

Impact of Gender Friendly Teacher Practices on Students' Participation and Achievement in Chemistry

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Abstract

This study was designed to investigate the impact of gender friendly classroom teacher practices on students' participation and achievement in chemistry. The design used for the study was quasi-experimental design. The non-equivalent control group was used. Three hundred and twenty (320) SS I students formed the sample. Four schools were purposively selected from fifty one co-educational schools in Nsukka education zone of Enugu State. Two intact classes were randomly assigned to experimental and control groups. The experimental group was exposed to the gender friendly classroom teacher practices (GFCTP) while the control group was exposed to the conventional classroom teacher practices (CIP). Six research questions and corresponding null hypotheses guided the study. Two instruments used for data collection were: Chemistry Achievement Test (CAT) and Classroom Participation Index Scale (CPIS). These instruments were validated. The reliability of the CAT was determined using Kuder-Richardson formula 20 (K-R 20) and a reliability index of 0.94 was obtained. An inter raters reliability was done for the participation checklist using Kendall's W Test and an index of 0.77 was obtained. The data were analyzed using mean and standard deviation for answering research questions and ANCOVA employed for testing the hypotheses, observation was analyzed using Pearson product correlation coefficient. The result revealed that the use of gender friendly classroom teacher practices enhanced students' participation in chemistry classes and promotes a high level of achievement. The students taught with the GFCTP were more superior in terms of hands -on- activities. Gender had no significant effect on students' achievement and has no significant effect on students' mean participation score. Based on the findings recommendations were made: Since the use of gender friendly classroom teacher practices has been seen to improve students achievement and enhance participation, Teachers should therefore endeavor to use the GFCTP well on their day to day lesson delivery, the curriculum planers should develop and integrate gander friendly teachers' guide for teachers, who are the key implementers of the curriculum. Government agencies and professional associations whose responsibility it is to design and review the curriculum should incorporate and emphasize the use of gender friendly classroom practices.

Introduction

Chemistry is an enterprise that offers a lot of opportunities in manufacturing such goods as Medicine, food stuffs, fragrances, paper, paints, metals, textile, agricultural products, oxygen, and chlorine among others. Other occupational opportunities offered by chemistry include analytical and consultancy services, laboratory services and consumer education services. Apart from the occupational significance, basic knowledge of chemistry is needed for self and national development, also enables one to understand and cope well with environmental degradation, such

as the depletion of ozone layer, which exposes man and other living things to health hazards. This therefore underscores the need for effective study of chemistry.

In spite of the importance of chemistry in self and national development and its' key position in relation to vocational and allied disciplines, Chemistry Education is plagued with such problems as poor achievement of candidates and lack of interest, which have led to low participation and enrolment in the subject (Akinsola&Igwe, 2009). A study carried out by Baanu, Oyelekan, Olorundare (2016), indicated that students' achievement in chemistry is still low, regardless of high self – efficacy. However, researchers have linked these problems to a number of factors, which include lack of qualified personnel (Akpan, 2009); inappropriate teaching method (Udo&Eshiet, 2011; Ahore, 2010); poor classroom management; noisy environment, unavailability of laboratory equipment and perception of chemistry as a difficult subject by students (Uzezi, Danjuma&Abdul-Kadiri, 2017). The West African Examination Council (WAEC) chief examiner in the WAEC Annual report of 2017 & 2018 attributed the poor achievement by students to lack of understanding of basic concepts and principles, and lack of students' participation in the teaching/learning process.

The concept of participation refers to students' active involvement in preparing for all exercises, discussions and projects with enthusiasm and positive attitude. Participation is important for the success of the class. It can result in insightful comments and interesting connections being made by students and can foster a high level of enthusiasm in the classroom learning environment (Brookfield, 2012). Participation is often associated with discussion, which typically involves a lengthy conversation with the class.

Charles (2008) suggested that equitable class participation could achieve the following: explore different perspectives, discover new materials and enable a student to relate relevant experience. Based on Piaget's learning theory we know that children are not passive vessels into which education and experience or knowledge is just poured. Children actively interpret their world; therefore, participation in meaningful projects, learning by doing, encouraging problem solving, should be central in teaching and learning of chemistry.

Since learning should be learner centered, there is therefore need to investigate how to enhance participation in chemistry classroom by all students irrespective of gender. Jerome Bruner's Theory of Constructivism, emphasizes the importance of the active involvement of the learner in constructing knowledge for themselves and building new ideas or concept based on current knowledge and past experience. Just teaching the subject does not mean the teacher is teaching well. When children interact with their environment through exploration of objects and work together to form hypothesis they are actively engaged. Minimally guided student centered lesson, according to Bruner, works best with activities designed to encourage searching, manipulating, exploring and investigating the content to be learnt, the learning environment and the instructional materials by the learner. This is what gender friendly teacher practice is emphasizing.

Gender friendly teacher practice refers to all the activities and teaching methods used by the teacher that promotes equity in the classroom, develop responsive learning environment that allows all students to participate on equal level, irrespective of gender. Gender refers to all the characteristics of man and woman, which a particular society has determined and assigned each sex. Ezeh (2013) describes gender as personality traits, attitudes, behaviors, values, relative power, influence, roles and expectation (femininity and masculinity) that society ascribes to the two sexes on a differential basis. Gender is important in educational system because it influences the curriculum, instructional materials, career choices and general behavior of pupils and teachers

alike. Gender has been found to be an important factor influencing learning in science class room in favor of the males (Adeyinka, 2006; United Nations Educational, Scientific & Cultural Organization (UNESCO) women in science, 2017). This therefore is suggestive that measures which will carry both male and female students along giving adequate room for their equal participation in science lessons should be put in place and adopted.

The worrisome situation here is that, despite all the research findings on how to improve on teaching and learning through different pedagogical changes, the achievement of students in chemistry remains poor over the years. It means that if student must achieve much in chemistry, something else apart from what has been regularly done, must be tried out; there must be a way of making the students actively participate in learning process they are exposed to. Halliander (2010) noted that poorly managed participation of students in classroom activities can lead to instruction frustration and students confusion. Therefore, the way and the manner a teacher presents the lesson, manages the class during the teaching period, organizes the learning environment, reacts to the responses of the students whether male or female without bias is very crucial for learning to occur in a subject like chemistry which already wears a difficult look before many students. Brookfield (2012) identified some strategies that can help manage classroom activities well, which include; being clear with definition and intention of subject matter to seek consensus, and to accommodate every student in the class activities, the teacher should seek and provide feedback; manage wait time well during class discussion and acknowledge students' contributions. The teacher should invite students' participation by giving the students time to formulate questions or responses; acknowledging all contributions even if they are not what you are looking for among other suggested classroom strategies. The teacher should as well look for opportunity to interact with individual students, selecting people in a day to summarize key points from previous lesson. The teacher should have high expectation for the success of all the students. The entire aforementioned and many more, embedded in a well developed gender friendly teacher package are going to be carefully considered and used in the teaching-learning process in the cause of this research work to find out their impact on students' participation and achievement in chemistry.

Statement of Problem

The teacher is an important determinant of the quantity and quality of learning by students in the classroom. Studies abound on this fact that the quantity and quality of learning may be dependent on the teacher's methods. However, it have been reported that what predominates in most Nigeria classrooms from primary to tertiary level is the unidirectional lecture mode with minimal use of instructional materials and lots of teacher classroom practices that are gender biased. Such bias as recruiting students to perform classroom 'chores' based on traditional gender roles which involves such act as inviting the males to handle equipment in the laboratory and inviting the female to sweep the laboratory and dust the windows; inability to use gender fair language such as using masculine pronouns all the time to describe scientists among numerous other such practices have been common in our classrooms (Hall & Sandler, 2012).

Accordingly, Mani (2010) suggests that the extent, to which a student participates in classroom activities and understands the basic concepts and principles, may depend to large extents on the teacher classroom practices. Although studies have indicated inadequate exposure of students to relevant concepts, poor mathematical skills, and lack of understanding of basic concepts and principles, as the major causes of poor achievement of students in chemistry, there is need to ensure that classroom practices of teachers enhance all students' full participation in the teaching/learning activities irrespective of gender. Studies are replete on effect of the use of gender friendly practices of teachers on the participation and achievement of students in Chemistry

classrooms, hence the need to explore such on Chemistry. The problem of this study posed as a question therefore is; what will be the impact of gender friendly classroom practices of teachers on the participation and achievement of Senior Secondary School male and female students in Chemistry?

Research Questions

The following research questions guided the study

1. What are the mean achievement scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices and those exposed to the conventional teacher classroom practices?
2. What are the mean participation scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices and those exposed to the conventional teacher classroom practices?

Research Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of significance

1. There is no significant difference between the mean achievement scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices and those exposed to the conventional teacher classroom practices.
2. There is no significant difference between the mean participation scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices and those exposed to the conventional teacher classroom practices.

Research design

The research design adopted in this study is quasi-experiment. Specifically, the non-equivalent control group design was adopted. The design is chosen because random assignment of subjects to experimental and control groups is not possible. Intact classes were used for both the experimental and control groups in their respective schools..

Population of the study

This study was carried out in Nsukka Education zone located in Enugu North of Enugu State. The population of this study comprised of all the senior secondary one (SS1) chemistry students in the sixty governments owned secondary schools in Nsukka Education zone with a total population of 23,786 students (PPSMB Nsukka Zone 2016).

Sample & Sampling Technique

The sample size for the study was 302 senior secondary one (SS1) students in Nsukka education zone. Purposive sampling was used to select only co-educational schools in this educational zone, which are fifty one in number. Four (4) schools from these fifty one (51) co-educational schools were selected by simple random sampling technique. These four schools were randomly assigned, two to each of the experimental and control groups. In each of the selected schools, two intact classes were selected using simple random sampling technique.

Experimental Procedure

The regular teachers were used in each school in the course of this study to teach the experimental groups and to teach the control groups the following topics; Introduction to chemistry; Acid, Bases

and Salts. The experimental group was exposed to the gender friendly class room practices while the control group was exposed to the conventional class room practices. One teacher delivered the lesson while another teacher served as the observer who used the activity participation check list to assess the level of the students' participation and records all the observations based on the items stipulated on the classroom participation check list. The teachers that taught both the experimental and the control groups were provided with lesson notes adequate for all the lessons.

The teachers that taught the experimental groups were given one week training, with the prepared lesson note on how to teach with the gender friendly class room practices. The teachers were trained to apply these principles and practices among others which were integrated in the lesson note; Use gender-neutral language as much as possible, giving equal opportunity for both male and females to participate in class activities and demonstrations, acknowledging wrong and right answers uniformly for male and female, increasing the time spent on observations and demonstrations, holding the same behavioral expectation for all students irrespective of gender, complementing and commenting on all students equally, teacher's facial expression should not say a different thing for boys and a different thing for girls, assigning collaborative group project, Set up a sign-up list for students to use equipment evenly among the males and female students,, creating a non threatening environment, allow mistakes, while putting right the wrong answers, demonstrate a caring attitude, students and teachers must speak in complete sentences addressing each other by name, recognizing and eliminating all form of bias during class instruction, and the teacher making him/herself available to both male and female students in class in class, during free times, before and after school.

While the teachers that taught the control groups were allowed to use a conventional lesson note. The control groups had only the original illustrations in the school certificate chemistry text books and no emphasis on gender friendly practices. All lessons were videotaped, this enabled the researcher to sit back at the end of the lesson and observe the level of participation in terms of quality and quantity. Oral interview was organized at the end of the experiment to find out some factors that affected their participation.

Instruments for Data Collection

Two instruments were used for data collection in this study namely:

- Chemistry Achievement Test (CAT): This is a test on Chemistry content, covering two major topics in Chemistry which was set to test what the students know in this subject matter before the experiment and after the experiment.
- Classroom Participation Index Scale (CPIS). This is an activity participation check list that was used to rate the students activities while the lesson was going on. Classroom participation index indicated the degree of attention, and participation of a student during the Chemistry lesson.

Method of Data Analysis:

The scores obtained from the pretest and post - test was analyzed using mean and standard deviation for answering the research question while ANCOVA was employed for testing the hypotheses. ANCOVA permits the use of the pretest as covariant to the post- test.

RESULTS

The results are presented in tables, in line with the research questions and hypotheses that guided the study. The scores obtained from the pretest and post - test will be analyzed using mean and

standard deviation for answering the research question while ANCOVA will be employed for testing the hypotheses.

Research Question 1: What are the mean achievement scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices (GFTCP) and those exposed to the conventional teacher classroom practices (CTCP)?

Table 1: Mean and Standard deviation of pretest and posttest scores of the effect of gender friendly teacher classroom practices (GFTCP) and conventional teacher classroom practices (CTCP) on students' achievement in chemistry

Variable Methods	N	Pretest		Posttest		Mean gain
		\bar{x}	SD	\bar{x}	SD	
GFTCP	152	40.22	11.88	57.36	10.02	17.14
CTCP	152	35.82	10.27	44.41	9.31	8.32

Table 1 shows that the group taught chemistry using gender friendly teacher classroom practices (GFTCP) had a pretest mean achievement score of 40.22 with a standard deviation of 11.88 and a posttest mean of 57.36 with a standard deviation of 10.02. The difference between the pretest and posttest mean was 17.14. The group taught chemistry using conventional teacher classroom practices (CTCP) had a pretest mean of 35.82 with a standard deviation of 10.27 and a posttest mean of 44.41 with a standard deviation of 6.31. The difference between the pretest and posttest mean was 8.32. However, for each of the groups, the posttest means were greater than the pretest means with the group taught using gender friendly teacher classroom practices (GFTCP) having a higher mean gain. From this result the mean achievement scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices (GFTCP) appeared to be higher than that of the students exposed to the conventional teacher classroom practices (CTCP)? In order to ascertain whether the observed difference is real or due to error variance this result was subjected to inferential testing as hereunder shown.

Hypothesis 1 There is no significant difference between the mean achievement scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices (GFTCP) and those exposed to the conventional teacher classroom practices (CTCP).

Table 2: Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement scores of students taught Chemistry using gender friendly teacher classroom practices (GFTCP) and conventional teacher classroom practices (CTCP)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	23297.835	4	5824.459	98.169	.000
Intercept	22556.816	1	22556.816	380.187	.000
Achiv pre	10227.832	1	10227.832	172.387	.000
Methods	7466.400	1	7466.400	125.844	.000
Gender	137.005	1	137.005	2.309	.130
Methods * Gender	109.166	1	109.166	1.840	.176
Error	17739.902	29	59.331		
Total	828074.000	304			
Corrected Total	41037.737	303			

The result in Table 2 shows that an F-ratio of 125.84 with associated probability value of 0.00 was obtained with respect to the achievement of the group taught Chemistry using gender friendly teacher classroom practices (GFTCP) and those taught using conventional teacher classroom practices (CTCP). Since the associated probability value of 0.00 was less than 0.05 set as level of significance, the null hypothesis (H_{01}) of no significant difference is rejected. This implies that the earlier observed difference between the overall mean achievement score of students taught the chemistry topics with gender friendly teacher classroom practices and those students' taught with the conventional teacher classroom practices as shown in table 1 is a real difference which is not attributed to the error associated with the study.

Research Question 2: What are mean participation scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices and those exposed to the conventional teacher classroom practices?

Table 3: Mean and Standard deviation of pretest and posttest scores of the effect of gender friendly teacher classroom practices (GFTCP) and conventional teacher classroom practices (CTCP) on students' participation in chemistry

Variable	Pretest		Posttest		Mean gain
Methods	N	\bar{x}	SD	\bar{x}	
GFTCP	152	4.06	1.16	9.13	5.07
CTCP	152	4.09	1.28	6.09	2.00

Table 3 shows that the group taught chemistry using gender friendly teacher classroom practices (GFTCP) had a pretest mean participation score of 4.06 with a standard deviation of 1.16 and a posttest mean of 9.13 with a standard deviation of 1.19. Mean gain was 5.07. The group taught chemistry using conventional teacher classroom practices (CTCP) had a pretest mean of 4.09 with a standard deviation of 1.28 and a posttest mean of 6.09 with a standard deviation of 1.28. The mean gain was 2.00. The groups taught using gender friendly teacher classroom practices (GFTCP) appeared to have a higher participation mean gain of 5.07 while the CTCP group had a lower mean

gain of 2.00. In order to ascertain whether the observed difference is real or due to error variance this result was subjected to inferential testing as hereunder shown.

Hypothesis 2 There is no significant difference between the mean participation scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices and those exposed to the conventional teacher classroom practices.

Table 4: Analysis of Covariance (ANCOVA) of the significant difference in the mean participation scores of students taught Chemistry using friendly teacher classroom practices (GFTCP) and conventional teacher classroom practices (CTCP)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1124.490 ^a	4	281.122	2.1173	.000
Intercept	334.673	1	334.673	2.5203	.000
Part pre	422.005	1	422.005	3.1783	.000
Methods	690.517	1	690.517	5.2003	.000
Gender	.009	1	.009	.067	.795
Methods * Gender	.011	1	.011	.081	.776
Error	39.708	299	.133		
Total	18778.000	304			
Corrected Total	1164.197	303			

The result in Table 4 shows that an F-ratio of 5.20 with associated probability value of 0.00 was obtained with respect to the participation of the group taught Chemistry using gender friendly teacher classroom practices (GFTCP) and those taught using conventional teacher classroom practices (CTCP). Since the associated probability value of 0.00 is less than 0.05 set as level of significance, the null hypothesis, is rejected. Thus, there is a significant difference between the mean participation scores of senior secondary school chemistry students exposed to gender friendly teacher classroom practices (GFTCP) and those exposed to the conventional teacher classroom practices (CTCP) with those taught using gender friendly teacher classroom practices having a higher mean participation gain. This implies that the earlier observed difference between the overall mean participation gain score of students taught the chemistry topics with gender friendly teacher classroom practices and those students' taught with the conventional teacher classroom practices as shown in table 3 is a real difference which is not attributed to the error associated with the study.

Discussion

The findings of the study revealed that the students taught chemistry using the gender friendly classroom practices (GFCTP) performed better in the achievement tests than the students taught chemistry using the conventional teacher practices (CTP). This implies that when a teacher uses the gender friendly teacher classroom practices in teaching chemistry, achievement of students in chemistry is higher when compared to the conventional practice. This could be explained by the fact that the gender friendly teacher classroom practices begin with strategies and ideas that create learning settings that encourage all students in science focusing on the emotional and physical

organization of the classroom. The result here agrees with the findings of Agbi (2006), that teaching methods have statistically significant effect on the achievement and interest of students in chemistry.

This is also agrees with Okafor (2008), that the achievement of secondary school chemistry students was not dependent mainly on learning environment, but also on method and gender. This present research work has shown that good learning environment, which involves the use of gender friendly classroom practices, enhances the achievement of both male and female students in chemistry.

The result from Table 3 reveals that the group taught chemistry using the gender friendly teacher classroom practices have a higher participation mean gain than those taught with the conventional teacher practices, indicating that as the teacher uses the GFCTP approach to deliver every lesson in chemistry, the students' level of participation will improve significantly. It was noted during the observations, that the students in the experimental group (GFCTP group) both male and female were readily taking active part in all the classroom activities, and experiments. The students in this group were seen asking and answering questions, taking down notes, subsequently it was discovered that very few arrived late for lessons and many were ready to initiate their own ideas in each topic taught. Interestingly, no student appeared confused and distracted in the experimental class but majority were confused and distracted in the control group. This finding agrees with that of Beam and Peterson (2008) that class participation enables students to take risk. It also increased their exposure to other ways of thinking as well as enabled them to demonstrate and develop their communication skills. Indeed, participation increased engagement of students in class work, provided the students and the teachers with feedback, and thereby increased their achievement; it therefore implies that participation positively affected achievement. The finding of this research is in line with Guido and West (2017), which found that involving students in test construction enhanced their participation and retention in geometrical contents. Hence participation generally increased the students 'achievement.

Conclusion

Based on the discussions of the findings the following conclusions can be made;

1. The use of gender friendly teacher classroom practices in teaching chemistry significantly increased students' mean achievement, in chemistry.
2. Gender friendly teacher classroom practices enhanced the participation mean score of students in chemistry.

Educational Implication of Findings

This research has established the fact that the use of gender friendly teacher classroom practices increases students' achievement and participation. This means that the classroom practices of teachers, if made gender friendly, will change the longtime historic report of student's poor achievement in chemistry both at the secondary and tertiary levels of education. This work has shown that if the students are made to participate more in their classroom activities, through the use of gender friendly teaching packages, their achievement will be higher. Student were aroused and became more eager to participate, hence learning increased.

There should therefore be a zero tolerance of any form of bias towards either gender, regarding fair and equal instruction. The responsibility belong to everyone; schools and school teachers, the government, the policy makers and the curriculum planners, to ensure that fairness and equity in the classroom are not just catchy buzz words but are pillars upon which learning is built.

Recommendations of the study

In view of the findings of this study, the following recommendations were made:

1. The arm of government in charge of post primary schools should organize training programs periodically for teachers on the use of gender friendly classroom practices, or organizes periodic workshops to educate teachers on the use of GFCTP.
2. Curriculum planners should develop and integrate gender friendly teachers' guide for teachers, who are the key implementers of the curriculum. Teachers should therefore endeavor to use the GFCTP well on their day to day lesson delivery.
3. Government agencies and professional associations whose responsibility it is to design and review the curriculum for secondary school should incorporate and emphasize the use of gender friendly classroom practices.
4. Government and professional bodies like STAN should sponsor further research on other ways of enhancing equity in chemistry classrooms both at the secondary and tertiary institutions.
6. There is a call for periodic analysis/evaluation of chemistry curriculum and chemistry text books with a view to eliminating some gender bias that could disrupt gender equality in chemistry classrooms.

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