GENDER REPRESENTATION IN CHEMISTRY EDUCATION IN SENIOR SECONDARY SCHOOLS IN ANKPA LOCAL GOVERNMENT AREA, KOGI STATE

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Abstract

This study is designed to examine gender representation in Chemistry education in ten selected secondary schools in Ankpa Local Government Area, Kogi State. The research design for this study is an expo- facto which involved the use of already existing data on the 27,756 chemistry students in Senior Secondary Schools (SSS) I-III and 165 Chemistry teachers in all secondary schools in Ankpa Local Area of Kogi State. A sample of 4,514 students' enrolment, 1,094 students that sat for chemistry in WAEC, 1,001 students that sat for Chemistry in NECO, all for five consecutive academic sessions (from 2016/2017 to 2021/2022) and 15 Chemistry teachers as at 2022 in ten (10) randomly sampled coeducational secondary schools in the study area. Four research questions guided this study. Descriptive statistics such as frequency counts and percentage were employed for data analysis. The results of this study revealed that male enrolment and achievement tend to outshoot the females in Chemistry education for the period studied. In addition, female Chemistry teachers are under-represented in secondary schools studied. The implication of this study is that the under representation of females has definitely given birth to meagre number of Chemistry teachers who could have served as role models. It is recommended that government and other non-government organizations should undertake a more vigorous enlightenment campaigns to disabuse the minds of females from accepting that they are less intelligent than their male counterparts.

Key Words: Gender representation, enrolment, achievement, chemistry education.

Introduction

Chemistry occupies a unique position in the scientific and technological advancement of any country in the world today (Ibrahim *et al.*, 2017). Chemistry is a central science that forms the indispensable foundation of many disciplines such as Biology, Physics, Medicine, Plant Sciences, Nuclear Chemistry, Engineering, Geology, Cosmetics, and Environmental Science (Salman, Olawoye & Yahaya, 2011). Chemistry is offered at the senior secondary classes in order to help student learn important aspects of scientific concepts that would enable them live effectively in their immediate environment (Jimson, 2018). Chemistry is an experimental and practical oriented core subject that is required in the study of many courses such as Medicine, Biochemistry, Microbiology, Pharmacy, and Engineering among others (Okafor & Uzoechi, 2012). This may account for its inclusion in school curriculum as a compulsory subject for every science students of school age to acquire the appropriate skills to cope with life challenges as observed by (Omoniyi, 2014). The relevance of Chemistry in scientific and technological development of any nation has been widely reported (Agogo & Onda, 2014). Anugwo and Asogwa (2015) argue that Chemistry has contributed greatly towards providing our basic needs and improving the quality of life. The developments of Chemistry have dramatically influenced every aspect of human life such as our health, quality of life and wealth creation. The rightful application of knowledge and skills acquired from Chemistry helps the individuals and the nation to solve everyday problems (Achumugu, 2016). According to the Nigerian Educational Research and Development Council (FRN, 2013), Chemistry is crucial for effective living in this modern age of science and technology. Chemistry education is indispensable in this 21st century.

Chemistry education as an indispensable investment requires equal participation of gender in any meaningful development. Gender, as a concept, has captured the interest of educators in Nigeria, especially now that gender equity is being emphasized in many quotas (Filgona & Sababa, 2017). In this text, the word gender is the range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between the feminine and masculine population (Adigun *et al.*, 2015). Gender in common usage refers to the sexual distribution between male and female, while the social scientist however refers to the term as a social construction rather than a biological phenomenon

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(Leonard *et al*., 2011). Also, gender refers to social differentiation or cultural distinction between male and female and the attribution of certain roles on the basis of differentiation (Abe *et al*., 2013). The Education for All (FME, 2014) has emphasized the importance of Chemistry education for all, irrespective of gender. In the same vein, the Federal Government of Nigeria (2013) through its National Policy on Education has provided equal opportunities for all citizens to study chemistry in schools irrespective of their gender.

Unfortunately, the study of chemistry in our schools is bedevilled with gender disparity. According to Olagbaju (2014) the two sexes (male and female) have differences in their strengths and weaknesses. Amedu (2015); Nwona and Akogun (2015) documented that female students have lower self-efficacy in science compared to male students. Dania (2014) found that male students perform better than female students in chemistry. On the other hand, Udo and Udofia (2014) and Furo (2014) also revealed that girls perform better than boys in schools. Ezeudu *et al*. (2015) and Natasha (2018) investigated gender effect and discovered that females perform better than males. Veloo, Hong, & Lee (2015) reveal that male students outperform their female counterparts in performance achievement in chemistry. An analysis across the STEM fields has shown that women in chemistry are underrepresented at a higher proportion than women in other STEM fields (Dabney & Tai, 2014). Ezenwafor and Obidile (2016) explained that the influence of gender and differences in academic achievement is a complex task thus many studies appear to be contradictory. In line with this observation, Joseph *et al*. (2015) found that there are no significant differences in male-female science performance at any level. Adedamola (2015) and Aniaku (2012) also contend that gender had no significant influence on students' achievement in science. While on the contrary, Azibaolanari *et al*. (2016) and Odagboyi (2015) reported a significant difference in achievement between male and female students in science.

Various reasons have been advanced for this gender inequality in sciences especially chemistry. Wang and Degol (2013) found six explanations for women under representation in science fields: (a) cognitive ability, (b) relative cognitive strengths, (c) occupational interests or preferences, (d) lifestyle values or work/family balance preferences, (e) field-specific ability beliefs, and (f) gender-related stereotypes and biases. A variety of factors have been identified as contributing to a male- dominant culture in the science professions, which in turn poses stereotype threats to women (Hazari *et al*., 2013). Background factors include gender differences in parental support (Alexander *et al*., 2012), teacher support (Patall *et al*., 2018), and prior enjoyable science experiences (Dou *et al*., 2019). Social factors include a discriminatory (Griffith, 2010), segregated (Morton & Parsons, 2018), and harassing study or work space (Clancy *et al*., 2014). In classroom, teachers encourage gender stereotype by giving different treatment to males and females in class. Teachers often go further to give different career guidance to males and females (Ezechi & Adukwu, 2018). According to Umar and Samuel (2018), girls' passive attitudes towards science subjects are also progressively formed by their day-to-day interactions with teachers and with other students. In particular, it has been well studied that gender stereotypes alone can hamper one's identity, efficacy, and performance, known as stereotype threat (Carli *et al*., 2016). Research found that those who were vulnerable to stereotype threats were likely to have a static rather than a growth perspective on their ability (Wang & Degol, 2017).

Globally, the growing importance of gender equality has been recognized, accepted and become a matter of concern. The attainment of gender equality is not only seen as an end in itself and human rights issue, but also as a prerequisite for the achievement of building a safer world (Fatile & Ejalonibu, 2016). The need to ensure gender equality in the world has however been attracting the attention of those in governments. Many conventions, conferences, seminars and workshops had been convened at international level where the issue was a theme which includes: The 1948 United Nations Charter and the Universal Declaration on Human Rights which set the tune for gender equality and women empowerment around the world. The First World Conference on Women (FWCW) held in Mexico City, Mexico (1975), followed by the Second World Conference on Women (SWCW) held in Copenhagen, Denmark (1980), then the Third World Conference on Women (TWCW) held in Nairobi, Kenya (1985) and lastly, the Fourth World Conference on Women held in Beijing, China in 1995. All these conferences championed the course of gender equality and social justice principles around the world.

Similarly, the UN General Assembly landmark Convention for the Elimination of all forms of Discrimination against Women (CEDAW) adopted in 1979, to which all African States are signatories. The United Nations (UN) World Conference on Human Rights in Vienna in 1993; World Conference on Education for All held in Joemtien, Thailand in 1990 and advocates the right of all people to education and

knowledge; World Summit for Children in New York in 1990; Education for All Summit of nine countries with the highest illiteracy rate in the world (Bangladesh, Brazil, China, Egypt, Indonesia, Nigeria, India, Mexico & Pakistan), held in New Delhi in 1993 which requires the countries to drastically reduce the illiteracy within the shortest possible time frame; Pan Africa Conference on Education for Girls, held in Ouagadougou in 1993; Statement of Commitment, held in 1998 in Durban, South Africa which requires Africa Education Ministers to pursue the goals of lifelong learning for Girls; OAU Decade of Education in Africa (1997-2000) requiring Africa States to generalize access to qualitative basic education as foundation for socio-economic development; UNESCO's *World Atlas of Gender Equality in Education*, published in 2012 ; World Education Summit, held in Dakar, Senegal in 2000 where the need to achieve Education for All by 2015 was emphasised; UN Millennium Development Goals (2000) on Gender Equality and women empowerment and the African Union Protocol on the Rights of Women in Africa (2004) and the Post-2015 Sustainable Development Goals (SDGs), which also flags 'Gender Equality and Women Empowerment' as a priority goal (Gberevbie *et al.*, 2014).

In the same direction, the 1999 Nigeria constitution also makes provision for equality of women, guarantees the rights and protects the interest of women considering the religious, traditional and cultural norms that govern the society. Since post-independence era in Nigeria, education has been emphasized both as a basic right and as a major enabling factor for the development process. There is a continual reminder that Nigeria is a signatory to various declarations of human rights 1948, 1959, 1966, 1989 and 1999, all of which agree that the child irrespective of sex has the right to good education, freedom from all forms of discriminations and freedom to participate freely in any national development programme (Allele, 2000). All these were designed to help enhance gender equality in education. In the same vein, the launching of the Universal Basic Education (UBE) and the world declaration of Education for All (NPE, 2014), to which Nigeria is a signatory, underscores the importance of education for all. Also, the Federal Government of Nigeria (2013) through its National Policy on Education has provided for equal opportunities for all citizens to study education in schools irrespective of their gender. The first indices considered by Ejumudo (2013) for this achievement is through school enrolment at the primary, secondary and tertiary levels. More so, organizations such as Nigerian Association of Women in Science, Technology and Mathematics (NAWSTEM), Nigerian Association of Women in Science and Mathematics (NAWASM), Girls and Science and Technology (GASAT) and Nigerian Association of Women Scientists (NAWAS) and Women in College of Education (WICE) do organize conferences, seminars, workshops and make publications with the aim of promoting gender equality in sciences especially chemistry education. Also, professional subject association such as Science Teachers' Association of Nigeria (STAN), Nigerian Association of Technology Teachers (NATT), Chemical Society of Nigeria (CSN) and the Mathematics Association of Nigeria (MAN) have been making meaningful contributions in the curriculum diversification in promoting gender equality.

With the various efforts directed at promoting gender equality in sciences, it is necessary to investigate the outcome of such efforts. The problem of this study is therefore to investigate gender representation in Chemistry education in selected secondary schools in Ankpa Local Government of Kogi State.

Research Questions

i). What are the differences between male and female students' enrolment in Chemistry education from 2016/2017 to 2021/2022 academic sessions?

ii). What are the differences between male and female students' achievement in Chemistry education in WAEC from 2016/2017 to 2021/2022 academic sessions?

iii). What are the differences between male and female students' achievement in Chemistry education in NECO from 2016/2017 to 2021/2022 academic sessions?

iv) What are the differences between male and female Chemistry teachers in selected secondary schools as at 2022?

Methodology

The research design adopted for this study is a non-experimental type called expo-factor design. This is because all variables had already occurred before the commencement of the study. Also, there was no treatment and manipulation of subjects. Instead, it involved the collection of data from records. The area of the study is Ankpa which one of the oldest local governments in Kogi State and falls on the Eastern flank of the state. It was created in 1968 out of the former Igala Native Authority. Ankpa Local Government Area consists of fifty seven approved (57) senior secondary schools. The target population of this study comprised of 27,756 Chemistry students in senior secondary schools one to three (SSS I- SSS III) and 165 Chemistry teachers in all secondary schools in Ankpa Local Area of Kogi

State. A sample of 5,503 students that enrolled for Chemistry from SSS I to III; 1,339 students that sat for Chemistry in West African Examination Council; 1,262 students that sat for chemistry in National Examination Council for five consecutive academic sessions and 18 Chemistry teachers presently teaching chemistry in ten (10) randomly sampled coeducational secondary schools in the study area.

Students Enrolment, Results and Staffing Proforma were used for data collection. Section A consisted of the records which contained SSI-SSIII students' enrollment lists from 2016/2017 to 2021/2022 academic sessions. Section B consisted of Senior School Certificate Examination (SSCE) results of students (both West Africa Examination Council and National Examination Council in chemistry) from 2016/2017 to 2021/2022 academic sessions. Section C is the record which contained the list of Chemistry teachers in each school under study. The data collected for the study were analyzed using descriptive statistical frequency count and percentage. Bar charts were also used to present vital information.

Research Question One: Are there differences between male and female students' enrolment in Chemistry education from 2016/2017 to 2021/2022 academic sessions?

Table 1: Gender Enrolment Status in Chemistry Education

Academic Session	Total enrolment	Male (%)	Female (%)
2016/2017	918	518(56.4)	400(43.6)
2017/2018	873	487(55.8)	386(44.2)
2018/2019	923	529(57.3)	394(42.7)
2019/2020	938	565(60.2)	373(39.8)
2020/2021	862	541(62.8)	321(37.2)
2021/2022	989	612(61.9)	377(38.1)
Total	5,503	3,252(59.1)	2,251(40.9)

Source: Examination and Record Office of Sampled Schools

Table 1 and figure 1 show that out of the 918 students that enrolled for Chemistry education in 2016/2017 academic session, 518(56.4%) were males while 400 (43.6%) were females; out of the 873 students that enrolled in 2017/2018, 487(55.8%) were males while 386(44.2%) were females; out of the 923 students that enrolled in 2018/2019, 529 (57.3%) were males while 394(42.7%) were females; out of the 938 students that enrolled in 2019/2020, 565(60.2%) were males while 373(39.8%) were females; out of the 862 students that enrolled in 2020/2021, 541(62.8%) were males while 321(37.2%) were females and out of the 989 students that enrolled in 2021/2022, 612 (61.9%) were males while 377(38.1%) were females. In the overall, out of the 5,503 students that enrolled for chemistry education for the five (5) academic sessions, 3,252(59.1%) were males while 2,251(40.9%) were females. From all indications, it is glaring that enrolment of male students tend to outshoot the females in Chemistry education for the period studied.

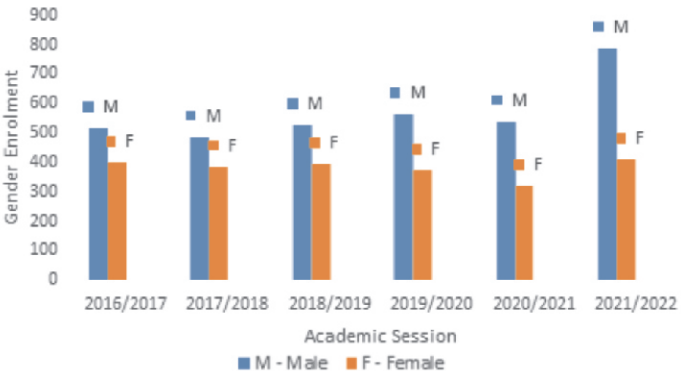

Figure 1: Gender Enrolment Status in Chemistry Education

Research Question Two: Are there differences between male and female students' achievement in Chemistry education in WAEC from 2016/2017 to 2021/2022 academic sessions?

Table 2: Gender Achievement Status of Students in Chemistry Education in WAEC.

Academic Session	Number of student	Credit and above	
		Male (%)	Female (%)
2016/2017	263	156(59.3)	107(40.7)
2017/2018	206	117(56.8)	89(43.2)
2018/2019	191	120(62.8)	71(37.2)
2019/2020	239	135(56.5)	104(43.5)
2020/2021	195	112(57.4)	83(42.6)
2021/2022	245	143(58.4)	102(41.6)
Total	1,339	783(58.5)	556(45.5)

Source: Examination and Record Office of Sampled Schools.
WAEC= West African Examinations Council.

Table 2 and figure 2 show the gender achievement status of students in Chemistry in WAEC for the periods of five academic sessions. It shows that out of the 263 students that sat for Chemistry in 2016/2017 academic session, 156 males students (59.3%) scored credit and above while 107 female students (40.7%) scored credit and above; out

of the 206 students that sat for chemistry in 2017/2018, 117 male students (56.8%) scored credit and above while 89 female students (43.2%) scored credit and above; out of the 191 students that sat for chemistry in 2018/2019, 120 male students (62.8%) scored credit and above while 71 female students (37.2%) scored credit and above; out of the 239 students that sat for chemistry in 2019/2020, 135 male students (56.5%) scored credit and above while 104 female students (43.5%) scored credit and above; out of the 195 students that sat for chemistry in 2020/2021, 112 male students (57.4%) scored credit and above while 83 female students (42.6%) scored credit and above and out of the 245 students that sat for chemistry in 2021/2022, 143 male students (58.4%) scored credit and above while 102 female students (41.6%) scored credit and above. In overall, out of the 1,339 students that sat for Chemistry for five academic sessions, 783 male students (58.5%) scored credit and above while 556 female students (45.5%) scored credit and above. This is an indication that, male students achieved better than females in Chemistry in WAEC for the period studied.

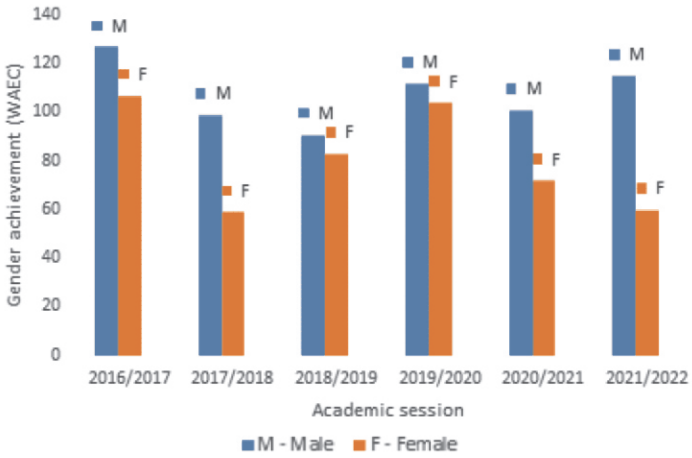

Figure 2: Gender Achievement Status of Students in Chemistry Education in WAEC

Research Question Three: Are there differences between male and female students' achievement in Chemistry education in NECO from 2016/2017 to 2021/2022 academic sessions?

Table 3 and figure 3 show the gender achievement status of students in Chemistry in NECO for the periods of five academic sessions. The table shows that out of the 249 students that sat for chemistry in 2016/2017 academic session, 156 males students (62.7%) scored credit and above while 93 female students (37.3%) scored credit and above; out of the 189 students that sat for Chemistry in 2017/2018, 114 male students (60.3%) scored credit and above while 75 female students (39.7%) scored credit and above; out of the 187 students that sat for chemistry in 2018/2019, 121 male students (64.7%) scored credit and above while 66 female students (35.5%) scored credit and above; out of the 221 students that sat for Chemistry in 2019/2020, 132 male students (59.7%) scored credit and above while 89 female students (40.3%) scored credit and above ; out of the 179 students that sat for chemistry in 2020/2021, 111 male students (62.2%) scored credit and above while 68 female students (38.0%) scored credit and above and out of the 237 students that sat for Chemistry in 2021/2022, 157 male students (66.2%) scored credit and above while 80 female students (33.8%) scored credit and above. Out of the overall 1,262 students that sat for Chemistry for five academic sessions, 791 male students (62.7%) scored credit and above while 471 female students (37.3%) scored credit and above. From all indications, it is obvious that, male students achieved better than females in Chemistry in NECO for the period studied.

Table 3: Gender Achievement Status of Students in Chemistry Education in NECO

Academic Session	Number of student	Credit and above	
		Male (%)	Female (%)
2016/2017	249	156(62.7)	93(37.3)
2017/2018	189	114(60.3)	75(39.7)
2018/2019	187	121(64.7)	66(35.3)
2019/2020	221	132(59.7)	89(40.3)
2020/2021	179	111(62.0)	68(38.0)
2021/2022	237	157(66.2)	80(33.8)
Total	1,262	791(62.7)	471(37.3)

Source: Examination and Record Office of Sampled Schools.
NECO =National Examination Council.

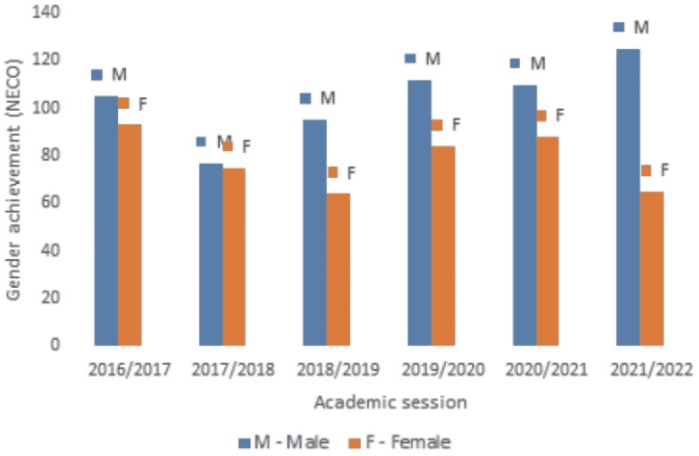

Figure 3: Gender Achievement Status of Students in Chemistry Education in NECO

Research Question Four: Are there differences between male and female Chemistry teachers in selected secondary schools as at 2022?

Table 4: Gender Status of Chemistry Teachers as at 2022

Gender	Number (%)
Male	13(72.2)
Female	5(27.8)
Total	18

Source: Principal Office of Sampled Schools

Figure 4: Gender Status of Chemistry Teachers as at 2022

Table 4 and figure 4 show gender representation among Chemistry teachers in the schools under study. It shows that out of 18 chemistry teachers presently teaching chemistry in ten (10) selected secondary schools, 13 (72.2%) were males while 5(27.8%) were females. It can be seen that female Chemistry teacher are under represented in selected secondary schools studied.

Discussion of Results

Generally, Tables 1.4 and figures 1.44 show that out of a total of 5,503 students that enrolled for Chemistry education for consecutive six academic sessions (2016/2017-2021/2022), 3,252 (59.1%) were males while 2,251 (40.9%) were females. In the same vein, out of the 18 chemistry teachers presently teaching chemistry in the sampled secondary schools, 13 (72.2%) were male chemistry teachers while 5(27.8%) were females. This is an indication that, females in terms of enrolment and staffing (as teachers) in chemistry are under represented. This result agrees with finding of Olasehinde and Olatoye (2013); Olatoye *et al*. (2016); Ceci *et al*. (2014); Dabney and Tai (2014): Miller *et al*. **(**2015) who observed that females are underrepresented in Chemistry.

In addition, this finding is in agreement with that of Unodiaku (2013); Matson (2013); Miller *et al*. (2015) which showed that females teachers are under-represented in sciences especially Chemistry. Also, results in Table 2 and figure 2 show that out of a total of 1,339 students that sat for Chemistry in WAEC for six academic sessions, 783 male students (58.5%) scored credit and above while 556 females student (45.5%) scored credit and above. Similarly, Table 3 and figure 3 show that out of a total of 1,262 students that sat for chemistry in NECO for five academic sessions, 791 male students (62.7%) scored credit and above while 471 female students ((37.3%) scored credit and above. It is obvious that, male students performed better than female students in Chemistry in WAEC/NECO for the period studied. This study is in with that of Dania (2014); Veloo ***et al*. (**2015); Nnenna and Adukwu (2018); Odagboyi (2015) who reported that the male students achieved academically better than the female students chemistry. While on the contrary, Udo and Udofia (2014) and Furo (2014) revealed that girls perform better than boys in Chemistry classrooms.

Implications of the Study

The preceding facts supplied in figures on sampled secondary schools under study, no doubt established the fact of under representation of females in Chemistry education.

The under representation of females has definitely given birth to meager number of Chemistry teachers. It is in fact a vicious circle.

Also, under representation of females may lead to over-loading of the very few available female Chemistry teachers. In our secondary schools, it is not strange again to see a Chemistry teacher engaged in the teaching of physics, mathematics or basic technology without increase in such teacher's take –home remuneration.

Again, there is also that implication of losing women who could be advocates for aids in Chemistry before the educational authorities. Women, by nature are more accommodating, ready to listen to students' problems and complaints, tender-hearted and sympathetic than men. These attributes are needed in the teaching of Chemistry.

Finally, female under representation may lead to low production of female Chemistry teachers to teach in secondary schools. These female Chemistry teachers are expected to serve as role models for girls to develop interest in chemistry education

Conclusion

It is therefore concluded that males outnumber females in Chemistry education in term of enrolment, achievement

and staffing in the sampled secondary schools for the period studied. The restoration of gender equity in Chemistry and the deliberate enhancement of Chemistry education opportunities for women are basic requirement for the proper diffusion of the spirit of Chemistry nationwide.

Recommendations

Based on the findings in this study, the following recommendations are made:

i. Government and other non-governmental organizations should undertake more vigorous enlightenment campaigns to disabuse the minds of females from accepting that they are less intelligent than their male counterparts.
ii. There should be enlightenment campaign on radio, television and news media to sensitize parents on the values of females reading science related courses especially Chemistry.
iii. Provision of special grants and scholarship for female students who are interested in studying sciences especially Chemistry from secondary to tertiary level.
iv. Schools should organize workshops for secondary school girls featuring women/females who have excelled in Chemistry and Chemistry related courses to deliver papers, in order to encourage them and as well disabuse the minds of those who consider science as a masculine domain.

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