science instructions; embarking on field trips to female domineering industries and institutions; attachment of females to female scientists as role models; invitation and the use of female scientists as resource persons; using appropriate instructional materials and real objects in science teaching; adoption of peer teaching and cooperative learning approaches and active engagement of female students in practical and hands-on activities.

### Discussion of the Results

The results of this study showed that several factors inhibit female students' participation in elective science in Ghanaian SHS. The four (4) most serious factors that inhibit females' participation in science as stated by all the 60 respondents were females' lack of self-confidence and low-esteem in solving scientific problems; inappropriate and uninspiring teaching strategies used by science teachers; lack of motivation, encouragement and support to female students and inappropriate science teacher's behaviours exhibited during science lessons. These findings are in agreement with the results of researchers (e.g. Erinosh, 1997; Obianyo, 2000; Roger & Duffield, 2000; Eminah, 2006; Njoku, 2006) that several factors inhibit female students' participation in science.

It was also observed that there were several effective school-based strategies that could be used to improve females' participation, interests and performance in science. Some of the identified effective school-based strategies include the use of eclectic approach in teaching science; adoption of gender-inclusive classroom strategies during science instructions; embarking on field trips to female domineering industries and institutions; attachment of females to female scientists as role models; using appropriate instructional material and real objects in science teaching; adoption of peer teaching and cooperative learning. These findings lend credence to the results of pioneer researchers (e.g. Okebukola, 1985; Obianyo, 2000; Njoku, 2006; Lynda, 2014) that several effective school-based strategies could be used to improve females' participation, interests and performance in science.

### V. Conclusions

Based on the findings of the study, the following conclusions were drawn:

- 1) It can be concluded that several factors inhibit Ghanaian SHS elective science female students' participation in science. The four (4) most serious factors identified by all the 60 respondents were females' lack self-confidence and low-esteem in solving scientific problems; inappropriate and uninspiring teaching strategies used by science teachers; lack of motivation, encouragement and support to females and inappropriate science teacher's behaviours exhibited in science class.
- 2) It can also be concluded that several effective school-based strategies can be used to improve female students' participation, interests and performance in science. Some of the effective school-based strategies identified include the use of eclectic approach in teaching science; adoption of gender-inclusive classroom strategies during science instructions; embarking on field trips to female domineering industries and institutions; attachment of female students to female scientists as role models; using appropriate instructional material and real objects in science teaching; adoption of peer teaching and cooperative learning.



## Recommendations

Based on the key findings and conclusions drawn, it is recommended that:-

- 1) Science teachers and other stakeholders in science education should guide and counsel female students to develop their self-confidence and low-esteem in solving scientific problems.
- 2) Science teachers should use appropriate and inspiring teaching strategies during science instructions so as to improve female students' interest and performance in science.
- 3) Science teachers should motivate, encourage and support female students during science lessons so as to enhance their participation in science.
- 4) Science teachers should exhibit appropriate behaviours to female students during science lessons.
- 5) Science teachers should involve female students in peer teaching and cooperative learning approaches so as to improve their participation, interest and performance in science.

## VI. ACKNOWLEDGEMENTS

Greatest thanks to Miss Eliza Kuofie, the science teachers and the elective science female students who participated in this study. We also thank the reviewers of this article.

## REFERENCES

- [1] Baker, D. (2014). *Teaching for gender difference in Science*. University of Nevada Reno.
- [2] Brichenon, P., & Thornton, M. E. (2007). Role model, hero or champion?. Children views concerning role models. *Educational Research*, 49, (4), 383-396.
- [3] Croxford, L. (2002) Participation in Science, Engineering and Technology at School and in Higher Education, Report to Scottish Executive, Edinburgh: CES, University of Edinburgh, 1-12.
- [4] Dadson, B. A. (1988). Trends in chemical education in Ghana. *Chemistry and industry*, 1(3), 60-66.
- [5] Eminah, J. K. (2006). Perceived hindrances to female's participation in science in tertiary teacher training institutions in Ghana. *Keffi Journal of Educational Studies*, 1(1), 12-18.
- [6] Erinoshon, S. Y. (1997). *Female participation in science: an analysis of secondary school science curriculum materials in Nigeria*. Abridged report No. 29. Nairobi Academic Press.
- [7] Eshun, V., & Krampa, R. (1997). A study of the causes of the under representation of girls in selected senior secondary schools in the Central Region. Unpublished project. UEW, Ghana.
- [8] Good, T. L., & Brophy, J. E. (1973). Effects of teacher sex and student sex on classroom interaction. *Journal of Educational Psychology* 65(1), 10 – 23.
- [9] Ghana Statistical Service, (2012). *Summary report of final results*. The 2010 housing and census report. Accra, Ghana.
- [10] Heidy, W., Walter, J., Hilk, F., & Rennate, P. (1986). Is the unpopularity of chemistry with girls caused by the unconscious behaviour of teachers? In Daniels, J. Z., and Kahle, J. B. (Eds). Contributions to the 4<sup>th</sup> GASAT conference. *GASAT* 4(2), 137-144.
- [11] Lynda, W. (2014). *Strategies for educators to support females in STEM*. University of Nevada.
- [12] Njoku, Z. C. (2006). School-based strategies for improving the interest, achievement and retention of girls in science and technology subjects. *Keffi Journal of Educational Studies*, 1(1), 12-18.
- [13] Nwagbo, C. (2001). The relative effect of guided discovery and expository methods on the achievement in biology of students of different levels of scientific literacy. *Journal of the Science Teachers Association of Nigeria*, 36(1&2), 43; 51.
- [14] Obianyo, B. N. (2000). *Career choice and gender stereotyping in science*. Paper at a national conference on gender equality in Nigeria. Umunze, Federal College of Education (T) Umunze 13-16 June, 2000.
- [15] Okebukola, P.A.O. (1985). Effects of student-student interactions on effective outcomes of science instruction. *Research in science and technology education*, 3(1), 5 - 17.
- [16] Okeke, E. A. C. (2000). *Towards gender equality in Nigeria in the 21<sup>st</sup> Century*. A key note address at the National Conference on gender equality in Nigeria. Umunze, Federal College of Education (T) Umunze 13-16 June, 2000.
- [17] Okeke, E. A. C. (1996). *Women participation in science, technology and mathematics: educators as facilitators*. A lead paper at the 8<sup>th</sup> National Conference of Nigeria Academy of Education, Enugu, 19-21; Nov., 1996.
- [18] Okeke, E. A. C. (1990). *Gender, science and technology in Africa: a challenge for education*. The 1990 Rama Mchta lecture. Radcliff College, University of Cambridge, U.S.A.
- [19] Roger, A. & Duffield, J. (2000). Factors underlying persistent gendered option choices in school science and technology in Scotland. *Gender and Education*, 12 (2), 367-383.
- [20] Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education*, 74(1), 1- 8.
- [21] Tadafferua, K., Ogundare, T., Obe, E., & Njoku, T. (1989). *Equal their chances*. New Jersey. Spectrum Books.
- [22] UNESCO, (2011). *Survival rate to last grade of primary*. UNESCO Institute for statistics, UIS Data Centre, Retrieved 22 may, 2018 from <http://www.uis.unesco.org/Data>.
- [23] UNESCO Science Report,(2010). *The current status of science around the world*.