Effects of Conventional and Demonstration Methods on Teaching and Learning of Secondary School Chemistry in Ikere Local Government Area of Ekiti State, Nigeria

Amoke M. KENNI
Department of Chemistry, College of Education, Ikere-Ekiti, Ekiti State Nigeria

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ABSTRACT: *This research investigated the effects of conventional and demonstration methods on teaching and learning of secondary school Chemistry in Ikere local government area of Ekiti State. The design of this study was the quasi-experimental research design. The population of the study was the entire senior secondary school two (SSS2) Chemistry students in all the public secondary schools in Ikere local government area of Ekiti State. SSS2 students are chosen because it is the class that is very close to preparation for external examination and that the topic introduction to organic chemistry to be taught are offered at Senior Secondary School II according to the new senior secondary school curriculum. The sample size for the study is fifty six (56) students in two (2) intact classes in the senior secondary school two (SSS2) class. The schools were randomly drawn from the ten (10) schools using simple random sampling by balloting without replacement. The instrument was the Chemistry Achievement Test (CAT) on the topic " introduction to organic chemistry". The test –retest method of reliability was used to establish the reliability index of the instrument. The reliability index obtained was 0.79 at 0.05 significance level. This showed that the instrument was reliable for the study. Frequency counts and percentage were used in analyzing the personal data of respondents. While the research hypotheses were tested using the t-test and analysis of covariance (ANCOVA) at 0.05 level of significance. The findings of the study indicated that there is no significant difference between Chemistry achievement scores of students taught with demonstration method and those taught with conventional method prior to the experiment; there was a significant difference between the performance of students taught with conventional method and those taught with demonstration method after the experiment; the mean performance gain of student taught with demonstration strategy was higher than that of those taught with conventional method; there is no significant difference between the posttest scores of male and female students taught with conventional method and those taught with demonstration method; and the mean performance gain of male and female students taught with demonstration strategy was higher than that of those taught with conventional method but this increment was not due to students' gender. Based on the findings, appropriate recommendations were made.*

Key Words: *conventional, demonstration, teaching and learning, secondary schools*

Introduction

Science has been accorded a prime position worldwide within the context of science education. Science subjects constitute a major part of the subjects being offered in most post-primary institutions in Nigeria today. These subjects are so important that the Federal Government National Policy on Education stated in specific terms that the secondary school education shall provide trained manpower in the applied science and technology (Omwirhiren & Ibrahim, 2016). Science subjects constitute part of the core subjects at both junior and senior secondary school levels. The importance attached to science by the Federal Government could be due to the general belief that science is capable of improving and changing skills, attitudes and cognition by increasing students' store of knowledge's about themselves, their environment and their world. One of the objectives of science education is to develop students' interest in science and technology, as today's society depends largely on development in science and technology.

It was as a result of the recognition given to Chemistry in the development of individual and the nation that has made it a core-subject among the science subject in the Nigerian secondary schools (Edomwonyi-Otu & Avaa, 2011). It has been a pre-requisite subject for offering most science oriented courses in the tertiary institution. Chemistry, in particular, is central to many of the scientific fields of human endeavours; therefore, the teaching of chemistry should be given serious attention. The importance of chemistry in the development of any nation cannot be underrated especially in Nigeria where the national income rests on petroleum and petrochemical industries.

Teachers are expected to devise ways of making their students to develop positive attitudes towards science (chemistry) and science-related disciplines. Teachers should be involved in formulating the

goals and objectives for teaching procedures that will best achieve those objectives, carrying out procedures, evaluating the successes and failures (Omwirhiren, & Ibrahim, 2016). Teaching can be described as the act of disseminating a well-planned and clear instruction to the learners by trained, qualified and certified personnel within the organized four walls of classroom. Teaching as a process is aimed at facilitating learning to bring about change in behaviour. Ayeni (2011) defined teaching as a continuous process that involves bringing about desirable changes in learners through use of appropriate methods. Teaching is the specialized application of knowledge, skills and attributes designed to provide unique service to meet the educational needs of the individual and of society. Teaching method is a product of the combination of strategies, tactics and techniques (Omwirhiren, & Ibrahim, 2016).

Learning is a change in behaviour; better or worse. It is a change that takes place through practice or experience, but changes due to growth or maturation are not learning. This change in behaviour must be relatively permanent, and it must last a fairly long time. Learning is a key process in human behaviour. The individual is constantly interacting with and influenced by the environment. This experience makes him to change or modify his behaviour in order to deal effectively with it. All learning involves activities. These activities involve either physical or mental activities. They may be simple mental activities or complex, involving various muscles, bones, among others. So also the mental activities may be very simple involving one or two activities of mind or complex which involve higher mental activities (Sharma, 2016).

Methodology is very vital in any teaching-learning situation. The method adopted by the teacher may promote or hinder learning. It may sharpen mental activities which are the bases of social power or may discourage initiatives and curiosity thus making self-reliance and survival difficult. There are different types of methods for efficient and effective teaching of chemistry. These methods include: conventional, demonstration, laboratory, field trip, assignment, peer-teaching method, among others. Teaching methods are the means for helping students to study effectively. Teaching methods concern the tactics teachers use to meet teaching objectives, including instructional organization and techniques, subject matter, and the use of teaching tools and materials. Ameh & Dantani (2012) noted that methodology is very essential and critical in any teaching-learning process and the methodology selected by the teacher can promote or hinder learning process (in chemistry).

Conventional method of teaching is the oldest teaching method applied in educational institution. This teaching method is one way channel of communication of information. Students' involvement in this teaching method is just to listen and sometimes pen down some notes if necessary during the conventional, combine the information and organized it (Farroq, 2012). One of the problems in this method is to grab the attention of students in class room. Another big problem is that many students in the class cannot follow the theme. Learning has a strong influence on method of teaching (Farroq, 2012).

The adoption of conventional method by most teachers in order to overcome the bulky chemistry syllabus before the SSCE affects students' performance. Researchers believe that in the conventional method, theory is taught as an absolute knowledge; hence pupil-centered activities for developing scientific reasoning skills and processes are lacking. Ameh & Dantani (2012) asserted that the conventional method is also known to cause lack of interest and poor performance in science and this limit science teaching exclusively to telling, reciting and testing of information as it does not convey either the meaning or intent of science.

Conventional method has become the method dominating science (chemistry) teaching in Nigerian Secondary Schools. Chemistry as a science subject is bulky in nature. The chemistry teachers usually adopt conventional method in teaching in order to cover the syllabus within the stipulated time and this do not give room for proper understanding of chemistry (Ameh & Dantani, 2012).There is need in change from conventional method in teaching Chemistry. This is because of its disadvantages in the learning of chemistry in chemistry classrooms. The demonstration method has the advantage of being a good way of motivating students to learn and also believed to save time and materials as well as shows how to avoid breakages and accidents.

Chemistry teaching should develop in the students manipulative and experimental skills to make him or her competent and confident in conducting experiments and/or researches. Students should do practical work of conducting experiments, reporting their observations and making inferences or conclusions, thus, developing their scientific knowledge and experimental skills and at the same time arousing and maintaining interest of the students in the subject. Furo, Abdullahi & Badgal (2014) suggested that demonstration method could be appropriate for teaching the students of primary and secondary schools because it encourages adequate participation of students in the learning process. The demonstration method has the advantage of being a good way of motivating students to learn and also believed to save time and materials as well as shows how to avoid breakages and accidents. However, it

does not allow pupils/students to develop manipulation demands for carrying out activities on their own. Also, less scope is covered in demonstration seeing details of objects being demonstration (Francis, 2014).

Demonstration approach is a practical method of teaching. It involves showing, doing and telling something (Omwirhiren & Ibrahim, 2016). The onus is therefore on the teacher to display the steps in the process and explain them accurately and clearly, while students are expected to practice by repeating the things the teacher has done. This method have been noted for bridging the gap between theory and practice (Daluba, 2013). It controls the rate of breakages and accidents as students watch the teacher do it before attempting to do the same and enable the teacher to teach manipulative and operational skills.

The choices of appropriate pedagogies for application then become imperative. While conventional method of instruction largely involves telling as teacher-centered, the demonstration method of learning entails teaching through learning by doing in addition to telling. Berry (2008) observed that the demonstration method has been found to be extensively used in sciences, and by extension should be applied in teaching agricultural courses. The traditional conventional approach often consists of a teacher centered methodology in a face to face capacity (Berry, 2008). Given the prevalence of this prescribed mode of instruction, there has been a shift in students attending classes with the intention of gaining new and meaningful knowledge. However, the incentive in
attending conventional now is to get the current information needed to pass the assessment (Omwirhiren & Ibrahim, 2016).

In these types of conventional environments, the formal style of lecturing alone has not proven to be effective. However, researchers have instead found that combining traditional methods of lecturing with learner centered methodologies can be a more productive approach. According to Omwirhiren & Ibrahim (2016), teachers should seek to replace some conventional time with interactive engagement and cooperative work. Indeed, as instructors have labored to accommodate learners, the structure of conventional has taken on more innovative techniques. Students' persistent poor performance has been partly ascribed to inadequate teaching and instructional methods adopted by science teachers (Ameh & Dantani, 2012). Ifamuyinwa (2008) reported the deplorable performance of secondary school students in science subjects and identified persistent use of the traditional mode of instruction as one of the major short-coming affecting the learning and higher achievement in science subjects. This therefore calls for the adoption of activity-based strategy that will not only be stimulating and motivating to the learners but should also have the potential of improving learning outcomes significantly.

It is important for a teacher to have good understanding about learning, its concept and meaning because teaching is not complete without learning. Both teaching and learning complement each other. Learning is the process of acquiring new, or modifying existing, knowledge, behaviors, skills, values, or preferences (Gross, 2019). A teacher must know about how learners learn so as to enhance teaching method. Learning is of huge importance in human behaviour as it is a natural phenomenon to all individual. Sequeira (2012) stated that learning is a relatively change that is permanent in behaviour and it occurs intentionally. Other learning can take place without planning, for example by experience.

Learning has been defined in various ways based on various theories explaining the process of learning. Learning involves changes in the behaviour patterns of an individual. Simply put, learning is the process of acquiring knowledge or skills and attitudes (Dorgu, 2015). It is important to understand the primary objective of teaching which is to bring about good education. Prospective teachers are encouraged to know the operation and approaches to learning in order to develop better teaching methodologies. In using these teaching methods, teachers should consider every learner's unique attribute (Dorgu, 2015).

Learning affects a child's development and a child learns new habits only through the process of learning and through imitated traditions and customs. Karban (2015) stated that the ability to learn is possessed by humans. Some learning is immediate, induced by a single event (e.g. being burned by a hot stove), but much skill and knowledge accumulates from repeated experiences. Intellectual skills are also developed through learning. The decision of right and wrong, the concepts of justice and aesthetic sense, among others. develop through learning. This process of learning continues throughout life. Learning is the basis of maturation. The changes induced by learning often last a lifetime, and it is hard to distinguish learned material that seems to be "lost" from that which cannot be retrieved *(Schacter, Gilbert and Wegner, 2011)*. Wortham (2016) stated that learning takes place in many settings, but educational institutions foster both breadth and depth of learning. Different types of teaching make very different assumptions about what learning is.

A teaching method comprises the principles and methods used by teachers to enable student learn. These strategies are determined partly on subject matter to be taught and partly by the nature of the learner. For a particular teaching method to be appropriate and efficient it has to be in relation with the

characteristic of the learner and the type of learning it is supposed to bring about. Okon (2002) opined that teaching methods include not only the manner of presentation that the teacher employs but everything that he/she does in the way of arranging condition, grouping students, guiding activities, making assignments, and providing information to aid learning.

Teaching methods play very important role in the teaching and learning process. The methods a teacher employs in teaching chemistry will go a long way in making the learning to be effective or ineffective. Mannison (2011) proposed six (6) instructional/teaching methods for teaching subject like chemistry as follows: direct instructional methods, indirect instructional methods, interactive instructional methods, experimental instructional methods, independent instructional methods and materials/visual aids instructional methods. There are different method of teaching that can be used for teaching chemistry.

The conventional method is a teaching method where the teacher as instructor acts as the primary information giver. The instructor typically stands in front of the students and may use a visual aid, such as a PowerPoint presentation, chalkboard or handout. Students are expected to listen and take notes during conventional, and there is limited interaction and exchange between teacher and student. The lecture method is common in tertiary institutions classes due to its convenience and ability to pass on information to a large group at once. Paris (2019) stated that the conventional method is just one of several teaching methods, though in schools it is usually considered the primary one.

Paris (2019) stated that the conventional method is convenient and usually makes the most sense, especially with larger classroom sizes. This is why lecturing is the standard for most tertiary institutions courses, when there can be several hundred students in the classroom at once; lecturing lets conventional address the most people at once, in the most general manner, while still conveying the information that he or she feels is most important, according to the lesson plan. Students who are not auditory learners or who lack note taking skills may struggle with the conventional method of teaching.

Conventional can be said as a form of interaction through illumination and oral narratives from teachers to students (Suseno, 2013; Rizki, 2014). Very simply, a conventional is an organized verbal presentation of subject matter often augmented by visual aids. A conventional is a period of more or less uninterrupted talk from a teacher. The conventional method can also be said as the delivery of lessons by the teacher by speaking or oral explanation directly in front of students. The conventional begins by explaining the objectives to be achieved, discussing the outlines to be discussed, and connecting the material to be presented with the material that has been presented (Sudjana, 2013). The conventional will succeed if it gets serious attention from students, presented systematically, excitingly, providing opportunities for students (Suryosubroto, 2009).

Demonstration method is an instructional approach in which the teachers are the role players while the students observe with the aims of acting subsequently. Demonstration teaching approach gives the chemistry teacher the avenue to explain the lesson to the students step-by-step moving from simple to complex and show them the procedures and methodology involve in the lesson. Ameh & Dantani (2012) stated that demonstration approach is effective in enhancing chemistry achievement of secondary school students. And that the approach enhance active participation of students in the lesson.

A demonstration method is a teaching method used to communicate an idea with the aid of visuals such as flip charts, posters, power point, among others. A demonstration is the process of teaching someone how to make or do something in a step-by-step process. As you show how, you “tell” what you are doing. A demonstration always has a finished product. The key to a good demonstration is for the audience to be able to go home and do what you have taught them how to do. Ogologo & Wagbara (2013) and Udo (2010) argued that due to the adequate participation of students in the learning process, the achievement of demonstration approach for students was significantly better than that of their counterparts in the conventional approach. Hemanthakumar, Sultana & Zarzari (2013) reported a similar finding where the achievement of biological science students have improved significantly by using the demonstration instructional approach.

One of the advantages of the demonstration method involves the capability to include different formats and instruction materials to make the learning process engaging (*Du, 2012)*. This leads to the activation of several of the learners' senses, creating more opportunities for learning (*Neeraja, 2011)*. The approach is also beneficial on the part of the teacher because it is adaptable to both group and individual teaching (*Heidgerken, 2019)*. While demonstration teaching, however, can be effective in teaching chemistry, it can prove ineffective in a classroom setting that calls for the accommodation of the learners' individual needs.

Academic achievement is the level of attainment of the predetermined learning objectives by the learner. This is mainly shown by the results of either internal examinations in the school or external

examinations like Senior School Certificate Examination (SSCE). Poor academic achievement in senior secondary school Chemistry is alarming and disturbing. Reports of researchers and WAEC chief examiners show a continuous dwindling, and poor performances of candidates for over three decades in senior school secondary chemistry.

Despite the importance of chemistry and its education value which is relevant to the need of individual learner, economics and technological breakthrough of a nation and the effort of researchers to improve on its teaching and learning, the performance of students in the subjects is not still encouraging, this shows that the level of performance is still not good enough. The poor achievement of student in chemistry has continued to be a major cause of concern to all, particularly those in the mainstream of chemical education in Nigeria (Adamu, Boris & Kenni, 2013). Among the factors that have been identified to be responsible for poor performance in chemistry are poor methods of instruction, teacher attitude, laboratory inadequacy, poor science background and non-availability of effective teaching and learning resources in classrooms (Adamuet al., 2013).

Despite huge investment of the stakeholders in this sector, the performance of students continue to be generally poor. Several factors have been advanced to affect students' poor performance. Korau (2006) reported that such include the student factor, teacher factor, societal factor, the governmental infrastructural problem, language problem examination body related variables, curriculum related variables, test related variables, textbook related variables and home related variables. Saage (2009) identified specific variables such as poor primary school background in science, lack of incentives for test, lack of interest on the part of students, students not interested in hard work, incompetent teachers in the primary school, large classes, fear of the subject psychologically among others. However, students do not perform well in Senior School Certificate Examination (SSCE) in chemistry (Eze, 2010).

The implication of a student failing Chemistry at the ordinary level is that he/she will not be enrolled for science based courses at institutions of higher learning. The WASSCE Chief Examiner's Reports between 1999 and 2005 also showed that the percentage of passes in Chemistry is low across Nigeria, thereby affecting the general performance of most candidates who sat for Senior School Certificate Examination over the years. WASSCE Chief Examiner's Reports (2016) also showed that Chemistry students' poor performance in Chemistry paper 2 (theory) over the years, arises from students' having difficulties in tackling questions which required explanation, making logical deductions, calculations, plotting of graph, energy profile diagrams, distinguishing between nuclear and ordinary chemical reactions, chemical symbols and formulae. They lost marks for among other reasons: Inability to write balanced equations with the state symbols; non-adherence to rubrics; poor knowledge of basic chemical principles; poor communication skills; wrong spellings. From the above discussion it is understood that the Chemistry examination constitutes two aspects; the theory aspect and the practical aspect. It is also understood that students do fail in Chemistry examination, but it is not yet clearly understood in which of the two aspects of the examination do they have serious problems.

Durum (2003) observed that one of the problems found in science teaching in Nigeria is that science is presented dogmatically in most schools which students find difficult to relate to real world. Most of our secondary schools' laboratories are ill-equipped and as a result students are denied that feeling of participation in the reality, which practical classes and demonstration provide. All other factors put apart, this is enough to make students perform poorly in examination.

In Nigeria, and perhaps the whole of Africa, gender bias is still very prevalent. Sex roles are somewhat rigid in Africa particularly in Nigeria. It is common place to see gender stereotypes manifested in the day-to-day life of an average Nigerian. Consequently, an average Nigerian child goes to school with these fixed stereotypes. Oludipe (2012) stated that gender issues, both on the part of the teachers and students, have been documented to affect achievement generally. Conflicting results in gender-related research should, however, be expected as studies vary in their learning contexts. There are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender. Girls are being encouraged and sensitized into developing positive attitudes towards science. However, some researchers still found that there are still significant differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender (Oludipe, 2012).

In a study, Eze (2008) asserted that gender had significant effects on students' achievement in chemistry, and showed that male students achieved higher than their female counterparts did. Owoyemi (2007) asserted that student's achievement in chemistry course has 'nothing to do with whether the student is male or female. Adigwe (2012) showed that male students perform better in both achievement and acquisition of problem solving skills than female students in chemistry. Okorie (2016) showed that girls performed better than boys in chemistry, and that the difference between their mean achievement score

was significant. Male students were superior over female students in problem-solving and achievement in chemistry (Okorie, 2016). Adesoji & Babatunde (2008) showed that the difference between the mean achievement scores of female and male students was not statistically significant in chemistry. Okorie (2016) reviewed that gender was not a significant factor in the overall mean achievement rating of students in practical skills on acid-base titration.

Ssempala (2016) investigated gender differences in the performance of practical skills on quantitative analysis, an aspect of chemistry, among senior secondary school girls and boys in selected co-educational schools. The author showed that there were no statistical significant differences between girls and boys in their ability to manipulate the apparatus/equipment, take observation, report/record results correctly, and compute/interpret/analyse results during chemistry practical; girls performed slightly better than boys overall; boys performed slightly than the girls in the following skills: recording/reporting results correctly, and computing/ interpreting/ analysing results. Eze (2008) studied the effect of two questioning techniques on students' achievement, retention and interest in chemistry and found that gender had significant effects on students' achievement; male students achieved higher than their female counterparts did.

Dahiru (2006) made a comparative study of the effectiveness of conventional versus demonstration instructional approaches in selected topics in chemistry. The study used 30 students as a sample out of 150 students of senior secondary one. A design of pre-test, post-test experimental control group was used. A 50 item-instrument with reliability index of 0.76 was used. The study revealed that the demonstration approach enhances the academic achievement of students in senior secondary school chemistry. It then suggested that teachers should employ the possibility of using demonstration approach in teaching chemistry.

Abdulhamid (2010) conducted a quasi-experimental study to examine the effects of demonstration and discussion approaches on secondary school students' achievement in Agricultural Science. He observed that demonstration approach developed and sustained students' learning interests, which led to their better achievement in Agricultural Science.

Ameh & Dantani (2012) carried out a study to determine the effect of conventional and demonstration methods on academic achievement of students in chemistry in the Nassarawa Local Government Area of Kano State. Fifty eight (58) chemistry students (boys and girls) in the Senior Secondary School One (SS1) from two randomly selected schools were involved in the study. Necessary data were collected and the validated reliable data were analyzed using t-test at a significant level of 0.05. Results obtained revealed that students perform better in chemistry when taught using the demonstration method as compared to the conventional method. The boys and girls are better in academic achievement when taught using demonstration method than when conventional method was used. The demonstration method shows equality in the performance of boys and girls.

Omwirhiren, & Ibrahim (2016) investigated the effect of teachers' instructional methods on students learning outcomes in selected senior secondary school in Kaduna, Nigeria Two instructional methods (Demonstration and Conventional) were used on target population of one thousand nine hundred and eleven (1,911) senior secondary (S.S. II) Science Students. The sample consists of 100 Students randomly drawn from two co-educational senior secondary schools within Kaduna North LGA. The students were divided in to two groups: The experimental group and the control group of 50 students each based on a categorization test to ascertain the equivalence of the group. The pretest-posttest quasi-experimental control group design was adapted. The students in the experimental group were exposed to Demonstration Method, while those in the Control group were exposed to the conventional instructional strategy for a period of three weeks. The instrument developed and validated for data collection was Chemical Bonding Performance Test (CBPT). The data collected were analyzed using mean, standard deviation, t-test and ANOVA at 0.05 level of significance. The major findings from the study shows that there is significant difference in learning outcome on students exposed to demonstration and conventional strategies used to teach chemistry ($t_{cal} = 0.774 > t_{crit} = 0.443$ and $F_{cal} = 0.771 > F_{crit} = 0.710$ at $P<0.05$) and there is no significant difference in the academic performance of both male and female students exposed to demonstration instruction in teaching chemistry ($t_{cal} = 0.177 < t_{crit} = 0.861$ and $F_{cal} = 0.728 < F_{crit} = 0.781$ at $P< 0.05$).

Jeje, Gbenro & Aladesaye (2018) in their study on the influence of conventional method and peer tutoring found that there was a significant difference between the post-test scores of at-risk mathematics students taught with conventional method and those taught with peer-tutoring activities. The study further revealed that there was no significant difference between the posttest scores of male and female students taught with conventional method and peer-tutoring. There was a significant difference between the

retention ability of at-risk Mathematics students taught with conventional method, and those taught with peer-tutoring.

Statement of the Problem

Students' persistent poor performance has been partly ascribed to inadequate teaching and instructional methods adopted by science (chemistry) teachers (Hijazi & Al-Natour, 2012). A lot of reports have been made on the seriousness of the deplorable performance of secondary school students in chemistry and identified persistent use of the traditional mode of instruction like conventional method as one of the major short-coming affecting the learning and higher achievement in chemistry. The Chief WAEC Examiner Report (2014) noted that the rush over the topics to cover could be responsible for the poor performance in chemistry. It is observed by the researcher that the quality of teaching method used by the secondary school chemistry teachers is a key determinant of students' achievement. In view of the foregoing, this study examined the effects of conventional and demonstration methods on teaching and learning of secondary school Chemistry in Ikere local government area of Ekiti State.

Hypotheses

The following hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the academic achievement of students taught with conventional method and those exposed to demonstration method prior to the experiment.
2. There is no significant difference between the chemistry achievement scores of students taught with demonstration method and those taught with conventional method after the experiment.
3. There is no significant difference between the chemistry achievement scores of male and female students taught with conventional method and those taught with demonstration method after the experiment.

Methodology

The design of this study was the quasi-experimental research design. To be specific, it is non-equivalent control group design. The study was conducted in public secondary schools in Ikere local government area in Ekiti State, Nigeria.

The population of the study is the entire senior secondary school two (SSS2) Chemistry students in all the public schools in Ikere local government area of Ekiti State. SSS2 students are chosen because it is the class that is very close to preparation for external examination and that the topic introduction to organic chemistry to be taught are offered at Senior Secondary School II according to the new senior secondary school curriculum. The population of SSS2 Chemistry students in the entire senior secondary school is one thousand five hundred and eighty two (1,582) in 2018/2019 academic session.

The sample size for the study is fifty six (56) students in two (2) intact classes in the senior secondary school two (SSS2) class. The schools were randomly drawn from the ten (10) schools using simple random sampling by balloting without replacement. Amongst the schools that were selected, one was assigned to the demonstration method group and the other was assigned to conventional method group using simple random sampling by balloting without replacement.

The instrument used for the data collection was Chemistry Achievement Test (CAT) on the topic :introduction to organic chemistry".

The instrument (CAT) was developed by the researcher. Fifty multiple choice objective items based on the topic were collated and was used for pre - test and re – shuffled for post - test during the data collection.

Face and content validity of the instrument was ensured. In order to ascertain the consistent level of CAT, the instrument was administered to a total of 30 students in a co-educational school within the local government but not originally sampled for data collection. The test –retest method of reliability was used such that the researcher first administered the instrument to thirty (30) students and later re-administered the instrument to the same thirty (30) students within the interval of two-weeks after which the CAT had been re-shuffled. The data collected were subjected to item analysis using Pearson Product Moment Correlation Statistics. The reliability index obtained was 0.79 at 0.05 significance level. This showed that the instrument was reliable for the study.

Classes in the schools that were used for the study were randomly assigned to both experimental and control group. The first group was taught the introduction to organic chemistry with demonstration method of teaching and the second group was exposed to conventional method of teaching. Chemistry teachers of the schools sampled were used for teaching students in conventional method group while the

researcher handled the demonstration method class. The lesson notes for treating demonstration method was prepared and used by the researcher and lesson note for conventional method of teaching were used by the teachers for the study.

The researcher with the help of the subject teachers in schools administered the test to the students; the time allotted for the test was forty (40) minutes. The question papers were retrieved from the students after test. The researcher marked and scored the pre-test.

Also with help of the subject teachers, the treatment was administered using all the demonstration method with different instructional medium. Six lesson plans were prepared and were used for the treatment. Three lesson plans were used for the Demonstration Method group, while the other three were used for the Conventional Method group.

At the end of the treatment based on the two different teaching methods, the post-test was administered to the students with help of the subject teachers at the allotted time forty (40) minutes. The answer scripts were collected, marked and scored with the help of the subject teachers.

Frequency counts and percentage were used in analyzing the personal data of respondents. While the research hypotheses were tested using the t-test and analysis of covariance (ANCOVA) at 0.05 level of significance.

Results and Discussion

Test of Hypotheses

Hypothesis 1: There is no significant difference between the Chemistry achievement scores of students taught with demonstration method and those taught with conventional method prior to the experiment.

Table 1: t-test analysis of performance of students in chemistry pre-test.

Variable	N	Mean	SD	df	$t_{cal.}$	$t_{tab.}$	Decision
Demonstration	28	16.86	4.04	82	1.23	1.96	Not significant
Conventional	28	16.29	3.28				

P < 0.05 significance level

Table 1 shows the result of analysis of performance of students in chemistry pre-test. The table revealed that mean score for students taught using demonstration method (16.86) was less than the mean score of students taught with traditional method (16.29) with a mean difference of (0.57). The t-test revealed that t-calculated (1.23) was less than the critical t-value (1.96) at the 0.05 significance level. Hence, the null hypothesis was upheld. This means that there is no significant difference between Chemistry achievement scores of students taught with demonstration method and those taught with conventional method prior to the experiment.

Hypothesis 2: There is no significant difference between the chemistry achievement scores of students taught with demonstration method and those taught with conventional method after the experiment.

Table 2a: ANCOVA of performance of students taught with conventional method and those taught with demonstration method.

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial η^2
Corrected model	437.740[a]	2	218.870	7.395	.001	.154
Intercept	701.006	1	701.006	23.686	.000	.226
Chmpretest	344.734	1	344.734	11.648	.001	.126
St1rategy	11.636	1	11.636	.393	.532	.005
Error	2397.248	53	29.596			
Total	59567.000	56				
Corrected total	2834.988	55				

[a]R squared=0.154 (Adjusted R square= 0.134)

A one-way between subject analysis of covariance (ANCOVA) was conducted to compare the impact of the two teaching methods on the performance of students in the post-test score of chemistry achievement test as shown in Table 2a above. After adjusting for pre-test scores, there was a significant difference between the performance of students taught with conventional method and those taught with

demonstration method F(1, 53) = 0.393, p<0.05, Partial η^2 = 0.005. Hence, the null hypothesis was not upheld.

Table 2b: Mean, standard deviation and gain in achievement of experimental and control group.

		Pretest		Posttest		
Group	N	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$ gain
Demonstration	28	16.86	4.04	24.50	5.97	8.46
Conventional	28	16.29	3.28	19.73	5.69	3.44

Analysis in Table 2b reveals that the control group (conventional) and the experimental group (demonstration) got a score of 16.29 and 16.86 respectively in the pre-test while they got a score of 24.50 and 19.73 respectively in the posttest. This shows that there is an increment of 3.44 for the control group and 8.46 for the experimental group. Hence, the mean performance gain of student taught with demonstration strategy was higher than that of those taught with conventional method.

Hypothesis 3: There is no significant difference between the chemistry achievement scores of male and female students taught with conventional method and those taught with demonstration method after the experiment.

Table 3a: Two-way ANCOVA of the effect of gender on chemistry post-test performance of students taught with demonstration strategy and traditional method.

Source	Type III sum of squares	df	Mean square	F	Sign	Partial η^2
Corrected model	524.114[a]	4	131.028	4.479	.003	.185
Intercept	676.353	1	676.353	23.122	.000	.226
Chmpretest	360.376	1	360.376	12.320	.001	.135
Strategy	10.713	1	10.713	.366	.547	.005
Gender	.005	1	.005	.000	.990	.000
Gender* strategy	77.143	1	77.143	2.637	.108	.032
Error	2310.874	51	29.252			
Total	59567.000	56				
Corrected total	2834.988	53				

[a]R squared= 0.185 (Adjusted R square= 0.144)

The result in Table 3a above shows the effect of students' gender on post-test performance of student taught with conventional method and those taught with demonstration method. The ANCOVA reveals that students' gender have no effect on their performance in the post-test since F (1, 51) = 2.637, p<0.05, Partial η^2 = 0.032. Hence, the null hypothesis was upheld. This implies that there is no significant difference between the posttest scores of male and female students taught with conventional method and those taught with demonstration method.

Table 3b: Mean and achievement gain of male and female students in the experimental and control groups.

Group	Gender	N	Pretest $\bar{x}$	Posttest $\bar{x}$	$\bar{x}$ gain
Demonstration	Male	12	16.64	23.96	7.32
	Female	16	17.08	25.04	7.96
Conventional	Male	13	15.87	19.49	3.62
	Female	15	16.71	19.97	3.26

Analysis in Table 3b reveals the influence of gender on the academic performance of chemistry students. The table showed that male and female students in the control group (conventional) got the scores 15.87 and 16.71 respectively in the pre-test while they got 19.49 and 19.97 respectively in the posttest. Similarly, male and female students in the experimental group (demonstration) got a score of 16.64 and 17.08 respectively in the pre-test while they got a score of 23.96 and 25.04 respectively in the posttest. This shows that there is an increment of 53.62 (for male) and 3.26 (for female) in the control group while there is an increment of 7.32 (for male) and 7.96 (for female) in the experimental. Hence, the mean performance gain of male and female students taught with demonstration strategy was higher than that of those taught with conventional method but this increment was not due to students' gender.

Discussion of Results

The results of this study has added yet another empirical evidence to the library of data on the efficacy of the demonstration instructional strategy in the teaching and learning of chemistry. The experimental group produced higher mean achievement scores than the control group taught chemistry hydrocarbon families, classification of hydrocarbons, alkanes, preparation of alkanes, physical properties of methane uses of methane, ethane, physical properties of ethane, chemical properties of ethane, alkynes, preparation of ethyne, properties of ethyne and uses of ethyne in the scheme of work for Chemistry using the conventional methods. The importance of deeper learning as a means of developing learners' capacity to apply knowledge gained during the learning process was reflected in this study since the students taught through the demonstration method produced enhanced learning outcomes. Students' active participation, their interaction in groups and the
teacher's role as facilitator of thought provoking questions might have enhanced students' achievement in hydrocarbon tests. Findings from this study is in line with those of earlier investigators and activity based proponents like Ameh & Dantani (2012).

As to the effect of gender, findings from present study suggest that irrespective of the sex, status of the student, demonstration teaching method has positive effects in enhancing learning outcomes. This discovery therefore showed that both male and female students when exposed to the treatment of demonstration teaching method perform well in their academic mean scores implying that both male and female derive almost equal benefit from being taught using the demonstration teaching method. This is particularly instructive because a number of teacher instructional strategy tends to be gender bias in favour or against a particular sex. The findings are in line with the findings of Eze (2008) that gender had significant effects on students' achievement in chemistry and that male students achieved higher than their female counterparts did. Conversely, Owoyemi (2007) asserted that student's achievement in chemistry course has 'nothing to do with whether the student is male or female. Adigwe (2012) showed that male students perform better in both achievement and acquisition of problem solving skills than female students in chemistry. Okorie (2016) showed that girls performed better than boys in chemistry, and that the difference between their mean achievement score was significant. Male students were superior over female students in problem-solving and achievement in chemistry (Okorie, 2016). Adesoji & Babatunde (2008) showed that the difference between the mean achievement scores of female and male students was not statistically significant in chemistry. Okorie (2016) reviewed that gender was not a significant factor in the overall mean achievement rating of students in practical skills on acid-base titration

Conclusion

Based on the findings emanating from the study, the following conclusions and recommendations were drawn:

i. Students perform better in Chemistry when taught using the demonstration method as compared to the conventional method.
ii. The boys are better in academic achievement when taught using demonstration method than when lecture method is used.
iii. The girls achieve higher in Chemistry when taught using demonstration method than when taught using conventional method.
iv. The demonstration method shows differences in the performance of boys and girls.
v. The teaching of science in general and Chemistry in particular should be done in such a way that students learn effectively and perform to achieve high. The use of demonstration method seems to be suitable in achieving this goal.
vi. The use of conventional methods of teaching has been found in the study not be appropriate with respect to achievement in the learning of chemistry.

Recommendations

In view of the findings arising from present study, we recommend that:

1. Chemistry teachers should incorporate demonstration method for teaching at senior secondary school level so as to enhance academic performance
2. Curriculum planners should recommend and ensure that the demonstration method is used for teaching chemistry at senior secondary school level.
3. The demonstration teaching method should be applied to both male and female in view of its gender friendly nature.

4. Teachers should be sponsored by the government and other educationally friendly stakeholders to attend workshops and seminars on the appropriate and effective use of the demonstration teaching method in the realization of enhanced learning outcome in chemistry among senior secondary school students in Ekiti state.
5. The Ministry of Education as an agency of Government should provide all the needed instructional and infrastructural facilities for the effective application of demonstration teaching method in Chemistry in the senior classes in the state.
6. More topics in chemistry at this level of instruction should be tested using the demonstration method in order local government areas so as to compare findings.

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