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Enhancing Girl-Child Participation in Chemistry: The Role of Strategies, Mentoring, and Teacher Attitudes in Senior Secondary Schools in Egor Local Government Area, Edo State

Ibiede Sarah[1], Amadi, Uchechukwu Ph.D[2]

Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin sarahibiede2020@gmail.com
[2]Department of Educational Technology, Ignatius Ajuru University of Education, Rivers State Amadiuche.au@gmail.com

ABSTRACT

The study investigated the factors influencing the girl-child's participation in chemistry in Senior Secondary Schools in Egor Local Government Area, Edo State. Three research questions and corresponding hypotheses were formulated to guide the study. The study adopted a descriptive survey research design. The population of this study consisted of all the female students in the Public Senior Secondary School in Egor Local Government Area of Edo State, with a total population of 5,574. The sample size of the study comprised two hundred and ninety-seven (297) female students. Multistage sampling techniques, comprising the systematic sampling technique and simple random sampling technique, were adopted to select the sample of this study. The instrument for data collection was adapted from Oyakhirome (2021) and was face and content validated by three experts with a reliability index of 0.76 determined using Cronbach Alpha. The direct delivery and retrieval method was used to administer the instrument. Mean and standard deviation were used to analyse the data collected to answer the research question. The hypotheses were analysed using an independent sample t-test. Findings revealed that the majority of the respondents agreed on the strategies for enhancing the girl-child participation in chemistry. Also, respondents agreed that mentoring enhances the girl-child participation in chemistry. The study concluded that the strategies for enhancing the girl-child participation in chemistry were mentoring to enhance the girl-child participation in chemistry, attitude of teachers teaching influence girl child participation in chemistry and challenging gender biases and gender disparities in studying chemistry by enforcing girl-friendly regulations. It was recommended amongst others that career days in schools should target girls, bringing in successful women across various disciplines as speakers, and counsellors should be trained to encourage girls to explore fields in which they are underrepresented. Science fairs can actively reach out to girls, incorporating the work of female scientists and educators, and demonstrating the relevance of science to girls' lives and the importance of their participation. Also, more targeted efforts need to be made to reach a broader population of girls, particularly those from poor and rural households who are most marginalised.

Keywords: Girl-Child Participation, Chemistry Education, Teaching Strategies, Mentoring, Teacher Attitudes.

Introduction

Chemistry is an area of natural science focused on the properties, composition, and applications of matter (Ababio, 2007). It is one of the core branches of pure science, alongside biology and physics. We observe chemical changes in various everyday situations like burning firewood, making palm wine, rusting nails, decomposing leaves, and producing soap, detergents, and hair cream. Science plays a crucial role in our daily lives, encompassing almost everything we use. In Nigeria, chemistry is a popular subject among senior secondary school students due to its practicality and relevance. It meets the needs of the majority by providing valuable content, practicality, and real-world applications. A functional chemistry education that contributes to national development is crucial for countries like Nigeria (Ibrahim, 2007). Chemistry education encompasses the acquisition of knowledge and principles related to chemistry, including the properties, components, and applications of matter. It is a systematic process that equips individuals with essential knowledge about the universe. With this invaluable knowledge, individuals can shape and transform their world for their benefit. Thus, the progress of a nation is often measured by the extent of growth achieved through science education, with chemistry education serving as a gateway. Chemistry education acts as a vehicle to deliver chemical knowledge and skills to those who require them for development. Additionally, it addresses the societal objective of substance development, as education is now recognised as a primary means of empowerment, participation, cultural preservation, social mobility, and equity. Chemistry, being an incredibly versatile science, is associated with the development of excellent analytical and mathematical skills. Chemistry students possess problem-solving abilities and critical thinking skills. The concept of chemistry as a scientific discipline revolves around the fundamental aspects of life, including the interactions and transformations of matter in its three states: solid, liquid, and gas. Education is universally recognised as a vital tool for achieving national objectives. It equips learners with the necessary skills for survival (Ibrahim, 2007).

Chemistry education plays a significant role in national development because chemistry is indispensable in our daily lives. Without chemistry, there would be no chemical industry, leading to a lack of productivity and development. Therefore, any government aware of its responsibilities should ensure

that teachers and students are adequately motivated to engage in the study of chemistry. This encouragement will promote chemistry education, whose importance in the chemical industry cannot be overstated. According to the National Policy on Education (2013), chemistry education emphasises teaching and learning scientific processes and principles, fostering both fundamental and applied research in chemistry across all levels of education. The goals of chemistry education, as outlined in the National Policy on Education (2013), are as follows:

i. Cultivating an inquisitive, knowledgeable, and rational mindset for leading a fulfilling life and participating in democracy.

ii. Producing scientists for national development.

iii. Supporting studies in technology and contributing to technological advancements.

iv. Providing knowledge and understanding of the physical world and guiding the conduct of life.

It is widely recognised that a nation cannot advance without adopting chemistry education. Chemistry has significantly contributed to meeting our basic needs and improving our quality of life. Chemical processes are specifically designed to preserve and store food, increase food production through the creation of fertilisers and insecticides, and contribute to the construction of high-rise buildings using materials resulting from chemical research, such as cement, steel, concrete, and tiles. Chemistry also plays a role in space exploration by providing insights into other planets and the solar system. Additionally, chemistry contributes to the discovery and production of chemical substances, including those used in military explosives. Extensive chemical research has also contributed to creating synthetic fibers for use in the clothing industry.

Statement of the Problem

Studies have shown that a student's performance in chemistry is a strong indicator of later earnings (Crawford et al, 2013). Gender discrimination is a critical factor facing female effective participation in chemistry. According to Gardner (1984), as cited by Erinosho (2014), in Nigerian culture, female children are reared differently from males. Girls are protected and discouraged from explorative and risky activities while males are encouraged to be assertive and challenge their mental powers thus socialization leads to certain personality characteristics regarded as masculine or feminine independent qualities such as initiative and assertiveness for boys; dependency, submissiveness and complacency for girls towards science as they believe that they are inferior to boys physically and mentally. Schools specifically play an important role in females' access to chemistry due to the manner the school curriculum is implemented in Nigeria. Spear (1985) posits that sex, attitude and teaching approach of teachers influence the attitude of female students, who they believe view science to be more important to boys than girls. In support, the confidence of females is low, such that their ability to study science subjects like chemistry is practically unconnected with their actual ability. According to Udeani (2012), school factors like Instructional materials, illustrations, examples and applications presented in resource materials are more familiar in general to the experiences and interests of males than to those of females. The discrimination results from a combination of built-in biases that make them less likely to participate in chemistry, critical and technical professions. The family plays a vital role in the selection of a profession. A chemistry career requires scientists to devote most of their time to research, striving to solve problems and bringing about innovation. Stereotypes as a social barrier can influence individuals positively and negatively, and in evaluating performance, stereotype threat is one compelling explanation that has hindered women and is a major reason why females remain underrepresented in science. Closing the gaps in science is essential for ensuring that women, as much as men, benefit as citizens and contributors to their societies. Women should not be limited to be being passive users of science and technology but instead should be active participants and decision making, ensuring that science and technology but instead should be active participants in scientific development, applications and decision making, ensuring that science and technology initiatives are implemented to address the needs and preferences of both sexes. Although there has been considerable progress in facilitating women's access to education lately, there is still a gender disparity in performance and completion of chemistry. It has been speculated that women shy away from chemistry-related courses.

Aim and Objectives of the Study

The study aimed at examining the factors influencing the girl-child's participation in chemistry in Senior Secondary Schools in Egor Local Government Area, Edo State. Specifically, the following objectives guided this study:

1. To explore and identify effective strategies for enhancing the girl-child's participation in chemistry.

2. To assess the impact of mentoring on the girl-child's participation in chemistry.

3. To analyse the influence of teachers' attitudes on the girl-child's participation in chemistry.

Research Questions

The following questions were raised to guide the study:

1. What are the strategies for enhancing the girl-child participation in chemistry?

2. Does mentoring enhance the girl-child participation in chemistry?

3. Does the attitude of teachers enhance the girl-child participation in chemistry?

Hypotheses

The following hypotheses were formulated to guide this study:

H01: There is no significant difference in the extent to which students agreed on the strategies required to enhance the girl-child participation in chemistry based on location.

H02: There is no significant difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location.

H03: There is no significant difference in the extent to which the attitude of teachers enhances the girl-child participation in chemistry based on location.

Methodology

This study adopted a descriptive survey research design. The population of this study consisted of all the female students in Public Senior Secondary School in Egor Local Government Area of Edo State, with a total population of 5,574. The sample size of the study comprised two hundred and ninety-seven (297) female students. Multistage sampling techniques, comprising the systematic sampling technique and simple random sampling technique, were adopted to select the sample of this study. First, the systematic sampling technique was used to select the first and every third school in the population of the study. Hence, five schools will be selected. Then simple random sampling technique of balloting by replacement was used to select 10% of the female students in each of the selected schools. The instrument of the study was adapted from Oyakhirome (2021). The questionnaire has four sections. Section A covers the demographic data of the students, while part B was adapted from Mandina, Mashingaidze and Mafuta (2013). The demographic data of students covers their name of school and the school location. Section B was modified on a four-point Likert scale. The instrument was face and content validated by three experts. To test the reliability of the instruments, Cronbach Alpha was adopted to ascertain the internal consistency of the instrument, which yielded a reliability index of 0.76 for the instrument, hence, the instrument was deemed reliable. The instrument was administered by the researcher with the aid of three trained research assistants. The direct delivery and retrieval method was used. Mean and standard deviation were used to analyse the data collected to answer the research question. The hypotheses were analysed using an independent sample t-test.

Results

Research Question One: What are the strategies for enhancing the girl-child participation in chemistry?

Table 1: Strategies for enhancing the girl-child participation in chemistry

s/n		Mean	Standard deviation
1	Mentoring enhances the girl-child's participation in chemistry	2.94	1.13
2	The attitude of teachers teaching influences the girl-child participation in chemistry	2.92	1.02
3	Parental factors enhance the girl-child's participation in chemistry	2.41	1.13
4	Challenging gender biases and gender disparities in studying chemistry by enforcing girl-friendly regulations	2.74	1.10
	Grand mean	**2.75**	**1.05**

***Criterion Mean: 2.50**

Table 1 shows the strategies for enhancing the girl-child participation in chemistry. It can be observed from the response of the participants that the majority of the respondents agreed that mentoring enhances the girl-child participation in chemistry (mean=2.94), the attitude of teachers teaching influences girl child participation in chemistry (mean=2.92) and challenging gender biases and gender disparities in studying chemistry by enforcing girl friendly regulations (mean=2.74). With a grand mean of 2.75, it can be deduced that the majority of the respondents agreed on the strategies for enhancing the girl-child participation in chemistry.

Research Question Two: Does mentoring enhance the girl-child participation in chemistry?

Table 2: Mean and standard deviation distribution of mentoring enhancing the girl-child participation in chemistry

s/n		Mean	Standard deviation
1	Women teachers provide visible, immediate role models of educated women for girls to study chemistry	3.41	1.02
2	Increasing the proportion of female teachers teaching chemistry has a positive impact on female enrolments in chemistry	3.33	0.99
3	Mentorship can improve the self-confidence of female students in chemistry	2.56	1.33
4	Secondary school girls who enjoyed science could serve as mentors for younger girls in primary school	2.76	1.13
5	Younger girls are likely to respond positively to slightly older peers to whom they look up	2.68	1.18
	Grand mean	**2.94**	**1.13**

***Criterion Mean= 2.50**

Table 2 reveals how mentoring enhances the girl-child participation in chemistry. It can be seen that the majority of the respondents agreed that women teachers provide visible, immediate role models of educated women for girls to study chemistry (mean=3.41), increasing the proportion of female teachers teaching chemistry has positive impact on female enrolments in chemistry (mean= 3.33), mentorship can improve self-confidence of female students in chemistry (mean =2.56), secondary school girls who enjoyed science could serve as mentors for younger girls in primary school (mean = 2.76) and younger girls are likely to respond positively to slightly older peers to whom they look up to (mean= 2.68). However, a grand mean of 2.94 shows that the respondents agreed that mentoring enhances the girl-child participation in chemistry.

Research Question Three: Does the attitude of teachers enhance the girl-child participation in chemistry?

Table 3: Attitude of teachers enhances the girl-child participation in chemistry

s/n		Mean	Standard deviation
1	The attitude of the teacher makes girls drop out of school	3.10	0.83
2	Some teachers feel girls can only become secretaries, teachers or designers	3.06	1.03
3	The perception of teachers informs how they can teach and attend to the girls in classes	2.94	1.09
4	Chemistry teachers are more attentive to girls than boys in my school	2.83	1.12
5	Utilising girls' pictures in textbooks used for chemistry will improve female participation in chemistry.	2.67	1.03
	Grand mean	**2.92**	**1.02**

***Criterion Mean= 2.50**

Table 3 shows that the attitude of teachers enhances the girl-child participation in chemistry. It can be seen that the majority of the respondents agreed that attitude of teacher makes girls drop out of school (mean= 3.10), some teachers feel girls can only become secretaries, teachers or designers (mean= 3.06), the perception of teachers inform how they can teach and attend to the girls in classes (mean- 2.94), chemistry teachers are more attentive to girls than boy in my school (mean = 2.83) and utilizing girls picture in textbooks used for chemistry will improve female participation in chemistry (mean= 2.67). A grand mean of 2.92 shows that the respondents agreed that the attitude of teachers enhances the girl-child participation in chemistry.

$H0_1$: There is no significant difference in the extent to which students agreed on the strategies required to enhance the girl-child participation in chemistry based on location.

Table 4: Independent sample t-test on the difference in the extent to which students agreed on the strategies required to enhance the girl-child participation in chemistry based on location.

	Location	**N**	**Mean**	**Std. Deviation**	**Df**	**t-test**	**Sig.**
strategies	Urban	184	14.47	3.00	295	-2.05	0.04
	Rural	113	15.23	3.15			

The table shows the independent sample t-test for the difference in the extent to which students agreed on the strategies required to enhance the girl-child participation in chemistry based on location. It can be observed that the degree of freedom is 295, the t-test value is 2.05, and the level of significance is 0.04, which is less than the set alpha level of 0.05. Thus, the null hypothesis, which states that there is no significant difference in the extent to which students agreed on the strategies required to enhance the girl-child participation in chemistry based on location, is rejected. Thus, there is a significant difference in the extent to which students agreed on the strategies required to enhance the girl-child participation in chemistry based on location.

$H0_2$: There is no significant difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location.

Table 5: Independent sample t-test on the difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location.

	Location	N	Mean	Std. Deviation	Df	t-test	Sig.
mentoring	Urban	184	14.9565	3.37271	295	7.54	0.00
	Rural	113	11.9027	3.41207			

The table shows the independent sample t-test for the difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location. It can be observed that the degree of freedom is 295, the t-test value is 7.54, and the level of significance is 0.00, which is less than the set alpha level of 0.05. Thus, the null hypothesis, which states that there is no significant difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location, is rejected. Thus, there is a significant difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location.

$H0_3$: There is no significant difference in the extent to which the attitude of teachers enhances the girl-child participation in chemistry based on location.

Table 6: Independent sample t-test on difference in the extent to which the attitude of teachers enhances the girl-child participation in chemistry based on location.

	location	**N**	**Mean**	**Std. Deviation**	**Df**	**t-test**	**Sig.**
Attitude	urban	184	15.1033	2.06326	295	5.33	0.00
	rural	113	13.8496	1.79891			

The table shows the independent sample t-test for the difference in the extent to which the attitude of teachers enhances the girl-child participation in chemistry based on location. It can be observed that the degree of freedom is 295, the t-test value is 5.33, and the level of significance is 0.00, which is less than the set alpha level of 0.05. Thus, the null hypothesis, which states that there is no significant difference in the extent to which the attitude of teachers enhances the girl-child participation in chemistry based on location, is rejected. Thus, there is a difference in the extent to which mentoring enhances the girl-child participation in chemistry based on location.

Discussion of Findings

The study was conducted to assess the strategies that would improve the participation of girls in chemistry in senior secondary school. It was deduced that the majority of the respondents agreed on the strategies for enhancing the girl-child participation in chemistry. This is corroborated by Awortwi and Korang-Okrah (2007) when they stated that having shown that in a survey of five secondary schools in Lusaka, the majority of girls and boys agreed that housecraft was the most useful subjects for girls, while chemistry was most useful for boys thus emphasizing the influence of sex-difference stereotypes in participation and performance in chemistry and technology.

Also, it was discovered that the respondents agreed that mentoring enhances the girl-child participation in chemistry. This is corroborated by Danjuma (2010) when he stated that females who have made their mark in STEM education should serve as mentors and role models to female students from an early stage. Such a female should be invited to speak to the students on career days or other days as the need arises, as this goes a long way in encouraging the female student to study STEM and related courses. According to Khoo, as cited by Danjuma (2010), "As societies open up, they often create new opportunities for women, but those opportunities are lost when they are not trained to assume such roles."

The study showed that the respondents agreed that the attitude of teachers enhances the girl-child participation in chemistry. This is in line with Spear (1985), who posited that sex, attitude and teaching approach of teachers influence the attitude of female students, who they believe view science to be more important to boys than girls. In support, the confidence of females is low, such that their ability to study science subjects like chemistry is practically unconnected with their actual ability. According to Udeani (2012), school factors like Instructional materials, illustrations, examples and applications presented in resource materials are more familiar in general to the experiences and interests of males than to those of females.

Conclusion

This study concluded that the respondents agreed on the strategies for enhancing the girl-child participation in chemistry. The strategies were mentoring to enhance the girl-child participation in chemistry, attitude of teachers teaching influence girl child participation in chemistry and challenging gender biases and gender disparities in studying chemistry by enforcing girl-friendly regulations. Also, it was deduced that the respondents agreed that mentoring enhances the girl-child participation in chemistry. Meanwhile, they agreed that the attitude of teachers enhances the girl-child participation in chemistry. But they disagreed on the parental factor enhancing the girl-child's participation in chemistry. Meanwhile, the majority of the respondents agreed that challenging gender biases and gender disparities by enforcing girl-friendly regulations enhances the girl-child participation in chemistry.

Recommendations

Based on the findings and conclusions of this study, the following recommendations were made:

1. Promising programs need to be scaled up to reach a broader population of students. Attention must also be given across the lifetime of learning. If scientists are not born but made, increasing the number of women in science must be a long-term process that requires early and sustained attention.

2. Career days in schools should target girls, bringing in successful women across various disciplines as speakers. Counsellors should be trained to encourage girls to explore fields in which they are underrepresented. Science fairs can actively reach out to girls, incorporating the work of female scientists and educators and demonstrating the relevance of science to girls' lives and the importance of their participation.

3. More targeted efforts need to be made to reach a broader population of girls, particularly those from poor and rural households who are most marginalised.

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