EFFECTS OF CASE-BASED AND OBSERVATIONAL LEARNING STRATEGIES ON STUDENTS' ACHIEVEMENT IN CHEMISTRY IN SECONDARY SCHOOLS IN LAGOS STATE, NIGERIA

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Abstract

Students' achievement in Chemistry in Lagos State seems not to be encouraging, a trend attributed partly to persistent usage of teacher-centered instructional methods. This necessitates the adoption of students-centered instructional strategies such as theCase-based and Observational learning strategies. The effectiveness of these two instructional strategies in the teaching of Chemistry has however not been properly documented. This study, therefore, investigated the effects of Case-based and Observational learning strategies on students 'achievement in Chemistry in Lagos State. The moderator effects of gender was also examined. The study adopted a pretest-posttest, control group, quasi experimental design. The study sample consisted of three hundred and sixty eight students (188 males, 180 females)Senior Secondary School two (SSII) students which are from purposively selected nine different public schools in Educational District I, Educational District II and Educational District VI which were randomly selected from the six Educational Districts of Lagos State. Three schools were used in each of the experimental groups (1and11) and three schools were used as the control groups. Trained Chemistry teachers were used as research assistants for the purpose of this research. In all, a total of nine (9) Chemistry teachers and three hundred and sixty eight (188 male and 180 female) students participated in the study. However, intact classes were used and randomly assigned to treatment. The five instruments used were Students Chemistry Achievement Test, and instructional guides for Case-based, Observationalandmodifiedconventional strategies. Two null hypotheses were tested at 0.05 level of significance. Data were analysed using Analysis of Covariance and Tukey post-hoc test. Treatment had a significant main effect of treatment on students' achievement in Chemistry ($F_{(2,349)} = 21.12$: $P<0.05$; $\eta^2 = 0.108$). Case-Based learning strategy had the highest posttest mean score followed closely by those exposed Observational learning and modified

conventional strategy had the least posttest mean score. Case-Based and Observational learning strategies enhanced student's achievement in Chemistry in Lagos State. Therefore, these strategies should be adopted in teaching Chemistry to secondary schools students.

Keywords: Case-based and Observational Learning Strategies, Modified Conventional Strategy, Achievement in Chemistry.

Introduction

Chemistry is one of the basic science subjects for sustainable development. Chemistry is a branch of physical science that studies the composition, structure, properties and change of matter. Chemistry is chiefly concerned with atoms and molecules and their interactions and transformvations, for example, the properties of the chemical bonds formed between atoms to create chemical compounds. It deals with the substances made of atom that we use in cosmetics which are made up of chemicals and colours.Chemicals relate to Chemistry thus it plays an important role in our daily life. Chemistry is needed in all sorts of jobs like mpharmacy, medicine and business. Our daily activities today involve Chemistry, what we eat, drink, wears and breathe is Chemistry. Chemistry in few words is life (Chemweb, 2011).Its knowledge is important in the manufacturing of fertilizer, insecticides, food processing and storage, management of natural resources, provision of food and health facilities as well asfavourable living environment. It also provides a natural link between home and school and the means through which students understand the world around them and explore the wider implications of science in relation to man.

The specific objectives to be achieved by Senior Secondary School Chemistry curriculum as stated in the Nigerian Educational Research and Development Council, (NERDC, 2013) include: To

(1) Provide students with the basic knowledge in chemical concepts and principles through effective selection of content and sequential;
(2) Show Chemistry and its inter-relationship with other subjects;

(3) Provide a reasonable adequate foundation for a post-secondary school Chemistry course.

All these objectives can only be achieved by the teacher through giving the right type of instructions to Chemistry students. No matter how well developed and comprehensive a curriculum is, its success is dependent on the quality of the teacher implementing it and the method of instruction adopted. Despite the importance of Chemistry to mankind and the efforts of researchers to improve on its teaching and learning, the achievement of students in the subject remains low in Nigeria.
Table1.1 shows students' performance in May/June Senior Secondary School Certificate Examinations in the last fourteen years (2000-2013).

Table1: Statistics of the Chemistry Results by Grades of the West African Examinations CouncilSenior Secondary Certificate Examinations (2000-2013)

Year	Number of Candidates registered	% credit (1-6)	% Pass (7-8)	% Fail
2000	160953	24.52	30.23	45.25
2001	301740	23.42	29.82	46.76
2002	262824	20.94	25.61	53.45
2003	282120	24.62	28.54	46.84
2004	269774	38.94	28.30	32.76
2005	349996	50.91	21.81	27.28
2006	308104	55.34	14.55	30.11
2007	424747	46.16	24.81	26.49
2008	456980	44.37	27.13	26.10
2009	467612	43.49	26.65	22.82
2010	465643	50.80	24.11	22.14
2011	565668	48.95	26.94	24.11
2012	627025	44.36	31.52	24.11
2013	639131	74.67	14.86	9.59

Source: Department of Statistics West African Examination Council (WAEC), National office, Onipanu, Lagos, Nigeria (2013).

From Table1 provided, it shows that the performance was very poor and not stable. The percentage passes for the year 2000 to 2013 apart from 2005, 2006, 2010 that showed average performance and 2013 that showed an improvement compared to the previous years mentioned, are not good enough especially for candidates that want to study Chemistry

and Chemistry-based coursesor for any candidate that may include Chemistry as one of the five subjects passed at credit level in order to be admitted into any higher institution in Nigeria. Consequently, the high percentage of the candidates who failed SSCE from 2000 to 2013 is becoming worrisome. The fluctuation in achievement in Chemistry has been variously explained by researchers such as Abimbola (2013) who asserted that the percentage of candidates' admitted for science and science-based courses did not reach 20 percent during this period (from2000 to2013), except in 1998/1999 academic session when it was 23.09 percent.

The report compiled by WAEC Chief Examiner 2008 in table 1.1 indicated that students are weak in observation, identification of problems, lack recording and mathematical skills with poor practical/experimental exposure, and students' abstractness in some general Chemistry concepts found in SSCE Chemistry syllabus such as chemical reactions, ionic equations, and redox reactions (Oxidation-Reduction) and ionic theory. The report also confirmed that there was no improvement in candidates' achievement when compared to previous year. This fluctuation in performance has affected the education pursuits and aborted the ambition of many candidates who aspired to study professional courses like Medicine, Pharmacy Chemistry, and Chemistry education. Several studies have been conducted in and outside of Nigeria to investigate the causes of students' under-achievement in Chemistry (Adesoji, 2004, Osokoya, 2006, Cetin, 2009 and Cam, 2009) and the most recurring factor in all the reports is the inefficient teaching strategy employed by secondary school teachers which are the conventional teaching strategy.

Conventional Strategy is the strategy mostly used in Nigerian schools. It is a traditional teacher expository strategy. The teacher dominates the class and "gives out" the facts to the students, while the students in turn listen and digest the knowledge (Osokoya, 2006). There are reasons listed by Adesoji (2004) which make teachers refuse to change their conventional teaching strategy

(a) Lack of infrastructural facilities

(b) Overloaded curriculum
(c) Lack of training programmes/workshops and
(d) Lack of skill in handling difficult concepts identified by Olagunju, (2002)

The achievement of students in Chemistry is also reported to be casually influenced by the previous experience of the students in basic science a student cannot learn Chemistry effectively without going through some experiences in basic science (Adeosji and Olatunbosun, 2008). Chemistry teaching can only be result oriented when students are willing and the teachers are favourably disposed, using appropriate methods and resources in teaching the students with the current increase in scientific knowledge the world over, much demand is placed, and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of science (Adesoji, 2008). Despite the importance of Chemistry to mankind and the efforts of the researchers to improve on its teaching and learning, the achievement of students in the subject remains low in Nigeria. Among the factors that have been identified as students learning outcomes in Chemistry are; poor methods of instructions (Osuafor, 1999) teachers attitude and students attitude to Chemistry (Adeyegbe, 2005)

There are varieties of strategies that can be employed to teach secondary schools students in Chemistry, such as Demonstration (Palmer, Peter and Streetman, 2003). Guided Discovery (Adesoji, 2004), Experiential and Generative strategies (Udofia, 2015) to mention a few. All the objectives set up for chemistry in the National policy of education (NERDC, 2013) can only be achieved through giving the right types of instructions to science students. No matter how well developed and comprehensive a curriculum is, its success is dependent on the quality of the teacher implementing it and the method of instruction adopted. There are varieties of strategiesthat can be employed to teach secondary schools students in Chemistry, such as Demonstration (Palmer, Peter and Streetman, 2003). Guided Discovery (Adesoji, 2004), Experiential and Generative strategies (Udofia, 2015) to mention a few.

Research however indicated that students who were taught with metacognitive learning strategies learned and retained significantly more information than students taught with conventional teaching methods (Palmer, Peter and Streetman, 2003).Olagunju,Busari and Ogunbiyi (2004) also emphasised the importance of peer group in secondary schools for teaching-learning process. These strategies (Demonstration, Guided Discovery) encouraged student-student interaction thus making students learn better from each other. In spite of all these strategies, the fluctuation in performance rates are still experienced in the years examined, hence the need for more effective strategies. Yesilyurt (2012) suggested that the use of Case-Based and Observational learning instructional strategies that allows for conscious teaching of Chemistry through modelling and creating cases to solve problem of misconceptions and negative influences towards the teaching and learning of Chemistry. In this study therefore, Case-Based and Observational learning instructional strategies were used to educate students in Chemistry. Case-Based learning is the ability to spontaneously restructure one's knowledge in many ways, in adaptive response to radically changing situational demands and social constructivism, in the area of the importance of culture and circumstances in constructing Case-Based learning according to Collins (1989) was defined as learning through-guided experience and more on cognitive and metacognitive as well as physical skills and processes.

Case-Based learning has long been used as independent variables in many professions including law, medicine and business education. The strong belief in effective learning through case methods is supported by several theories, including situated cognition described by Yesilyurt (2012) as "the notion of learning knowledge and skills in contexts that reflect the way they will be used in real life" knowledge (Wasserman and Graddy,2001). In a study, Cam (2009) compared the effectiveness of Case-Based learning strategy over traditional method of instruction on eleventh grade high school students' understanding of solubility and equilibrium concept. It was also reported that students' attitude towards Chemistry and students' epistemological beliefs in this study improved. The result of study also indicated that students instructed with Case-

Based learning had higher academic achievement than the traditional instruction. This researchfocused on Case-Based learning strategy in senior secondary schools in which academic achievement of students serves as dependent variable.

Moreover, Cam (2009) confirmed that there was a significant difference between the experimental and the control group with respect to their attitudes towards Chemistry and epistemological beliefs in eleventh grade high school, the result favoursthe experimental group**.** This research focusedon Case-Based learning strategy in senior secondary schools in which attitude of students serve as dependent variable. Based on literature, Case-Based learning strategy may be a better strategy in enhancing students' understanding of Chemistry concepts. Also, Cam (2009) concluded that this strategy could help students to relate chemical concepts and principles to their lives more easily and produce more positive attitudes toward Chemistry**.**This research focusedon the concept Chemical reactions, Ionic equation, Oxidation-Reduction (Redox reactions) and lastly, ionic theory.

Another research conducted by Herreid (2011) found the effect of Case-Based learning on students' awareness of the relevance of science in his research. This research was conducted with 200 students who enrolled in general Chemistry at university. The result of the study indicated that students enjoyed the Case-Based activities because it made the topic more interesting and controversial. In addition, the students expressed that Case-Based instructional strategy made science more relevant to their life situations. A similar study was conducted by Cornerly (1998). In this study, the researcher developed the cases concerning metabolic diseases in biochemistry courses. Firstly, the class was divided into groups of 3-5 students, then, each group received a different case and the students researched into these cases. It was observed that students evaluated the courses according to the scale which consisted of 30 statements related to the courses better than they had always been doing, as a result of this, it was determined that students enjoyed Case-Based learning than any other strategies previously employed.This research focusedon Case-Based learning strategy in senior secondary

schools in which students' achievement serve as dependent variables. Another strategy that has been proved efficient and student-centered in various subjects, such as Mathematics (Schunk, 1996), reading (Couzijn and Rijlaarsdam, 2004), argumentative writing (Zimmerman and Schunk, 2003), learning to collaborate (Rummel and Spada, 2005), and learning argumentation skills (Schworm and Renkl, 2007), Biology (Adeoye, 2014), Basic science (Anore, 2014) is Observational learning strategy. This has not been used in Chemistry. This can be defined as a learning process in which there is an interaction between the observed (students) and the model (teachers) being observed by the students; it records what actually happens rather than depend on individuals.Observational learning, as examined in the present study, is also triggered by a form of modelling; students learn by watching, interpreting, and evaluating peers carrying out a task. In formal education, the study therefore, examined the effects of Case-Based and Observational learning strategies on students'attitudetoand achievement in Chemistry.

Another contributing variable to the achievement towards Chemistry is the gender of students. Gender has remained an issue that has remained relevant in education because it has been linked to achievement and participation in certain profession (Sotonade, 2004). Certain culture restricts particular gender to certain professions like engineering and trading (Olatoye and Afuwape, 2004). Olatoye and Adekoya (2010) asserted that there have been conflicting findings on how gender influences academic achievement. It looks like the influence of gender differs according to subject classification in the school for instance Science, Art and Commercial. Olatoye and Afuwape (2004) reported that there is no significant difference between male and female achievement in science. Several research findings at all levels of education in Nigeria indicated that females are grossly under represented. Young and Fraser (2006) revealed significant gender differences in Chemistry achievement in favour of the boys. Soyibo, (2004) reported that girls performed at significantly higher levels on tasks where the content was drawn from the biological sciences and those written tasks assessing science skills. Boys, however, were found to have greater success in the physical sciences. Girls had significantly higherachievement than boys, regarding

students' achievement. These inconclusive evidences by researchers had shown that gender is still an issue in science education research; this research addressed the effect of gender on the attitude and achievement towards Chemistry.

Statement of the Problem

The poor performance recorded by students in public examinations has been attributed to students' poor achievement in Chemistry. Most studies aimed at improving students' achievement in Chemistry such as activity, discussion and lecture methods were without conscious teaching of the rudiments of Chemistry to help learners overcome their perceived weaknesses. Case-Based and Observational learning strategies have, therefore, been canvassed. Studies have shown the individual effectiveness of Case-Based learning strategy including individual effects of Observational learning strategy in improving students' achievement in other science subjects, without looking at the effects of these two strategies on students' achievement in Chemistry. Hence, this study determines the effects of Case-Based and Observational learning strategies on senior secondary schools students' achievement in Chemistry in Lagos State. The moderating effects of gender was also determined.

Research Hypotheses

The following null hypotheses were tested at $P < 0.05$ level of significance.

H_{O1}: There is no significant main effect of treatment on students'achievement in chemistry.

H_{O2}: There is no significant main effect of gender on students'achievement in chemistry.

Methodology

Research Instruments

Five instruments were used for the study as stated below:

1. Student Chemistry Achievement Test; r = 0.81 (SCAT),
2. Teachers' Instructional Guides on the:Case-Based Learning Strategy (CBLS)

3. Teachers' Instructional Guides on the Observational Learning Strategy (OBLS)
4. Teachers' Instructional Guides on the Modified Conventional Strategy (MCS)
5. Evaluation Sheet to Assess Teachers' Performance during Training (ESATPT)

Student Chemistry Achievement Test (SCAT)
Chemistry Achievement Test was aimed at collecting scores on students' Achievement in Chemistry. All questions designed by the researcher were based on West African Examinations Council senior secondary school Chemistry curriculum.
This is made up of two sections.

Section A: This consists of the personal data of the participants name, gender and school.

Section B: This consists of 20 multiple choice items with four options. All the questions were answered by the participants in one hour. The table of specification for the development of the test was in Table .2. The table was in accordance with Yoloye(1982) in which the six levels of Bloom taxonomy was reduced to three levels

Table 2: Specifications for SCAT

Chemistry Areas	Knowledge	Understanding	Thinking	Total
Chemicalreactions	2(12,20)	1(11)	2(13,18)	05
Ionicequations	2(1,19)	2(5,17)	2(3,8)	06
Oxidation-reduction (Redox reactions)	2(2,16)	1 (9)	2 (7,14)	05
Ionic theory	2(4,6)	1(10)	1(15)	04
TOTAL	8	5	7	20

Validation of Student Chemistry Achievement Test
This instrument was subjected to face and content validity by giving copies to experts in Chemistry education. These experts were asked to determine its suitability for the targeted population in terms of clarity,

breath and language. Out of the initial 40 items prepared, only 20 items survived scrutiny. The difficulty and discriminating indices of each of the test items was computed for validation. The difficulty level and the discrimination indicesrange of 0.4 to 0.60 were obtained. The reliability of the instrument was established by using Kuder – Richardson formula 20 (KR-20) which yielded.

Teacher Instructional Guide on Case-Based Learning Strategy

The main features of the guide were: general information which consists of subject, topic, sub-topics, class, duration, general objectives, instructional materials, reference book, introduction, presentation, evaluation, assignment and procedure expected to be followed by the teachers in teaching general Chemistry concepts selected in the classroom using Case-Based learning strategy (CBLS) This was prepared and used in the training of teachers to allow for uniformity in the teaching method.

Steps involved in Case-Based Learning Strategy includes

Step I: Students were arranged in heterogeneous small groups of five with a leader selected in each group.

Step II: The teacher linked the previous knowledge to the new concept

Step III: The teacher frame cases for thoughtful investigation which should be logically arranged

Step IV: Students listened to the case story narrated by the teacher and answered questions from the case in relation to the content and instructional objectives of the topics

Step V: Students linked to the current problem in relation to the content and instructional objectives of the topics.

Step VI: Students developed ideas, use facts to substantiate thought and analysis in order to make cases relevant to the content and instructional objectives of the topics.

Step VII: Students answered questions that were relevant to the cases at the end of the lesson and later did assignment on the cases.

Validation of Teacher Instructional Guide on Case-Based Learning Strategy

This is an instructional guide for teachers participating in the experimental group 1(Case based Learning Strategy).This instrument was validated using Scott Pi's inter-rater reliability index and the value 0.73 was obtained which shows substantial agreement between the raters making the instrument reliable for use.

Teacher Instructional Guide on Observational Learning Strategy

The main features of the guide were: general information which consists of subject, topic, sub-topics, class, duration, general objectives, instructional materials, reference book, introduction, presentation, evaluation and assignment.

Observational Learning Strategy has the following steps:

Step I: Teacher presented the topic in form of observation through demonstration and discussion

Step II: Students in five member heterogeneous academic teams within the group engaged themselves on an experiment based on the learnt materials provided by the teacher.

Step III: Students wrote questions on the topic in form of quiz.

Step IV: Students answered the questions individually without assistance from their mates.

Step V: The average score of members of each student was calculated and added to find the groups mark.

Step VI: Students received reward from the teacher.

Step VII: Students copied assignment on the topics.

Validation of Teacher Instructional Guide on Observational Learning Strategy

This is an instructional guide for teachers participating in the experimental group 2(Observational Learning Strategy)

This instrument was validated using Scott Pi's inter-rater reliability index and the value 0.83 was obtained which shows substantial agreement between the raters making the instrument reliable for use.

Modified Conventional Strategy Instructional Guide

This contains the roles of the teacher and the students in Modified conventional learning situation. Here students would sit individually and not in group throughout the lesson. The treatment for each lesson involved the following steps:

Step I: The teacher made students to sit individually and briefly reviewed the previouslesson

Step II: The teacher introduced the topic to the students.

Step III: Students listened to the teacher and wrote down chalkboard summary.

Step IV: Students asked the teacher questions on areas of the topic that was not clear to them.

Step V: The teacher asked the students questions and the students answered individually.

Step VI: The teacher gave assignment based on the topic.

Validation of Teacher Instructional Guide on Modified Conventional Strategy

This instrument was validated using Scott Pi's inter-rater reliability index and the value 0.76 was obtained which shows substantial agreement between the raters making the instrument reliable for use.

Evaluation Sheet for Assessing Teachers' Performance on the use of the Learning Strategies (ESATPLS)

These instruments were used for the selection of participating research assistants on each strategy before the commencement of the treatment. This gives the guidelines for evaluating performance of the trained teachers on the effective use of these strategies

(1) Case-Based Learning Strategy
(2) Observational Learning Strategy
(3) Modified Conventional Strategy

This was a rating scale that was made up of two sections

Section A – This consisted of the personal data of the trained teacher containing name, school, period, date and the summary of the concept discussed in the class.

Section B - This consist of items that were placed on a 5-point rating scale ranging from Very Good (VG), Good (G) Average (AV) Poor (P) and Very Poor (VP).
The scoring of ESAT was as stated below:

Very Good (VG) - 5marks
Good (G), - 4 marks
Average (AV) - 3 marks
Poor (P) – 2 marks
Very Poor (VP). – 1 mark

Validation of ESATPLS

The instruments were given to the experts in the field of Science Education. Their comments, criticism and contributions and suggestions were used to modify the items. The reliability coefficient of ESATPLS in

(a) Case-Based Learning Strategy was 0.81
(b) Observational Learning Strategy was 0.81
(c) Modified Conventional Strategy was 0.78

Method of Data Collection

The data collection lasted twelve weeks. The phases were:

- Visitation to the Educational Districts and schools for one week
- Training of teachers (research assistant) for two weeks
- One week for pretest (,SCAT)
- Six weeks for treatment using the research assistants and Teacher's Instructional Guides on the listed strategies. This took place simultaneously in all the nine schools selected.
- One week for posttest administration of SCAT.
- A total number of twelve weeks were used for the field work of the study.

Training of Teachers for Case-Based Learning Strategy, Observational Learning Strategy and Modified Conventional Teaching Method

The researcher trained the research assistants (Teachers) for two weeks. The training of the teachers was focused on the use of Case Based Learning Strategy, Observational Learning Strategy and Modified Conventional Strategy.

Administration of the Pretest

The instrument students' achievement test on Chemistry and finally student's numerical ability test was administered.

Administration of Treatment

(i) Experimental group 1 (Case-Based Learning Strategy)

Treatment in this group involved Case-Based Learning Strategy with the following steps:

Step I: Students were arranged in heterogeneous small groups of five with a leader in each group.

Step II: The teacher linked the previous knowledge to the new concept.

Step III:The teacher Frame cases for thoughtful investigation which should be logically arranged.

Step IV: Students listened to the case story narrated by the teacher and answered questions in relation to the content and instructional objectives of the topics.

Step V: Students linked to the current problem in relation to the content and instructional objectives of the topics.

Step VI: Students developed ideas, use facts to substantiate thought and analysis in order to make cases in relation to the content and instructional objectives of the topics.

Step VII: Students answered questions that were relevant to the cases at the end of the lesson and later did assignment on the cases.

Experimental group 2(Observational Learning Strategy)

Treatment in this group involved Observational Learning Strategy with the following steps:

Step I: Teacher presented the topic in form of observation through demonstration and discussion
Step II: Students in five member heterogeneous academic teams within the group engaged themselves on an experiment based on the learnt materials provided by the teacher.
Step III: Students wrote questions on the topic in form of quiz.
Step IV: Students answered the questions individually.
Step V: The average score of members of each student was calculated and added to find the groups mark.
Step VI: Students received reward from the teacher.
Step VII: Students copied assignment on the topics.

Control group(Modified Conventional Strategy)

The treatment for each lesson involved the following steps:
Step I: The teacher made students to sit individually and briefly reviewed previous lesson
Step II: The teacher introduced the topic to the students.
Step III: Students listened to the teacher and copied chalkboard summary into their notebooks.
Step IV:Students asked the teacher questions on areas of the topic that was not clear to them.
Step V:The teacher asked the students questions and the students answered individually.
Step VI: The teacher gave assignment based on the topic.

Administration of Posttest on the Experimental and the Control groups

Posttest was administered on the two experimental and the control groups. The administration of the posttest on Student's Chemistry Achievement Test (SCAT) was done.

Method of Data Analysis

The data collected from this study were analysed with the use of inferential statistics of Analysis of Covariance (ANCOVA) in which the pretest scores served as covariate.Estimated Marginal Mean (EMM) was used to determine estimated means of different groups.

Tukey's post-hoc test was used to show where the directions of the significant main effect were obtained and to indicate the level of contribution of each group to the significant main effect.

RESULTS

H_{O1}: There is no significant main effect of treatment on students' achievement in Chemistry.

Table 3: Summary of Analysis of Covariance of Posttest Achievement Scores of Students by Treatment and Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Etta Squared
Corrected Model	1258.716(a)	18	69.929	5.708	.000	.227
Intercept	3244.812	1	3244.812	264.854	.000	.431
Pretest	58.402	1	58.402	4.767	.030	.013
Treatment	517.522	2	258.761	21.121	.000*	.108
Gender	16.792	1	16.792	1.371	.243	.004
Error	4275.716	349	12.251			
Total	36085.000	368				
Corrected Total	5534.432	367				
a R Squared = .227 (Adjusted R Squared = .188) Significant at P<0.05						

Table 3 revealed that there is a significant main effect of treatment on students' achievement in Chemistry ($F_{(2,349)} = 21.12$: $P<0.05$; $\eta^2 = 0.108$). Therefore, the null hypothesis Ho l is rejected. This implies that the treatment has a significant main effect on students' achievement in Chemistry with an effect size of 10.8%. The magnitude of the mean of posttest score of students, across the experimental groups and control group, is presented below in the Estimated Marginal Means (EMM) in Table 4.

Table 4. Estimated Marginal Mean Analysis of the Posttest Scores of Students' Achievement in Chemistry

Treatment Grand mean=9.115	N	Mean	Std. Error	95% Confidence Interval	
				Upper Bound	Lower Bound
Case- based	135	9.865	.472	10.793	8.937
Observational	121	9.758	.312	10.372	9.144
Modified Conventional	112	6.931	.347	7.614	6.249

Table 4. revealed that students exposed to Case-Based learning strategy had the highest posttest mean score (9.86), followed closely by those exposed Observational learning (9.75) and modified conventional strategy had the least posttest mean score (6.93). This implies that students in the Case-Based instructional strategy had the highest contribution to the observed significant difference in the treatment, followed by Observational learning group. The least contribution to the observed significant difference is from the students in the modified conventional strategy which is the control group.

Table 5:Tukey's Posthoc Analysis of Posttest Scores of Students' Achievement in Chemistry

			Treatment		
Treatment	N	**Mean**	**Case based**	**Observational**	**Modified Conventional**
Case based	135	9.865			*
Observational	121	9.758			*
Modified Conventional	112	6.931	*	*	

From the table 5 students in the experimental group I (Case-Based) are significantly different from those in control group (Modified) conventional but not significantly different from the experimental group II (OBLS). The table also indicated that those in experimental group II (OBLS) are significantly different from those in the control group. However the table indicated that those in experimental I (Case-Based learning) and II (Observational learning) are not significantly different

from one another. This implies that Case-Based learning and Observational learning strategies are the main source of significant difference in treatment. Notably, they produced better achievement scores of students compared to conventional group.

H_{O2}There is no significant main effect of gender on students' achievement in Chemistry.

Table 3 revealed that there is no main effect of gender on students achievement in Chemistry ($F_{(1,349)}$ = 1.371: p > 0.05). Therefore, the null hypothesis HO2 is not rejected.

Table 6: Estimated Marginal Mean Analysis of the Posttest Scores of Students' Achievement in Chemistry according to Gender

Gender	N	Mean	Std. Error	95% Confidence Interval	
				Upper	Lower
Male	188	9.15	2.12	9.28	9.02
Female	180	8.52	1.81	9.01	8.03

Table 6 revealed that Male students had higher achievement score of 9.15 while the female counterpart had lower achievement mean score of 8.52, but the difference in their mean scores was not significant.

Discussion of Results

There was a significant main effect of treatment on student achievement in Chemistry. It was shown that students in the experimental group I (Case-Based) are significantly different from those in control group (modified) conventional. This finding is in support of Demircioglu, Ayas and Demircioglu (2006]where Case-Based practices, students work with teachers and experts who use higher-level thinking processes; they are exposed to these processes through cognitive modelling. After receiving initial stages of support from teacher and experts, students actually explore new ideas and make discoveries using advanced reasoning processes. Diverse simple cases of Case-Based turn up whenever teachers report on ways that they have found, through classroom experience, to iteratively build the intellectual skills of their students. Sendur (2012) in his study indicate that Chemistry is often regarded as a

difficult subject by students at each level some reasons may be due to the fact that the chemical concepts are abstract and daily life terminologies and scientific terminologies are difficult to understand (Sendur, 2012). Also, in many countries like Turkey, Chemistry teaching is textbook oriented and based on the chalk and talk method. The table 4.5 also shows that those experimental group II (OBLS) was significantly different from those in the control group. The Observational learning was very beneficial and significantly different from the conventional group because there are positive and reinforcing peer models involved in OBLS which contributed to the greater achievement. According to Demirbas, (2011) individuals go through four different stages in observational learning: attention; retention; production; and motivation, this does not simply mean that when an individual's student attention is captured it automatically sets the process in the exact order. One of the most important ongoing stages for Observational learning, especially among children, is motivation and positive reinforcement. Agoro (2013) confirmed that performance is enhanced when children are positively instructed on how they can improve a situation and are reinforced in order to improve the occurrence of such behaviour where children actively participate alongside a more skilled person.

Conclusion

The findings of this study have shown that Case-Based and Observational learning strategies were effective in accomplishing these and even in improving the students' achievement in Chemistry concepts than the traditional or conventional teaching strategy. The reason for this was that the two instructional strategies enhanced critical thinking, active involvement in learning activities and effective interaction with themselves. Hence, they were able to identify and make proper corrections. It is noteworthy that students showed more level of commitment to solving the problems in Chemistry when taught using these strategies. Hence, Case-Based and Observational learning Strategies can be used to foster the learning of selected concepts in Chemistry irrespective of students' gender and numerical ability.

Educational Implications of Findings

From the study, a lot of pedagogical implications could be drawn.
First, when teaching Chemistry, teachers should actively engage students to work together during the teaching-learning sessions. There is also the need for learners to actively participate in the teaching-learning process through practice sessions and corrective feedback given by the teacher. Second, teaching of rudiments of Chemistry equips the learner with the much needed numerical tools for dealing with Chemical formula, equation and answering mathematical questions.

Contributions of the Study to Knowledge

This study has contributed to knowledge in the following ways :

1. The study helped to improve learners'achievement inChemistry
2. The findings serve as a basic foundation for future studies in the area of Case -Based and Observational learning strategies and their proper utilisation for effective teaching and learning of Chemistry in secondary schools.
3. The two instructional strategies are active learning based because they encourage team work and interactions among the students and all categories of learners were helped to acquire more knowledge.
4. It helps to contribute significantly towards curriculum planning, development and training of Chemistry teachers for better classroom management.
5. Ithas well help Curriculum planners, educational administrators and government in providing a better programme of teacher training course for would - be Chemistry teachers, which might invariably enhance the attainment of the goals of education.

Recommendations

Based on findings of this study, the following recommendations were made:

1 Case -Based and Observational learning strategies should be adapted as viable strategies for learning concepts in Chemistry since they involve students' participation in their learning process.

2 Government should organise an in-service and retraining programmes for teachers for the effective use of innovative strategies such as Case-Based and Observation learning strategies through seminars, workshops, and conferences.

3 Government should ensure that there are not more than 30 students in a class so that class management would not be difficult for teachers.

4 These strategies are viable for improving achievement needed by students in secondary schools.

5 Government and other employers of labour should ensure that professionally qualified and competent teachers are engaged in teaching Chemistry.

6 There is need to integrate into the school Chemistry curriculum, systematic ways in which practicing teachers and would - be teachers can be trained in the use of Case-Based and Observational learning strategies.

7 In order to improve students' achievement in Chemistry Case-Based and Observational learning strategies are particularly recommended to secondary schoolChemistry teachers.

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Reference to this paper should be made as follows: Okediji Adejare Alabi & F,A. Adesoji (2016), Effects of Case-Based and Observational Learning Strategies on Students' Achievement in Chemistry in Secondary Schools in Lagos State, Nigeria. *J. of Education and Leadership Development Vol. 8, No. 2, Pp. 32-59*.