International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 9 Issue 10, October 2022

ISSN: 2394-4404

Exploring Entrepreneurial Motivated Approach in Chemistry Classroom: Can Students learn better?

OLUDIPE, Olajumoke S.

Science and Technology Education Department
Faculty of Education, Lagos State University, Ojo, Lagos, Nigeria

OWOLABI, Olatunde L.

Science and Technology Education Department
Faculty of Education, Lagos State University, Ojo, Lagos, Nigeria

SAIBU Sakibu O.

Integrated Science Education Department
College of Science Education, Lagos State University of Education, Oto/Ijanikin, Lagos, Nigeria

Abstract: ***This study explored the use of Entrepreneurial Motivated Approach in chemistry teaching and learning in senior secondary school in Lagos State, Nigeria. In pursuance of the objectives of the study, three research questions and three null hypotheses were formulated to guide the study. The study adopted a 2x2 non-randomized pre-test, post-test, quasi-experimental design with the population of the study comprising all chemistry students in public co-educational senior secondary schools under Education District V, Lagos State. Purposive sampling technique was used to select two public schools from two zones (Ojo and Badagry) in the district which were randomly assigned to the experimental and control groups using a toss of coin. Chemistry students in two intact classes of an arm of SSS II in the two senior secondary schools took part in the study. The sample size comprised 118 SSII chemistry students with 58 students in the experimental group (30 male 28 female) and 60 students in the control group (27 male 33 female) which were taught the same course contents for a period of eight weeks. The experimental group received their instructions through the use of Entrepreneurial Motivated Approach while the control group was taught using the conventional teaching method. The researcher trained the teachers involved in the experimental group on the use of the technique involving Entrepreneurial Motivated Approach before the treatment. Chemistry Students' Cognitive Achievement Test (CSCAT) was used for data collection after their validation by experts in test and measurement, science education and chemistry entrepreneurship. The reliability coefficient of the CSCAT was established using Kuder Richardson-21 to yield 0.87. The research questions were analysed using descriptive statistics in form of mean and standard deviation while the hypotheses were tested using MANCOVA at 0.05 level of significance. The study findings showed a statistical significant main effects of entrepreneurial motivated approach on students' cognitive achievement [F(1,111)= 94.223; p<0.05] than those taught using convectional strategy. This implies that entrepreneurial motivated approach is effective in facilitating learning skills and students' cognitive achievement in the chemistry. Finding also revealed that gender had no statistical significant influence on the students' cognitive achievement [F(1,111)=.001; p>0.05]. Based on the findings, it was recommended, among others that Chemistry teachers should make effective use of entrepreneurial motivated approach strategy in teaching of chemistry.***

Keywords: Chemistry, entrepreneurial motivated approach, gender, students' cognitive achievement.

I. BACKGROUND TO THE STUDY

Chemistry plays a crucial role in helping to find answers to various human and socio-economic problems and thus making the society more scientifically literate. Ababio, (2016) defined chemistry as one of the main branches of science that deals with the composition, properties and uses of matter which lobes into the principles governing the changes that matters undergo. Chemistry essentially is the study of matter, its properties, how and why substances combine or separate to form other substances, and how substances interact with energy (Bagley, 2017). Indeed, Chemistry is part of everything

in our lives and it is involved in everything we do; the air we take, the water we drink, the food we take which contains minerals, the clothes we wear, as well as the medicines that we take to cure diseases. Importantly, love, jealousy, envy, infatuation and infidelity all share a basis in chemistry (Helmenstine, 2017). What on earth is not Chemistry? This is a popular saying among chemists worldwide (Oyeku et al. 2015).

Chemistry as a subject serves as the interface to practically all of the other sciences, as well as to many other areas of human endeavours and it is often referred to as a "central science" because the understanding of its basic concepts is important for almost every other profession such as: Biochemistry, Pharmacy, Medicine, Food Technology, Agricultural Chemistry, Chemical and Polymer Engineering, Geochemistry, Radiochemistry, Zoochemistry, Astrochemistry to mention few.

Ezechinyere (2019) stressed that the power of chemical science is what creates an enabling infrastructure that delivers food, medicine and materials that are the hallmarks of modern life. Umoh (2009) corroborated that the concepts in chemistry cannot be isolated from man's daily activities as everyone interact or make use of chemical products such as soap, detergent, toothpaste, firewood, fuel, and so on every day. Chemistry is an artistic enterprise which offers a lot of occupational opportunities in areas like manufacturing of goods and sales of goods (Kassim, 2013; Nbina et al. 2011). The study of chemistry therefore is vital to mankind because it will be difficult to imagine life without chemistry (Danjuma, 2009; Umar, 2007).

The National Research Council, NRC (1996) asserted that learning chemistry is something students do, not something that is done for them. It is on this premise, that the Nigeria Federal Ministry of Education, through its curriculum development parastatal - the Nigerian Educational Research and Development Council (NERDC), developed curriculum standards for all fields of education especially at the basic (primary and junior secondary) and senior secondary school levels. The curriculum is a very useful tool in changing the pedagogical landscape of the educational system. The chemistry curriculum at senior secondary school level therefore focuses on promoting discovery, project and activity-based methods of teaching and learning using locally sourced materials in order to enhance students' high order thinking, learning by doing and skills development (James, 2016). It is for this reason that in chemistry syllabus, it is encouraged that project tasks be undertaken at the end of chemistry topics. This is viewed as very important in the learning of chemistry as it involves variety of capabilities such as problem-solving skills, intellectual skills, cognitive facility, motor skills, verbal information and attitude; which in essence will in turn enhance, incite and encourage the development of entrepreneurial skills in the students.

Nwakaego and Kabiru (2015) posited that Chemistry is just a classroom affair to majority of students and rarely do students know that the acid work in the science laboratory is found in the farm, at home and at play. The inability of the chemistry teachers to inculcate the economic relevance of chemistry to students through the appropriate teaching methods has led to students' poor conception about chemistry. Adesoji and Oginni, (2012) affirmed that despite the importance of chemistry, it is observed that students do not have good understanding of many of the concepts in the subject. Research studies have shown that many factors are affect effective teaching and learning of chemistry at the senior secondary school level. These range from low enrolments, inadequate content knowledge and ineffective methodology by teachers, inadequate or lack of laboratory equipment, students' attitude towards chemistry and unconducive learning environment as well as dominated socio-cultural lapses (Ogunmade & Saibu, 2017; Matazu, 2010; Ogunmade, 2006; Offorma, 2005), student`s aptitude indices viz background in science, poor mathematical ability, poor practical skills (Adesoji & Oginni, 2012); inability of students to tackle most of the problems, poor expression, use of non-chemical terms and poor exposure to practical (West African Examination Council, WAEC, 2003a, 2015 & 2018), poor preparation towards the examination and non-familiarity with the syllabus, and inability to present their answers or results in a systematic manner (WAEC, 2016).

Furthermore, Ezekannangha (2009) stressed that there is a disjunction between the knowledge of learners in school chemistry and their everyday experiences, a major factor responsible for poor instructional methodology. To corroborate this, Wandiga, (2000) stressed that chemistry teachers had been reproached for adhering to the lecture method at the expense of other teaching strategies that engage learners in actual doing. The teaching of Chemistry as a practical oriented subject is devoid of the practical approach; and most topics are taught without the appropriate demonstrations. Majority of learners are exposed to only practical experiences meant to test the cognitive domain as they are prepared for their terminal certificate examination, (Ewanshia & Sadoh, 2009). WAEC (2016) emphasized that senior secondary school students should be exposed to more practical work to obtain the necessary techniques and knowledge required for chemistry.

Dike and Avwiri, (2020) emphasized that cognitive development in chemistry should be backed with real practical oriented activities but it is quite unfortunate that most of the science teachers who are to guide the learners are short sighted in developing the practical skills of learners couple with the lack of necessary facilities to work with. The worst implication is that the secondary school leavers of the present school system lack the creative ability to stimulate critical thinking. Therefore, the current trend in school Chemistry teaching requires initiatives in the learning of key conceptual scientific concepts with particular interest in the depth understanding of basic chemistry contexts for opportunities in schools to prepare students for useful learning higher education, self-development and the development of the society at large. Onyirioha and Amina (2015) pointed out that the major problem in the teaching of chemistry in schools is using inappropriate methods, which have failed to expose students to economic relevance of chemistry and to develop in the students' the skills embedded in chemistry curriculum. This situation according to Dike and Avwiri, (2020) calls for urgent need to seek the services of a trained entrepreneur as resource person, possibly as adjunct instructor to complement

the efforts of the serving teachers particularly chemistry or science related subjects.

Conceptually, entrepreneur motivated approach is a project-based learning (PBL) that empowers learners to define real world problem and create solution for these problems. In essence, learners gain 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 (Dawson, 2017). Gibbs, (2005) asserted that entrepreneur motivated approach focuses on students' activity in learning, and this approach could be considered as a non-traditional teaching method. The learning situations here are flexible, interactive and based on multidimensional knowledge development. Nancy (2011) stated that the objectives of the entrepreneur motivated approach program in chemistry teaching are:

- ✓ growing the entrepreneurship attitudes of senior high school students through chemistry study.
- ✓ growing students' capabilities in relating the concepts of chemistry to entrepreneurship opportunities
- ✓ growing students' interests in becoming entrepreneurs
- ✓ growing students' interest in becoming entrepreneurs;
- ✓ stimulating students' interests and student's like of studying chemistry; and
- ✓ understanding the concepts of chemistry and the interrelation thereof, as well as their application for solving problems in daily.

In a likewise manner, Hilario, (2017) stressed that entrepreneur motivated approach to teaching and learning has different objectives, such as: developing entrepreneurial drive among students, therefore raising awareness and motivation; training students in what is needed to set up a business, and to manage its growth; and developing the entrepreneurial abilities needed to identify and exploit business opportunities. Entrepreneurship subjects are becoming important in the 21st century all around the world. In the view of De Rablo et al. (2016), learning in the 21st century is no longer a standard process in an active learning process, but transformed into customized shapes, which developed problem solving skills, creative thinking, and learning.

Adiele and Brown (2010) investigated chemistry for entrepreneurship education and found that entrepreneurship education was not given adequate attention in the curriculum of many educational institutions in the country. They also revealed that the facilities, qualified teachers, and instructors needed for teaching of entrepreneurship education are in short supply in both public and private secondary schools. Their findings further revealed that entrepreneurship education promotes and fosters entrepreneurial cultures and mindset, skills acquisition, self-employment, economic independence and self-actualization necessary for sustainable entrepreneurial development and poverty alleviation.

It is on this noted that the study intends to integrate Entrepreneurial Approach into senior secondary school chemistry teaching as a means of enhancing students' learning and self-reliance in the world of works.

II. PURPOSE OF THE STUDY

RESEARCH QUESTIONS

The following research questions are raised to guide the study:

- ✓ Would there be any difference in the pre- and post-test cognitive achievement scores of students taught with Entrepreneurial Motivated Approach and conventional method?
- ✓ Would there be any gender difference in the pre- and post-test achievement scores of students taught with Entrepreneurial Motivated Approach and conventional method?
- ✓ Would there be any interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on senior secondary school students' cognitive achievement?

NULL HYPOTHESES

$H0_1$: There is no significant main effect of treatment (Entrepreneurial Motivated Approach and conventional method) on senior secondary school students' cognitive achievement in chemistry.

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

H03: There is no significant interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on senior secondary school students' cognitive achievement in chemistry.

III. METHODOLOGY

This research adopted was a quasi-experimental pretest, posttest nonequivalent groups in two intact classes. The use of this design was to identify the effect of innovation (intervention) on the students' learning of chemistry. Therefore, a 2x2 factorial matrix consisting of the two levels of instructional strategies (entrepreneurial motivated approach and conventional method) and two levels of gender (male and female) were used.

POPULATION AND SAMPLE

The population of this study comprised all senior secondary school two chemistry students in co-educational public senior secondary schools in Lagos State Education District V, Agboju. Two senior secondary schools with relatively similar characteristics in terms of teachers' (chemistry) qualifications, functional chemistry laboratories, students' population and location (semi-urban) were purposefully selected out of all senior secondary schools under Ojo and Badagry zones of the district. One school from Ojo zone and one school from Badagry zone were selected and were assigned experimental and control groups by simple flip of a coin. The experimental group was given the code (A)

while the control group was given the code (B). The school from Ojo Zone formed the experimental group and the school from Badagry formed the control group.

The chemistry students in the two nonequivalent intact classes SSS 2A of the schools formed the samples for the study. Both classes comprised male and female students. The choice of SSS 2 was informed because the students have a fairly stable classroom teaching and learning environment as they are not under pressure of preparation for the WASSCE and NECO. More so, SSS 2 students are believed to have been facing Chemistry problems since they were in SSS 1, so they might have gained some prerequisites, but have not been taught the topics (chlorine compounds and saponification) that were selected for the study at the time it was conducted (2nd and 3rd term of SSS 2 2021/2022 session) based on the structure of the national curriculum.

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

Table 1: Sample for the Study

RESEARCH INSTRUMENT

The Chemistry Students' Cognitive Achievement Test (CSCAT) was used to collect data for the study. The CSCAT measured the cognitive mastery of the chemistry concepts in two selected topics that were taught by the researcher and research assistants in the experimental and control groups. This was administered as pre-test and post-test (CSCAT 1 and CSCAT 2 respectively). The CSCAT 1 served as a baseline assessment and also determines the effects of the treatment in conjunction with the CSCAT 2. The CSCAT had two sections, A and B. Section A contained of 25 multiple choice questions while section B contained short and long essay questions. This is in line with WAEC and NECO format of setting external examination question. Each item of the multiple choices had three distractors and one key. The CSCAT was developed on chlorine and saponification (soap production) concepts.

The instrument was 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 the performance objectives highlighted in the teachers' instructional guides for the study, the researcher ensured that all the stated objectives were tested within the 25 items. The test items were constructed using the Bloom's revised taxonomy (Wilson 2016) of cognitive domain for its table of specifications and following the 20-golden rule for multiple-choice questions (Okebukola, 2015).

To ensure that the instrument measured what it was intended to measure, the researcher employed the services of two SSS 2 chemistry teachers currently teaching in senior secondary schools, one expert in test, measurement and evaluation from Lagos State University of Education, Ojo 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. Consequently., the reliability of the CSCAT was determined using test-retest method. Data generated from the tests were analysed using Kuder Richardson (KR-21) formula. The results showed reliability index of 0.87. Meanwhile, the difficulty index and the discriminating power of the achievement tests were done to give room for modification if need be.

DATA COLLECTION

The researcher sought for the approval the appropriate authorities to have access to the senior secondary schools selected for the study. Thereafter, the assistance of the school principals was sought to conduct the research. Then, chemistry teachers were briefed about the purpose of the research. Likewise, the students' consent to voluntarily participate in the study was sought. Four chemistry teachers in the two senior secondary schools formed the research team. The reason why their regular chemistry teachers were allowed to teach their students was to help eliminate any form of bias that would have occurred if the researcher had a direct involvement with the students. The two chemistry teachers in the experimental school were trained on how to effectively use entrepreneurial motivated approach for the delivery of chemistry classroom and laboratory instruction 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 researcher. They were given the copies of the validated lesson plans and the instructional packages on entrepreneurial motivated approach to teach the concepts of chlorine and saponification. At the end of the training session, the researcher 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. The two teachers for control group were also briefed on the adoption of convectional strategy.

The CSCAT 1 was administered to all the sampled students prior to the treatment as pre-test. The pre-test (O_1) served as covariate to control for the initial differences among the subjects. This was also to find out if the two groups (EG and CG) were equivalent in their performance and ability levels before exposure to treatment (Obeka, 2010; Muhammed, 2019). After the test was conducted the scripts were collected by the researcher for marking and recording of the scores. Thereafter, the treatment packages (TIGEMA and TIGLM) prepared by the researcher was used by the research assistants in teaching the concepts of chlorine and saponification in their respective schools. The treatment lasted for six weeks. Students in experimental group were exposed to chemistry learning with EMA. The teachers were supervised properly by the researcher during the processes in order to ensure that they did not deviate from the set lesson plan and procedures.

Meanwhile, the EMA chemistry teaching consisted of classroom activities, hands-on laboratory activities, products-making activities, presentations and assessment stages**.** In the

laboratory and product making activities, presentation and assessment stages**, s**tudents were grouped into small mixed experimental groups of twelve each comprising of male and female. Each group consisted five members. To ensure effectiveness, the twelve groups were further divided into two sets. The first set was allowed to carry out their production and follow by the second set. The experiments were carried out simultaneously to prevent threat to external validity.

Furthermore, the chemistry teachers taught the control group the same topics; chlorine and saponification. The control group was also exposed to how to make bleach and liquid soap with the conventional lecture approach. In order to make the control group get acquainted with the production processes, the teachers demonstrated how to make bleach and liquid soap for students.

The reshuffled version of the pretests; CSCAT 2, was administered as post-test (O_2) to the experimental group (EG) and control group (CG) after the completion of both the classroom and hands-on laboratory activities.

DATA ANALYSIS

The CSCAT was graded on a range of 0 and 1 (i.e., correct answer carried one mark and incorrect answer carried 0) and the theory was scored using the marking guide prepared. The total attainable score was 50 marks (25marks for objective questions and 25 marks for theory). Data collected from the CSCAT were analyzed using descriptive and inferential statistics. The research questions were answered with means, standard deviation while the research hypotheses were tested with multiple analysis of covariance (MANCOVA) at 0.05 level of significance using the Statistical Package for Social Science (SPSS 23.0).

IV. RESULTS

RESEARCH QUESTION 1

Would there be any difference in the pre- and post-test cognitive achievement scores of students taught with Entrepreneur Motivated Approach and conventional method?

Groups	N	Mean		Mean Diff.	SD		SD Dif.
		Post test	Pre-test		Post test	Pre-test	
EMA	58	29.19	15.34	13.85	7.80	4.81	2.99
CM	60	19.48	14.11	5.37	5.35	3.42	1.93

Table 2: Pre- and post-test cognitive achievement scores of students taught with Entrepreneur Motivated Approach and Conventional Method

Table 2 reveals that students taught with entrepreneur motivated approach had the higher posttest mean and standard deviation values of 29.19 and 7.80, while the students taught with conventional method of teaching had the mean and standard deviation values of 19.48 and 5.35 respectively. Furthermore, the pretest mean and standard deviation scores reveal marginal difference in the cognitive achievement of students prior to the treatment. To determine whether the observed effect was significant, null hypothesis 1 was tested.

HYPOTHESIS 1

$H0_1$: There is no significant effect of Entrepreneurial Motivated Approach and convectional method on senior secondary school students' cognitive achievement in chemistry.

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	$p\eta^2$
Corrected model	Post-Achievement	5233.709[a]	6	872.285	45.917	000	.713
Intercept		323.560	1	323.560	17.032	.000	.133
Pre-Achievement		1547.341	1	1547.341	81.452	.000	.423
Groups		1789.961	1	1789.961	94.223	.000	.459
Error		2108.664	111	18.997			

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

Table 3: Effect of entrepreneurial motivated approach on senior secondary school students' cognitive achievement in chemistry

The F-value associated with pre-achievement test was found to be significant [F(1,111)=81.452; p<.05]. This demonstrates that before the treatment, the students in the two instructional groups had drastically diverse cognitive achievement levels. The posttest results as shown in table 2 reveals that EMA has statistically significant effect on students' cognitive achievement in chemistry [F(1,111)=94.223; p<0.05]. The R Squared shows that the independent variables accounted for 71.3% of the variation in students' cognitive achievement in chemistry. The partial eta squared estimated indicates that the treatments accounted for 45.9% of the variance observed in the post-test on students' cognitive achievement in chemistry. The implication of this is that the students in the EMA group improved on their cognitive achievement in chemistry than their counterparts in control group after treatment. Therefore, the null hypothesis which states there is no significant main effect of treatment (entrepreneurial motivated approach and convectional method) on senior secondary school students' cognitive achievement in chemistry is rejected.

RESEARCH QUESTION 2

Would there be any gender difference in the pre- and post-test cognitive achievement scores of students taught with Entrepreneur Motivated Approach and conventional method?

Groups	Male			Female		
	Post test	Pre-test	Mean Dif.	Post test	Pre-test	Mean Dif.
EMA	29.87	16.17	13.70	28.46	14.42	14.04
CM	19.78	14.81	4.97	19.24	14.21	5.03

Table 4: Gender difference in the pre- and post-test cognitive achievement scores of students taught with entrepreneur motivated approach and conventional method

Table 4 shows the posttest mean performance scores of male and female students in entrepreneur motivated approach group to be 29.87 and 28.46 respectively. While in the conventional method group, posttest mean performance scores

of male and female students are 19.78 and 19.24 respectively. The result indicates that the male mean performance score was marginally higher than female mean performance score. More so, the table reveals that in EMA group the pretest mean performance scores of male and female students were 16.17 and 14.81 respectively, which showed that the male mean performance score was higher than female mean performance score prior to the treatment. In the conventional group, the pretest mean performance scores of male and female students were 14.42 and 14.21 respectively, with the female mean performance score marginally higher than male mean performance score. To determine whether the observed effect was significant, null hypothesis 2 was tested.

HYPOTHESIS 2

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

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	$p\eta^2$
Corrected model		5233.709[a]	6	872.285	45.917	.000	.713
Intercept		323.560	1	323.560	17.032	.000	.133
Pre-Achievement	Post-Achievement	547.341	1	1547.341	81.452	.000	.423
Gender		.292	1	.292	.015	.902	.000
Error		2108.664	111	18.997			

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

Table 5: Effect of gender on senior secondary school students' cognitive achievement in chemistry

The F-value associated with pre-achievement test in table 5 was found to be significant. [F(1,111)=81.452; p<.05]. This implies 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 5 further reveals that gender has no statistically significant main effect on students' cognitive achievement in chemistry [F(1,111)=.015; p>0.05]. The R Squared shows that the independent variables accounted for 71.3% of the variation in students' cognitive achievement in chemistry. The partial eta squared estimated indicates that the treatments accounted for 0.00% of the variance observed in the post-test on students' cognitive achievement in chemistry. This implies that the use of the entrepreneurial motivated teaching approach has no interception effect on gender difference in terms students' cognitive achievement in chemistry. Therefore, the null hypothesis which states that there is no significant main effect of gender on senior secondary school students' cognitive achievement in chemistry when taught using Entrepreneurial Motivated Approach is not rejected.

RESEARCH QUESTION 3

Would there be any interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on senior secondary school students' cognitive achievement in chemistry?

	Groups	Gender	Mean	Std. Deviation	N
Post CSCAT	EMA	Male	29.8667	7.92190	30
		Female	28.4643	6.60352	28
		Total	29.1897	7.22922	58
	CM	Male	19.7778	5.55170	27
		Female	19.2424	5.30652	33
		Total	19.4833	5.43361	60

Table 6: Posttest interaction effect of treatment (entrepreneurial motivated approach and conventional method) and gender on senior secondary school students' cognitive achievement in chemistry

Table 6 shows that male students taught with EMA had slight higher cognitive means and SD (29.87 and 7.92) than female (28.46 and 6.60). In the convectional group, male students did not have higher cognitive means and SD (19.78 and 5.55) than their female counterpart (19.24 and 5.30). To determine whether the observed effect was significant, null hypotheses 7, 8 and 9 were tested.

HYPOTHESIS 3

$H0_3$: There is no significant interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on senior secondary school students' cognitive achievement in chemistry.

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	$p\eta^2$
Corrected model		5233.709[a]	6	872.285	45.917	.000	.713
Intercept	Post-Achievement	323.560	1	323.560	17.032	.000	.133
Pre-Achievement		1547.341	1	1547.341	81.452	.000	.423
Groups * Gender		.019	1	.019	.001	.975	.000
Error		108.664	111	18.997			

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

Table 7: Interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on senior secondary school students' cognitive achievement in chemistry

Table 7 reveals no statistically significant interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on students' cognitive achievement in chemistry [F(1,111)=.001; p>0.05]. The partial eta square (0.000) depicts that the effect size is not significant. Therefore, the null hypothesis which states that there is no significant interaction effect of treatment (Entrepreneurial Motivated Approach and conventional method) and gender on

senior secondary school students' cognitive achievement in chemistry is not rejected.

DISCUSSION OF FINDINGS

The result of research question one as contained in table 2 reveals that the mean (29.19) and standard deviation (7.80) cognitive achievement scores of students taught chemistry using entrepreneurial motivated approach is higher than conventional group in the posttest 19.48 and 5.35 respectively, meaning that treatment positively improved students' cognitive learning of chemistry concepts. The inferential testing in hypothesis 1 in table 3 revealed that entrepreneurial motivated approach has significant main effect on students' cognitive achievement in chemistry [$F(1,111)=94.223$; $p<0.05$], implying that students taught chemistry concepts improved on their cognitive achievement in chemistry concepts through entrepreneurial motivated approach than their counterparts in conventional group after treatment. This finding is in consonant with the study conducted by Nduudee and Shedrack, (2021) who found that students taught saponification concept as an example of entrepreneurship education perform better than those not taught saponification concept as an example of entrepreneurship in science education.

In a similar study by Nanik and Wara (2016) using a Chemo-entrepreneurship (CEP) approach, it was found that the CEP teaching method when successfully implemented, led to student's better achievement. Dewi and Mashami (2019) studied the effect of Chemo-Entrepreneurship Oriented Inquiry Module (COIM) on improving students' creative thinking ability showed that the COIM is effective in the learning and teaching process. Andriani et al. (2018) stated that the application of the Chemo-entrepreneurship oriented POE (Predict-Observe-Explain) learning model had significant effect on students' conceptual understanding. This finding also agrees with Cakici and Tuckmen (2013), and Kadala (2014) who emphasized that students 'performance significantly improved with project-based activities. This means EMA spurred learners' curiosity towards learning, thereby promoting knowledge construction, deeper understanding of concepts and greater command and mastery of content. The accruable effect being manifested through improved academic achievement.

To further corroborate the above, Muhamed (2018), Onyebu (2015), Adiele and Brown (2010) found that a strong significant relationship exists between entrepreneurial skills and academic achievement of students. This tally with Muhammed (2019) confirmed that there was significant difference in performance mean scores of students taught biology concepts for entrepreneurship using Project-based Approach. The finding of this study equally affirms the results of Distor, (2018) who confirmed that entrepreneurship-based biology learning group had a significantly higher academic performance than the traditional learning group. Similarly, Johansen and Shanke (2014) studied entrepreneurship projects and pupils' academic performance and affirmed that, with less focus on the enterprise part, entrepreneurship projects can be a good teaching method for improvement of academic performance. Meanwhile, the finding of this study is at variance with the finding of Mohammed (2015) who stressed that there was no significant difference in the performance of students when use project-based instructional strategies when compared with the students exposed to lecture method.

Result on table 4 indicates that the male mean performance score (19.78) was slightly higher than female mean performance score (19.24). It can be inferred that there is a little or no gender difference. To determine whether the observed effect was significant, analysis of null hypothesis 2 on table 5 reveals that gender has no significant main effect on students' cognitive achievement in chemistry [$F(1,111)=.015$; $p>0.05$]. This implies that the use of entrepreneurial motivated approach approaches has no interception effect on gender difference in terms students' cognitive achievement in chemistry. This finding however concords with work of Delmang (2019) who found no significant difference in the performance means scores of male and female Undergraduate Chemistry Students. This is buttressed by Muhammed (2019) and Muhammed (2018) who found that use of the entrepreneurship and conventional teaching approaches has no interception effect on gender difference in terms of students 'performance. In the same vein, Ibrahim and Magaji (2016) showed there were no statistically significant differences in the academic performance mean scores of male and female students in Biology, Chemistry and Physics, though the female students' academic performance mean scores at dependent measures level were a little bit higher than those of the male students, the differences were not significant.

In contrast to this finding, Jia et al. (2021) affirmed that the boys had significantly greater variabilities in science achievement and interest (variance ratio), while the girls had slight greater variability in creativity. Further confirmation of the finding of this study by Hsin-Hui (2015) indicated that gender had significant effects on students' science performance in third, fifth, and eighth grade. They stressed that starting in third grade, male students performed better than female students. This trend continued; males still outperformed females in the fifth and eighth grade. The gender difference on science performance already existed in third grade. Inconsistent with the finding, Ibiri (2012), and Godpower-Echie and Amadi (2013) stressed that there is a positive correlation between gender and students' achievement. Similarly, Aina and Akintunde (2013) study revealed that male performed better than females in physics. This confirmed the submission of Awoniyi (2000) that, male candidates performed better, relative to female in subjects requiring quantitative ability. He said male show superiority in science, statistics and accounting. In the same vein, Schmidt, et al. (2017) identified gender differences both among entrepreneurial characteristics and in their relationship with performance.

It is worthy to note that, in order to encourage more women into pure sciences, and science-oriented courses, teaching needs to be done not only to focus on the academic performance of girls but also in how to make science-related occupations more interesting for them. This type of teaching should start early in the academic careers of girls. Lack of interest in science at the senior Secondary School level is the main reason why many girls do not show interest in science-oriented courses at the nation's tertiary institutions. On the

other hand, the result contradicts the submission of Uzezi and Zainab (2017) who found no statistically significant difference in the achievement of male and female students in volumetric analysis using guided discovery.

Result of research question 3 on table 6 shows that male students taught with EMA had slight higher cognitive means and SD (29.87 and 7.92) than female (28.46 and 6.60). In the convectional group, male students did not have higher cognitive means and SD (19.78 and 5.55) than their female counterpart (19.24 and 5.30). Further confirmation in table 7 reveals no statistically significant interaction effect of treatment (entrepreneurial motivated approach and conventional method) and gender on students' cognitive achievement in chemistry [F(1,111)=.001; p>0.05] in chemistry. This result is in agreement with that of Oladejo et al (2020); Mohr (2014); and Clary and Wandersee (2010) who found that being male or female does not affect the chemistry students' academic achievement with the use of computer simulation. According to them, the interaction effect of gender and group was also found not to be statistically significant. This result depicts that there is a 95% confidence that if students are taught chemistry with entrepreneurial motivated approach, their performance will not be affected by their sex type. Furthermore, the result is of this study is in line with Ajayi and Ogbeba (2017) who reported that no statistically significant interaction effect of gender and method was found in the performance of senior school chemistry students when taught using hands-on activities.

V. CONCLUSION & RECOMMENDATIONS

The evidences from the study indicated that the implementation of Entrepreneurial Motivated Approach improved students' cognitive and practical achievement, and acquisition of business skills for self-employment among senior secondary school's chemistry students. Therefore, the training of students on essential and valuable entrepreneurial skills improves of chemistry students in the secondary schools. The findings from the study further revealed no significant differences between the gender categories of respondents in the scores for all the stated variables. This outcome implies Entrepreneurial Motivated Approach is gender-insensitive approach that can be employed as an activity-based strategy in senior secondary school's chemistry classrooms and laboratory.

Based on the findings it was recommended that:

- ✓ Entrepreneurial motivated approach should be adopted in the teaching of chemistry concepts for entrepreneurship among students. This should also be extended to other science subjects.
- ✓ A retraining of science and chemistry teachers is recommended to update their knowledge of entrepreneurship skills development.
- ✓ Science and chemistry teachers with entrepreneurial skills be recruited and adequately funded by the government to promote entrepreneurship education. Meanwhile, the science teachers currently teaching in schools should be encouraged to use appropriate methods and skills that promote entrepreneurial skills enhancement.
- ✓ 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.

REFERENCES

[1] Ababio, O.Y. (2016). New School Chemistry for Secondary Schools. 9th Edition. Onisha: Africana First Publisher.
[2] Adesoji, F.A. & Oginni, A.M. (2012). Students` Aptitude Indices as predictors of learning outcomes in chemistry. British Journal of Arts and Social Sciences, 8(II). http://www.bjournal.co.uk/BJASS.aspx
[3] Adiele, E.E. & Brown, D. (2010). Entrepreneurship education: A strategy for achieving self-reliance and economic development. Journal of Management and Enterprise Development, 7(4), 35 46.
[4] Aina, J.K., & Akintunde, Z.T. (2013). Analysis of gender performance in physics in colleges of education, Nigeria. Journal of Education and Practice, 4(6), 1-6. http://www.iiste.org
[5] Ajayi, O.V, & Ogbeba, J. (2017). Effect of Gender on Senior Secondary Chemistry Students' Achievement in Stoichiometry Using Hands-on Activities. American Journal of Educational Research, 5(8), 839-842. Doi: 10.12691/education-5-8-1.
[6] Andriani, R., Muhali, M., & Dewi, C. A. (2018). Pengaruh Model Pembelajaran Poe (Predict-Observe-Explain) Berorientasi Chemoentrepreneurship Terhadap Pemahaman Konsep Siswa Pada Materi Larutan Penyangga. Jurnal Kependidikan Kimia Hydrogen, 5(2), 45–51.
[7] Awoniyi, S.A. (2000). Sex differences in academic performance. Nigerian Journal Of Gender and Development, 1(1&2), 35.
[8] Bagley, M. (2017). What is Chemistry? Live science. https://www.livescience.com/45986-what-is-chemistry. html
[9] Benedict, C.U. (2015). Fundamental Issues in Educational Research: Research Design in Education. Doziens Graphics Nassarawa State University, Nigeria, 42.
[10] Cakici, Y. & Turkmen, N. (2013). An Investigation of the Effect of Project Based Learning Approach on Children's Achievement and Attitude in Science, Trakya University, Edirne Turkey, The Online Journal of Science And Technology (TOJSAT). 1(1)8-17.
[11] Clary, R. M., & Wandersee, J. H. (2010). Virtual Field Exercises in the Online Classroom: Practicing Science Teachers' Perceptions of Effectiveness, Best Practices, and Implementation. Journal of College Science Teaching, 39(4), 50-58.
[12] Danjuma, B.R. (2009). Teaching chemistry concepts in senior secondary school using everyday life experience. In A. M. Olayiwola & W.S. Umoh eds. "Linking School Chemistry with Learners' Day-To-Day Activities, STAN, Chemistry Panel series 4, 65-72.
[13] Dawson, G. (2017). How to teach entrepreneurship to students. Think CERCA Educator.

[14] Delmang, T.K. (2019). Entrepreneurial skills' training packages on disinfectant production among universities chemistry students in North Central, Nigeria. Kampala International University, 5(1), 7–18.
[15] De Pablo, J., Uribe-Toril, J., & Ruiz Real, J.L. (2019). Entrepreneurship and Education in the 21st Century: Analysis and Trends in Research. Journal of Entrepreneurship Education, 22(4), 67-70.
[16] Dewi, C. A. & Mashami, R. A. (2019). The effect of chemo-entrepreneurship oriented inquiry module on improving students' creative thinking ability. Journal of Turkish Science Education, 16(2), 253-263.
[17] Dike, J.W., & Anwiri, E. (2020).Enhancing entrepreneurship opportunities through chemistry education: Implication for Nigerian youths empowerment. In The 21st Century. International Journal of Innovative Social and Science Education Research, 8(3), 101-107.
[18] Distor, J. (2018). Entrepreneurship-based biology in teaching and learning: students' academic achievement, attitude, and motivation. Master of Science in Science Education. Ateneo de Manila University. https://archium.ateneo.edu/theses-dissertations
[19] Ewanshia, J.C. & Sadoh, O.A. (2009). Linking pH concept in chemistry with learners day-to-day activities. In A. M. Olayiwola & W.S. Umoh eds. "Linking School Chemistry with Learners' Day-To-Day Activities, STAN, Chemistry Panel series 4
[20] Ezechinyere, C.H. (2019). Entrepreneurship Skills Acquired by Undergraduate Chemistry Students during the Course of their Studies in the University. Covenant Journal of Entrepreneurship (CJoE), 3,(2), 2682-2695. URL http://journals.covenantuniversity.edu.ng/index.php /cjoe e. 2682-2695.
[21] Ezekannagha, G.N. (2009). Linking chemistry teaching to learners' day-to-day activities. In A. M. Olayiwola & W.S. Umoh eds. "Linking School Chemistry with Learners' Day-To-Day Activities, STAN, Chemistry Panel series 4, 59-64.
[22] Federal Government of Nigeria (2013). National Policy on Education. Lagos: National Curriculum for Senior Secondary School (NERDC) Press.
[23] Gibb, A. (2005). The future of entrepreneurship education – Determining the basis for coherent policy and practice? In The dynamics of learning entrepreneurship in a cross-cultural university context, eds. P. Kyrö, & C. Carrier, Entrepreneurship Education Series 2/2005: 44-67. Hämeenlinna: University of Tampere, Research Centre for Vocational and Professional Education
[24] Godpower-Echie, G. & Amadi, J. (2013). Attitude and gender differences on students' achievement in Chemistry. New Era Research Journal of Human Educational and Sustainable Development, 6(3), 64-68.
[25] Helmenstine, A.M. (2017). Examples of Chemistry in Daily Life. https://www.thoughtco.com/examples-of-chemistry-in-daily-life-606816
[26] Hilario, J.S. (2017). Integrating an Entrepreneurial Motivated Approach (EMA) in teaching and learning of general chemistry. International Journal of Contemporary Applied Researches, 4, 7. www.ijcar.net
[27] Hsin-Hui, L. (2015). Gender Differences in Science Performance. .Journal of Studies in Education, 5(4), 181. DOI: 10.5296/jse.v5i4.8526
[28] Ibiri, T.I. (2012). Influence of cultural differences on the educational choices of students in modern times. Journal of Modern Educational Advancements, 3(5), 16-21.
[29] Ibrahim, S.T., Sabitu, A. & Magaji, M.Y. (2016). Comparative Analysis of Gender Performances in Biology, Chemistry and Physics among Pre-Degree Students of Federal University, Dutsinma. International Journal of Educational Benchmark (IJEB), University of Uyo, Nigeria, 5(1), 106- 108,
[30] Iorhuna, A. (2018). Assessment of the impact of infrastructural facilities on students".
[31] James, G. (2016). Nigeria senior secondary school chemistry curriculum in comparism with china senior secondary school chemistry curriculum. EST 801: (Graduate Seminar Assignment). University of Jos, Nigeria.
[32] Jia1, C. Tao Yang, T., Yu Qian., & Xinye Wu (2021). Gender differences in science achievement, interest and creativity. Science Education International, 31(2), 195-202 https://doi.org/10.33828/sei.v31.i2.9
[33] Johansen, V., & Schanke, T. (2014). Entrepreneurship Projects and Pupils' Academic Performance: a study of Norwegian secondary schools. European Educational Research Journal, 13(2), 155-166. www.wwwords.eu/EERJ
[34] John, T.M. (2016). Effect of chemistry practical on students' performance in chemistry in public secondary schools of Machakos and Nairobi Counties in Kenya. Doctoral Thesis, Department of Educational Communication and Technology, School of Education University of Nairobi.
[35] Kadala, J. T. (2014). Effect of concept mapping and project-based instructional strategies on junior secondary school students 'performance and attitude towards geometry in Adamawa State Nigeria. PhD. Thesis, ABU Zaria, Nigeria.
[36] Kassim, A. G (2013). Enhancing Secondary School Chemistry Education for National Transformation. Conference Proceeding of First International Conference, Held at School of Technology Education, Federal University of Technology, Minna. 6th to 9th October.
[37] Matazu. S. S (2010). The relevance of science, technology and mathematics Education (STME) in developing skills for self-reliance: The Nigerian Experience. African Journal of Teacher Education, l(l), 223-225.
[38] Mohammed, I.B. (2015). Investigating teacher and learners' attitude towards entrepreneurship-based project approach as a substitute to laboratory practical activity in teaching biology among secondary school in Niger State. Proceeding of African conference, Faculty of Education ABU, Zaria.
[39] Mohammed, I.B. (2019). Effects of project-based approach on acquisition of entrepreneurial skills, retention and performance in biology among secondary school students in Niger State, Nigeria. P.hD Thesis, ABU, Zaria, Nigeria.

[40] Mohr, S. D. (2014). The Effect of Computer Simulations on the Conceptual Understanding in General Chemistry Lab. 1–59. https://scholarworks.montana.edu/xmlui/handle/1/3581
[41] Muhammad, M.B. (2018). Assessment of the of entrepreneurial skills acquisition on home economics students' performance in junior secondary school in Kaduna State, Nigeria. Master Dissertation, Department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University, Zaria, Nigeria
[42] Nancy, S. (2011). The Chemistry Teaching Program for Developing the Senior High School Students' Entrepreneurial Attitudes. US-China Education Review B 7 (2011) 909-923. Earlier title: US-China Education Review.
[43] Nanik, W & Wara, D.P.R. (2016). Implementation Of Chemo-Entrepreneurship Teaching Approach For improving students' life skills. Junal Ilmu Pendidikan
[44] National Research Centre (NRC, 1996). National Science Education Standards. Washington D.C. National Academy press.
[45] Nbina, J. B, Viko, B and Birabil S. T. (2011) Developing Improvisation Skills for Alleviating Poverty in Nigeria. The Place of Chemistry in Entrepreneurial education. Academic Leadership Journal, 9 (1): 8 – 12
[46] Nduudee, J. N. & Shedrack, T. (2021). The Impact of Entrepreneurship Education on Science Students in Senior Secondary Schools in Rivers State Tamunoiyowuna. Scholarly Journal of Education, 8(1), 7-11
[47] Nwakaego1, O.N. & Kabiru, A.M. (2015).zx The Need to Incorporate Entrepreneurship Education into Chemistry Curriculum for Colleges of Education in Nigeria. Journal of Educational Policy and Entrepreneurial Research (JEPER), 2(5) 84-90. http://www.ztjournals.com/index.php/JEPER
[48] Offorma, G.C. (2007). Curriculum for Wealth Creation. A Paper Presented at the Seminar of the World Council for Curriculum and Instruction Held at Federal College of Education, Kano
[49] Ogunmade, T.O. (2006). The status and quality of science teaching and learning in Lagos State secondary schools. Unpublished Ph.D Thesis, Edith Cowan University, Perth, Western Austrailia.
[50] Ogunmade, T.O., & Saibu, S.O. (2017). The mirror of science teaching and learning in Lagos State secondary schools. In T.O. Ogunmade eds, Readings in Education, Science and Human Kinetics, 23-29.
[51] Okebukola, P. A. 2015. 20 Golden Rules for Writing Multiple-Choice Questions. YouTube channel. https://www.youtube.com/watch?v=ysDZfXPJono
[52] Oladejo, A.O., Nwaboku, C.N., Okebukola, P.A., & Ademola I.A. (2021): Gender difference in students' performance in chemistry – can computer simulation bridge the gap? Research in Science & Technological Education, DOI: 10.1080/02635143.2021.1981280
[53] Onyebu, C.M. (2015). The role of entrepreneurial skills in academic performance: a case study of selected universities in Abia State, Nigeria. Review of Public Administration and Management 4(8), 20-25.
[54] Onyirioha, N.N. & Amina, M.K.(2015) The need to incorporate entrepreneurship education into chemistry curriculum for Colleges of education in Nigeria. Journal of Educational Policy and Entrepreneurial Research (JEPER). 2 (5), 84-90.
[55] Oyeku, O.M., Oduyoye, O.O., Elemo, G.N., Akindoju A.F., Karimu, F.A., &Unuigbe, K. (2015). Chemistry Entrepreneurship for Small and Medium Enterprises Development: A Panacea for Job and Wealth Creation. Industrial Engineering Letters, 5(4), 45. www.iiste.org.
[56] Schmidt, S., Bohnenberger, M.C., Nodari, C.H., Mayla, D., & Da Silva, J.C. (2017). Gender, entrepreneurial behaviour and firm performance of Brazilian students: integrating economic and behavioral perspectives. Feevale University, ERS-239, 2755. 93525-075 – Novo Hamburgo, RS, Brazil.
[57] Umar, H.M. (2007). Impact of chemistry on national development and economic empowerment. Nigeria Journal of science and Educational Research, 1(1), 227-231.
[58] Umoh, S.W. (2009). Relating school chemistry to learners' day-to-day activities. In A.M. Olayiwola & W.S. Umoh eds. "Linking School Chemistry with Learners' Day-To-Day Activities, STAN, Chemistry Panel series 4, 137-141.
[59] Wandiga, S.O. (2000). Science for development. Proceeding of World Conference on Science. UNESCO, Paris.
[60] West Africa Examination Council (2003a). The West Africa Examination Council Chief Examiner's Report for May/June, SSCE. The West Africa Examination Council.
[61] West Africa Examination Council (2015). The West Africa Examination Council Chief Examiner's Report for May/June, SSCE. The West Africa Examination Council. https://www.waecgh.org/uploads/examinersReport/2015/Science15.pdf
[62] West Africa Examination Council (2016). The West Africa Examination Council Chief Examiner's Report for May/June, SSCE. The West Africa Examination Council. https://www.waecgh.org/uploads/examinersReport/2016/Science16.pdf
[63] West Africa Examination Council (2018). The West Africa Examination Council Chief Examiner's Report for May/June, SSCE. The West Africa Examination Council. https://www.waecgh.org/uploads/examinersReport/2016/Science16.pdf
[64] Wilson, L. O. 92016). Anderson and Krathwohl–Bloom's taxonomy revised. Understanding the New Version of Bloom's Taxonomy. https://pdfslide.net/documents/anderson-and-krathwohl-blooms-taxonomy-revised-anderson-and-krathwohl-blooms.html