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Bridging gender disparities in senior secondary chemistry: What magic can Entrepreneurial-Motivated-Approach perform?

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Abstract

This study investigated the impact of Entrepreneurial-Motivated-Approach in bridging gender disparities in achievement among senior secondary chemistry students. The study adopted pre-test, post-test nonequivalent quasi-experimental design. The sample comprised 118 senior secondary 2 chemistry students with 58 students in the experimental group (30 male; 28 female) and 60 students in the control group (27 male; 33 female) in two intact classes from two senior secondary schools in Education District V, Lagos State, Nigeria. The experimental group was taught using Entrepreneurial-Motivated-Approach while the control group was taught the same concepts for a period of six weeks using the conventional lecture method. Chemistry Cognitive Achievement Test and Chemistry Practical Achievement Test were used for data collection after validated by experts in test and measurement, and chemistry entrepreneurship. The reliability coefficients of the CCAT and CPAT were established using K-21 which yielded 0.87 and 0.76 respectively. The research questions were answered using mean and standard deviation while the hypotheses were tested using multiple analysis of covariance (MANCOVA) at 0.05 level of significance. Results revealed that gender had no significant effect on the students' cognitive achievement [F(1,56)=.02; p>0.05] and practical achievement [F(1,56)=.48; p>0.05] in chemistry when taught using Entrepreneurial-Motivated-Approach. The study therefore recommended among others that Chemistry teachers should make effective use of Entrepreneurial-Motivated-Approach in chemistry instructions and the Curriculum planners should ensure the incorporation of entrepreneurial modules in the learning experience of senior secondary chemistry curriculum and textbooks to ensure skills acquisition among chemistry students.

Keywords: Chemistry; Entrepreneurial-Motivated-Approach; Gender; Cognitive achievement; Practical achievement

1. Introduction

Chemistry is an important branch of science which deals with the study of the nature and properties of matters and substances that make up our environment and the various changes which they undergo. Ababio [1] defined chemistry as a subject that deals with the composition, properties and uses of matter which lobes into the principles governing the changes that matters undergo. Chemistry is a compulsory subject for science students in Nigeria senior secondary schools and it is often referred to as a central science because the choice of courses and careers in science and technology is determined by how well a student performs in chemistry at senior secondary level. Today, chemistry has grown into a very diverse field as there is diverse overlap between chemistry and other branches of science and technology such as biochemistry (chemistry and biology), physical chemistry (chemistry and physics), medical chemistry (medicine and chemistry) among others. Hence, a student who has deficiency in chemistry will definitely not be offered any course of study in the faculties of science, medicine, engineering and other science related faculties [2]. The senior secondary

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chemistry curriculum in Nigeria emphasized that chemistry should be taught as activity-based subject in such a way that teachers teach the subject in an engaging mode so as to produce learners who can be critical thinkers, innovative, productive and economically comfortable rather than those seeking for white collar job where none is available [3]. Dike and Avwiri [4] affirmed that cognitive development in chemistry should be backed with real practical oriented activities in schools to enable students acquire high order high order cognitive thinking and practical skills.

Many studies carried out over the years to determine factors that influence students' achievement in Chemistry have revealed inadequate content knowledge and ineffective methodology by teachers, inadequate or lack of laboratory equipment, poor students' attitude towards chemistry, non-conducive learning environment as well as dominated socio-cultural lapses [5, 6, 7]; inability of students to tackle most of the chemistry problems, poor expression, use of non-chemical terms, poor preparation towards the examination, non-familiarity with the syllabus, inability to present their answers or results in systematic manners and poor exposure to practical [8, 9, 10]. More so, it was reported by [11, 12] that majority of learners are exposed to practical experiences only when they are being prepared for their terminal certificate examination which has led to poor achievement in chemistry. This abysmal performance in chemistry is no gender exception as it cuts across both male and female.

Gender issues on the part of the teachers and students, have been documented to affect achievement in science and chemistry in particular [13, 14, 15, 16]. A survey study by [17] in selected educational institutions in Sub-Saharan Africa, found that gender played a significant role in the performance in core science subjects. Some studies had also submitted opinions on the influence of gender disparities on students' achievement in chemistry with no significant differences [18, 19, 20, 21, 22]. Kauru [23] in a study compared the performance of students in mathematics and other science subjects and reported that female students outperformed their male counterparts in Biology while the male students performed better than female students in mathematics, physics and chemistry. In view of this, [24] affirmed that psychological, interest, and motivation factors were the main stumbling blocks for female students in chemistry. Additionally, study by [25] concluded that fewer male students and majority of female students are enmeshed by the phobia of studying chemistry due to brain tasking activities involved, learning chemical formulas by heartand inability to score pass marks due to incorrect formulae in calculations. According to them teachers' instructional strategies, psychological factors, parental influence and peer group pressure were found to influence students' perceptions of chemistry with male students showing greater positive attitude towards studying chemistry.

There are many conflicting results in gender related researches in sciences as studies vary in their learning contents and contexts which include research tasks, school environments, classroom and laboratory settings, methodology, population and sample, unequal exposure of males and females to learning instructions among others. In Nigeria and perhaps Africa as a whole, gender bias is still very prevalent [26] and this has been a major concern to science educators especially with increasing emphasis on boosting manpower for science and technological development as well asincreasing the population of female participation in science and technology disciplines. It has become imperative thereforeto close the gender gap in students' achievement in science particularly in chemistry. Thus, chemistry teachers should be encouraged to teachchemistry concepts through activity-based approaches in which Entrepreneurial-Motivated-Approach is one.

Conceptually, Entrepreneurial-Motivated-Approach (EMA) is an approach to teaching that enables learners acquire knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex questions, problem or challenges [27]. Gibbs [28] asserted that Entrepreneurial-Motivated-Approach emphasizes students' activities in learning. The learning situations here are flexible, interactive and based on multidimensional knowledge development. In a likewise manner, [29] highlighted the objectives of Entrepreneurial-Motivated-Approach as: developing entrepreneurial drive among students thereby raising awareness and motivation; training students in what is needed to set up a business and to manage its growth; and developing students' entrepreneurial abilities needed to identify and exploit business opportunities. According to [30] Entrepreneurial-Motivated-Approach is a powerful pedagogical approach aim at developing learner's deeper conceptual understanding and more applicable knowledge and skills in solving problem of its environment. Fundamentally, Entrepreneurial-Motivated-Approach as a teaching and learning model emphasizes learners-centred instruction by assigning learning task to students through production so as to be constructive in knowledge and skill acquisition [2].

Over the years, chemistry teachers in secondary schools have been teaching chemistry concepts using different methods to ensure that the subject is well taught and comprehended by their students and more so to promote gender equity in chemistry classrooms. Despite the application of these methods, students have not really been performing up to expectations [31, 32]. More so, the teaching of Chemistry in secondary schools is devoid of regular hands-on and minds-on practical activities in most laboratories and most topics are taught without the appropriate demonstrations [4]. It is based on this premise that the study investigated the impact of Entrepreneurial-Motivated-Approach in bridging gender

differences in achievement among senior secondary chemistry students. The study aims to answer the following questions.

- Is there any gender difference in cognitive achievement of students taught with Entrepreneurial-Motivated-Approach and conventional method?
- Is there any gender difference in practical achievement of students taught with Entrepreneurial-Motivated-Approach and conventional method?

1.1. Null Hypotheses

- $H0_1$: There is no significant main effect of gender on senior secondary students' cognitive achievement in chemistry when taught using Entrepreneurial-Motivated-Approach.
- $H0_2$: There is no significant main effect of gender on senior secondary students' practical achievement in chemistry when taught using Entrepreneurial-Motivated-Approach.
- $H0_3$: There is no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' cognitive achievement in chemistry.
- $H0_4$: There is no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' practical achievement in chemistry.

2. Methodology

2.1. Design

This study adopted a non-randomized pretest, posttest quasi-experimental design. The population of this study comprised all senior secondary 2 chemistry students in public senior secondary schools in Lagos State Education District V. Two senior secondary schools with relatively similar characteristics in terms of chemistry teachers' qualifications, functional chemistry laboratories, students' population and location (semi-urban) were purposefully selected from all senior secondary schools in Ojo and Badagry zones of the district. The school from Ojo zone formed the experimental group (Entrepreneurial-Motivated-Approach group) and the school from Badagry zone formed the control group (conventional method group). The chemistry students in two nonequivalent intact classes of SS 2A in the schools formed the samples for the study. Both classes comprised male and female students as shown in the table below.

Table 1 Sample size for the study

SN	Groups	Male students	Female students	Total
1.	Experimental Group (EMA)	30	28	58
2.	Control Group (CM)	27	33	60
	Total	57	61	118

2.2. Research Instruments

The Chemistry Cognitive Achievement Test (CCAT) and Chemistry Practical Achievement Test (CPAT) were used to collect data for the study. The CCAT which was drawn by the Researchers on the concept of chlorine and saponification had three sections; A, B and C. Section A contained demographic information of the students, section B contained of 25 multiple choice questions while section B contained short and long essay questions. This is in line with WAEC format of setting external examination question. Each item of the multiple choices had three distractors and one key. Consequently, the CPAT had two sections. Section A contained the demographic information of the students while section B contained test of practical knowledge and skills on the concepts of chlorine and saponification. The WAEC styles of setting practical questions was adopted which aimed at testing students' knowledge of the reactions that occurs among substances was used. These two instruments were developed by the Researchers with the aid of commonly used senior secondary school 2 chemistry textbooks as well as WAEC past questions (2012-2021) in line with SS II curriculum and the performance objectives highlighted in the Teachers' Instructional Guides for the study.

To validate the instruments, the Researchers employed the services of two SS 2 chemistry teachers currently teaching in senior secondary schools and two Lecturers in chemistry entrepreneurship from Lagos State University of Education,

Oto/Ijanikin to check for the appropriateness of the items in terms of the language used, class level and content coverage. All these variables were satisfied suitable for the study before the Researchers proceeded to use the instruments. Meanwhile, the reliability of the CCAT and CPAT were determined using test-retest method and data generated from the tests were analyzed using Kuder Richardson-21 formula. The results showed reliability indexes of 0.87 and 0.78 respectively.

2.3. Data Gathering Procedures

The Researchers sought for the approval from the Lagos State Education District V authority to have access to the selected senior secondary schools selected for the study. Thereafter, the Researchers went to each school to brief the chemistry teachers about the purpose of the study and informed the students to voluntarily participate in the study. Two chemistry teachers in the each of the two senior secondary schools formed the Research Assistants. The reason for engaging their regular chemistry teachers to teach the students was to help eliminate any form of bias that would have occurred if the Researchers had a direct involvement in teaching the students.

The two chemistry teachers from the experimental school were trained on how to effectively use Entrepreneurial-Motivated-Approach for the delivery of chemistry classroom activities and laboratory practical activities in order for them to acquire the necessary entrepreneurial skills to be adopted as intervention in the study. The training lasted for one week using validated Teachers' Instructional Guide on Entrepreneurial-Motivated-Approach (TIGEMA) prepared by the Researchers. This instructional guide was in form of lesson plans consisting of general information, performance objectives, instructional aids, content, procedures, teachers and students activities and so on based on selected concepts. The TIGEMA consisted of six lesson plans, three of which are on the concept of chlorine and the remaining three are on the concept of saponification. At the end of the training session, the Researchers assessed the Research Assistants as each of them undertook a mock presentation session using the teaching strategy in-order to measure their level of compliance and to offer help where necessary. Their performances were found satisfactory. The two Research Assistants for control group were also briefed on the adoption of conventional lecture method using the validated Teachers' Instructional Guide on Conventional Method (TIGCM) prepared by the Researchers. The TIGCM contained the same contents as the TIGEMA but different teaching procedures.

The CCAT and CPAT were administered as pretests to all the sampled students in both groups prior to the treatment. The pretests served as covariates to control for the initial differences among the subjects. The test scripts were collected by the Researchers for marking and recording of the scores. Thereafter, the treatment packages prepared by the Researchers were used by the Research Assistants in teaching the two concepts in their respective schools and the treatment lasted for six weeks. The Research Assistants in the experimental group exposed the students to chemistry learning with Entrepreneurial-Motivated-Approach. Meanwhile, the Entrepreneurial-Motivated-Approach chemistry teaching consisted of classroom activities (lecture discussion with integration of EMA and demonstration), laboratory activity, product-making activity (skills and competence in entrepreneurship) and presentation activity (group discussion on the output/product) based on the concepts of chlorine and saponification. The Research Assistants were supervised properly by the Researchers during the classroom and laboratory activities to ensure that they did not deviate from the set lesson plan and procedures. In the laboratory and product making activities, presentation activities**,** the 60 **s**tudents were grouped into small mixed experimental groups of twelve, each comprising of male and female. Each group consisted five members and to ensure effectiveness, the twelve groups were further divided into two sets. The first set was allowed to carry out their productions of bleach under the concept of chlorine and liquid soap under the concept of saponification. Simultaneously, this was follow by the second set. The Researchers and Research Assistants ensured that all members of the group participated actively in the production activities and each small group performance was adjudged the individual performance in the group for the practical activities.

Furthermore, the Research Assistants in the control group taught the students the same concepts using the conventional lecture method. In order to make the control group get acquainted with the production processes, the students in the control group were taught how to produce bleach and liquid soap using the conventional lecture method. The Research Assistants were supervised properly by the Researchers during the classroom and laboratory activities to ensure that they did not deviate from the set lesson plan and procedures.

The reshuffled versions of the CCAT and CPAT pretest questions were administered as posttests to the experimental group and control group after the completion of both the classroom and hands-on laboratory practical activities. The test scripts were collected by the Researchers for marking and recording of the scores for further processing.

2.4. Methods of Data Analysis

Data collected from the CCAT and CPAT were analyzed with descriptive statistics (means and standard deviation) and inferential statistics (multiple analysis of covariance) at 0.05 level of significance using the Statistical Package for Social Science (SPSS 23.0).

3. Results

3.1. Research Question 1

Is there any gender difference in cognitive achievement of students taught with Entrepreneurial-Motivated-Approach and conventional method?

Table 2 Mean and SD showing gender difference in cognitive achievement of students taught with Entrepreneurial-Motivated-Approach and conventional method

Gender	Groups	N	Mean		Mean Diff.	SD		SD Diff.
			Post test	Pre test		Post test	Pre test	
Male	EMA	30	29.87	16.17	13.07	6.92	3.24	3.68
	CM	27	19.78	14.81	4.97	4.55	2.67	1.88
Female	EMA	28	28.46	14.42	14.04	7.60	3.12	4.48
	CM	33	19.24	14.21	5.03	5.71	2.32	3.39

Table 2 shows that the posttest mean and SD cognitive achievement scores of male students in Entrepreneurial-Motivated-Approach group are 29.87 and 6.92 while that of the female students are 28.46 and 7.60 respectively. In the conventional method group, the posttest mean and SD of cognitive achievement scores of male students are 19.78 and 4.55 while that of the female students are 19.24 and 5.71 respectively. The result indicates that the male students mean and SD cognitive achievement scores are marginally higher than the female mean and SD cognitive achievement scores.

The table further reveals that in Entrepreneurial-Motivated-Approach group, the pretest mean and SD cognitive achievement scores of male students in Entrepreneurial Motivated Approach group are 16.17 and 3.24 while that of female students are 14.42 and 3.12 respectively. In the conventional method group, the pretest mean and SD cognitive achievement scores of male students are 14.81 and 2.76 while that of the female students are 14.21 and 2.32 respectively. This implies that the male mean and SD cognitive achievement scores are higher than female students' mean and SD cognitive achievement scores prior to the treatment. To find out whether the observed effect was significant, null hypothesis 1 was tested.

3.2. Hypothesis 1

- $H0_1$: There is no significant main effect of gender on senior secondary students' cognitive achievement in chemistry when taught using Entrepreneurial-Motivated-Approach.

Table 3 MANCOVA showing the effect of gender on senior secondary students' cognitive achievement in chemistry

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected model	Post-Achievement	5233.709a	6	872.285	45.917	.000
Pre-Achievement		547.341	1	1547.341	81.452	.000
Gender		.292	1	.292	.015	.902
Error		2108.664	56	18.997		

a. R Squared = .713 (Adjusted R Squared = .697)

The F-value associated with pre-achievement of students in Table 3 was found to be significant [F(1,56)=81.452; p<.05], implying that before the treatment, the male and female students in the two instructional groups had different cognitive achievement levels. The post test result on Table 3 further reveals that gender has no significant main effect on students' cognitive achievement in chemistry [F(1,56)=.02; p>0.05] after the treatment. This depicts that the use of the Entrepreneurial-Motivated-Approach has no interception effect on gender difference in terms of students' cognitive achievement in chemistry. Thus, the null hypothesis that there is no significant main effect of gender on senior secondary students' cognitive achievement in chemistry when taught using Entrepreneurial-Motivated-Approach is not rejected.

3.3. Research Question 2

Is there any gender difference in practical achievement of students taught with Entrepreneurial-Motivated-Approach and conventional method?

Table 4 Mean and SD showing gender difference in practical achievement of students taught with Entrepreneurial-Motivated-Approach and conventional method

Gender	Groups	N	Mean		Mean Diff.	SD		SD Diff.
			Posttest	Pretest		Posttest	Pretest	
Male	EMA	30	27.53	7.13	20.40	7.93	1.64	6.26
	CM	27	20.26	5.56	14.70	5.26	1.41	3.85
Female	EMA	28	28.21	7.39	20.82	7.79	1.89	5.90
	CM	33	19.88	5.21	14.67	5.57	1.30	4.27

Table 4 reveals that the posttest mean and SD practical achievement scores of male students Entrepreneurial-Motivated-Approach group are 27.53 and 7.93 while that of the female students are 28.21 and 7.79 respectively. In the conventional method group, the posttest mean and SD practical achievement scores of male students are 20.26 and 5.26 while that of the female students are 19.88 and 5.57 respectively. The result indicates that the female students mean and SD practical achievement scores were marginally higher than male mean and SD practical achievement scores in the EMA group but the male students performed better that their female counterparts in the conventional group.

The table further reveals that the pretest mean and SD practical achievement scores of male students in Entrepreneurial-Motivated-Approach group are 7.13 and 1.64 while that of female students are 7.34 and 1.89 respectively. In the conventional method group, the pretest mean and SD practical achievement scores of male students are 5.56 and 1.41 while that of the female students are 5.21 and 1.30 respectively. This implies that the male performed lesser than female students in the Entrepreneurial-Motivated-Approach group prior to the treatment. However, in the conventional method group male performed better than female students prior to the treatment. To determine whether the observed effect was significant, null hypothesis 2 was tested.

3.4. Hypothesis 2

- $H0_2$: There is no significant main effect of gender on senior secondary students' practical achievement in chemistry when taught using Entrepreneurial-Motivated-Approach.

Table 5 MANCOVA showing the effect of gender on senior secondary students' practical achievement in chemistry

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected model	Post-Achievement	3098.378b	6	516.396	14.761	.000
Pre-Achievement		312.239	1	312.239	8.925	.003
Gender		16.779	1	16.779	.480	.490
Error		3883.190	56	34.984		

b. R Squared = .444 (Adjusted R Squared = .414)

The F-value associated with pre-achievement of students was found to be significant [F(1,56)=8.93; p<.05]. This demonstrates that before the treatment, the male and female students in the two instructional groups had different practical achievement. The post test result on table 4 reveals that gender has no significant main effect of gender on students' practical achievement in chemistry [F(1,56)=.48; p>0.05]. This implies that the use of the Entrepreneurial-Motivated-Approach has no significant influence on gender in terms students' practical achievement in chemistry. Therefore, the null hypothesis which states that there is no significant main effect of gender on senior secondary students' practical achievement in chemistry when taught using Entrepreneurial-Motivated-Approach is not rejected.

3.5. Hypothesis 3

- $H0_3$: There is no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' cognitive achievementin chemistry.

Table 6 MANCOVA showing interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' cognitive achievement in chemistry

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected model	Post-Achievement	5233.709a	6	872.285	45.917	.000
Pre-Achievement		1547.341	1	1547.341	81.452	.000
Groups* Gender		.019	1	.019	.001	.975
Error		108.664	56	18.997		

a. R Squared = .713 (Adjusted R Squared = .697)

Prior to the treatment, the pretest achievement of students was found to be significant [F(1,56)=81.45; p<.05] implying that there was interaction effect of method and gender on students' cognitive achievement in chemistry. The post test result in Table 6 reveals no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on students' cognitive achievement in chemistry [F(1,111)=.00; p>0.05]. Therefore, the null hypothesis which states that there is no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' cognitive achievementin chemistry is not rejected.

3.6. Hypothesis 4

- H04: There is no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' practical achievement in chemistry.

Table 7 Interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' practical achievement in chemistry

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected model	Post-Achievement	3098.378b	6	516.396	14.761	.000
Pre-Achievement		312.239	1	312.239	8.925	.003
Groups* Gender		16.755	1	16.755	.479	.490
Error		3883.190	56	34.984		

b. R Squared = .444 (Adjusted R Squared = .414)

The F-value associated with pre-achievement of students prior to the treatment shows significant interaction effect of method and gender on students' practical achievement in chemistry[F(1,56)=8.93; p<.05]. Table 7 further reveals no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on students' practical achievement in chemistry [F(1,111)=.48; p>0.05] after the treatment. Therefore, the null hypothesis which states that there is no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on senior secondary students' practical achievementin chemistry is not rejected.

4. Discussion

Research Question 1 seeks to find out the gender difference in cognitive achievement of senior secondary students' when taught using Entrepreneurial-Motivated-Approach in chemistry. Result on Table 1 shows that the posttest mean and SD cognitive achievement scores of male students in Entrepreneurial-Motivated-Approach group are 29.87 and 6.92 while that of the female students are 28.46 and 7.60 respectively. In the conventional method group, the posttest mean and SD of cognitive achievement scores of male students are 19.78 and 4.55 while that of the female students are 19.24 and 5.71 respectively. The result indicates that the male students mean and SD cognitive achievement scores are marginally higher than the female mean and SD cognitive achievement scores. To determine whether the observed effect was significant, analysis of null hypothesis 1 on table 3 reveals that gender has no significant main effect on students' cognitive achievement in chemistry [$F(1,56)=.02$; $p>0.05$]. This implies that the use of Entrepreneurial-Motivated-Approach has no interception effect on gender difference in students' cognitive achievement in chemistry.

This finding is in agreement [18] who found no significant difference in the performance mean scores of male and female Undergraduate Chemistry Students. Similarly, [30] found that use of the entrepreneurship and conventional teaching approaches has no interception effect on gender difference in terms of students' performance in biology concepts. Muhammed [33] found no significant difference in the impact of skills acquisition on the performance of male and female among students in science. Consequently, the submission of [19] found that there is no statistically significant difference in the achievement of male and female students in volumetric analysis using guided discovery

In contrast to the finding of this study, [13, 34, 14, 35, 22] stressed that there is a positive correlation between gender and students' achievement in sciences. Likewise, [36] found that male students performed better relative to their female counterparts in subjects requiring quantitative ability. This confirmed the submission of [16] in their study which revealed that male students performed better than their female counterpart in physics. In the same vein, [37] identified gender differences among students' entrepreneurial characteristics and their relationship with performance. The result also aligns with that of [38] who found that male students performed better than female students in electrolysis when taught with analogy.

The similitude between these studies could be because Entrepreneurial-Motivated-Approach is gender friendly, was able to arouse the learners' interest, engaged them in active participation, and engendered individual learning. More so, when gender-friendly strategies are employed for chemistry teaching, gender barriers will dismiss. Hence, male and female learners will learn optimally and attain or achieve desirably in science. The difference between these previous studies and the present study could be due to differences in scope, population, concepts, and location.

The findings on gender difference in practical achievement of chemistry students in Table 4 reveals that the posttest mean and SD practical achievement scores of male students in Entrepreneurial-Motivated-Approach group are 27.53 and 7.93 while that of the female students are 28.21 and 7.79 respectively. In the conventional method group, the posttest mean and SD practical achievement scores of male students are 20.26 and 5.26 while that of the female students are 19.88 and 5.57 respectively. The result indicates that the female students mean and SD practical achievement scores were marginally higher than male mean and SD practical achievement scores in the Entrepreneurial-Motivated-Approach group but the male students performed better that their female counterparts in the conventional group. Further confirmation with null hypothesis 2 (Table 5) depicts that gender has no significant effect on students' practical achievement in chemistry [$F(1,56)=.48$; $p>0.05$] when taught using Entrepreneurial-Motivated-Approach. This implies that the use of Entrepreneurial-Motivated-Approach has no significant interception effect on gender difference in terms of students' practical achievement in chemistry.

This finding agrees with [39, 40] who in their studies examined the effect of gender on students' achievement in stoichiometry using hands-on activities and found no significant difference in the mean achievement scores between male and female students. Similarly, [41] found that male and female students' performance in a test of theoretical knowledge in chemistry does not significantly determine their performance in alternative to test of practical knowledge of Chemistry. Thus, this result is not surprising, as one may have observed, it appears that as entrepreneurship is penetrating every facet of human endeavour, women participation in all what used to be men dominated arena is now on the increase and vice versa. At home and in school, our girl-children do as much as the males with their practical equipment, exploring its functions for whatever they wish.

This finding however disagrees with that of [42, 43, 21] who reported statistical significant difference in the performance of male and female students taught acid-base reactions using computer simulation instructional strategy. To lend support to the above, [44, 40, 45] in their separate studies in various disciplines affirmed that there is significant difference between male and female students' performance when exposed to project-based approach, concept mapping,

outdoor laboratory instructional strategies and demonstration method. In addition, [46] in their study on gender gaps in the performance of Norwegian biology students found that female students expressed more test anxiety than did their male counterparts, and the anxiety they experienced negatively predicted their performance in class.

The third and fourth hypotheses which sought statistical significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on students' cognitive and practical achievements in chemistry were analyzed in Tables 6 and 7 respectively. Finding in Table 6 reveals no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on students' cognitive achievement in chemistry [$F(1,111)=.00$; $p>0.05$] in chemistry. Further result in Table 7 shows no significant interaction effect of treatment (Entrepreneurial-Motivated-Approach) and gender on students' practical achievement in chemistry [$F(1,111)=.48$; $p>0.05$]. This finding might be attributed to the fact that the strategy employed in this study was able to arouse the interest of the learners across gender and also engaged them in active participation in classroom and laboratory activities.

These results are in agreement with that of [2, 47, 39] who reported that no statistically significant interaction effect of gender and method was found in the performance of senior secondary chemistry students. Similarly, [48] reported no significant two-way interaction effect of strategy and gender on 7th-grade students' achievement in science. It could be inferred from this that interaction between teaching strategy and gender may not necessarily boost students' achievement and learning of some concepts in chemistry using Entrepreneurial-Motivated-Approach because the classroom and laboratory environment enhance active participation of the gender in the learning processes. Thus, according to [49] a learning environment that encourages collaboration and active students' participation in learning activities helps the female students learn better.

5. Conclusion and Recommendations

This study compared the cognitive and practical achievement of boys and girls using Entrepreneurial-Motivated-Approach in senior secondary chemistry. Finding revealed no significant gender difference in students' cognitive and practical achievements of students in Chemistry when taught using Entrepreneurial-Motivated-Approach. This implies that there are no longer distinguishing differences in the academic performance of students in respect of gender with this approach. This outcome depicts that Entrepreneurial-Motivated-Approach as a gender-insensitive approach has been able to bridge the seeming gender gap in senior secondary chemistry learning. This means that the age long disparities in senior secondary chemistry between male and female students can be laid to rest with the use of Entrepreneurial-Motivated-Approach.

This study therefore recommends that:

- Entrepreneurial-Motivated-Approach is effective in promoting students' cognitive and practical abilities in chemistry. Therefore, it should be encouraged in teaching of both theoretical and practical chemistry concepts to studentsat senior secondary schools level.
- A retraining of science and chemistry teachers is recommended to update their knowledge of entrepreneurship skills development.
- Entrepreneurship education should be incorporated into all levels of chemistry curriculum to ensure skills acquisition by students.
- Text book publishers should develop suitable training manuals and work books that will enhance effective delivery of chemistry concepts for entrepreneurship through entrepreneurial motivated approach.

Compliance with ethical standards

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