Effects of Advance Organizer teaching strategy on Students' Gender in Secondary School Chemistry in Ekiti State, Nigeria

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Abstract
The study examined the effects of Advance Organizer teaching strategy on Students' Gender in Secondary School Chemistry in Ekiti State, Nigeria. The research designed adopted for the study was non-randomized, non-equivalent pre-test and post-test control group design. The population consisted of all senior secondary class two (SSII) students taking Chemistry in Ikere – Ekiti while sample consisted of 97 senior secondary school two students were drawn from intact classes using purposive sampling technique. The instrument used for the study was Chemistry Achievement Test. The face and content validity as well as reliability of the research instrument were carried out and reliability coefficient of 0.86 was obtained. The results of the data collected from both pre-test and post-test were collated and analysed using statistical tools involving mean and standard deviation, graph t-test and Analysis of Variance (ANOVA) at 0.05 level of significance using). The findings of the study showed that students operate at moderate level performance in Chemistry before their exposure to expository advance organizer. However, the use of expository advance organizer improves the performance of students in Chemistry more than conventional method of instruction. Also, it was found that score level and gender classification of students has no influence on their academic achievement when exposed to expository advance organizer. Based on the findings, appropriate recommendations were made.

Keywords: Advance Organizer, achievement, Chemistry, students' gender.

Introduction

A nation can be classified as developed or underdeveloped based on her level of scientific and technological development. Any nation that cannot provide standard, effective, and efficient science education to her younger ones is still underdeveloped. For a developing country like ours to join other developed countries of the World, the scientific know-how is embedded in the curriculum has to be attained through the systematic procedure, well developed instructional strategies, and structured skills acquisition processes which are the hallmark of effective science education.

Education, particularly science and technical education is the 'factory' for the production of the needed technologists, technicians, and craftsmen as well as skilled artisans who are required to turn the nation's economy around and usher in the desired technological advancement (Abulude, 2009). However, according to Festus & Ekpete (2012), science and technology are imperative for sustainable global development, but cannot strive ahead without chemistry.

Chemistry is the study of composition, structure, and property of matter including the changes that matter undergoes and the related energy changes that accompany material

changes. It occupies a central position amongst the science subjects. The usefulness of chemistry is seen vividly around us in the areas of manufacture of textiles, fertilizers, herbicides, insecticides, and fungicides. It is equally very essential for the management and utilization of natural resources, provision of good health facilities, adequate food supply, and favorable living environment (Omiko, 2017; Babalola, 2015).

Inclusion of Chemistry as an important prerequisite subject in science in the secondary school calls for the need to teach and evaluate it effectively. Researchers such as Eke (2008); Ameh & Dantani, (2012); Bamidele & Oloyede (2013); Nnoli (2016); Eze & Ezeugo (2018); Eze, Egbo & Onyinye (2018) claimed that any nation aspiring to be scientifically and technologically developed must have an adequate level of chemistry education.

Zayum (2008) asserted that instructional format provided by the teachers seems to be the medium of effective learning and that good teaching helps the learner more quantitatively while poor teaching would lead to poor learning and poor performance. This is linked to the fact that it is the responsibility of the teacher to help students attain maximum achievement in their learning tasks. Some of the competencies include the ability to use appropriate instructional strategies in teaching.

Adesoji (2008) posited that the primary aim of any teacher is to ensure the success of his lesson and by "success" it is meant a process in which the majority of the students understand the essential points of the lesson. The author added that this "success" is invariably tied to the quality of the teacher and in his view; one of the common ways of assessing the quality of teachers is the performance of students in examinations. It is the responsibility of the class teacher to help students attain maximum achievement in their learning tasks. Such responsibility includes the ability to use appropriate instructional strategies in teaching (Sukolatambaya, 2018).

The government and chemistry teachers contribute to this problem because, while the government must provide funds and resources for teaching, teachers have to constantly search for teaching procedures that will provide better results by making learning more meaningful and fairly permanent for their students. For the teacher to achieve this, he must identify students learning problems and design appropriate teaching strategies that are inexpensive, workable, and efficient in attaining instructional objectives (Adesoji & Ibraheem, 2009).

Research shreds of evidence have proved that chemistry's contribution to the quality of life and nation-building is worthwhile in all aspects. It was based on this that the Federal government through her National Policy on Education made chemistry a compulsory science subject at the secondary school level (NPE, 2013). It is one of the core science subjects for registration in the senior secondary certificate examination (SSCE) and according to WAEC (1996 and 1998) chemistry is the second most registered science subject after biology (Igwe, 2002). Ojo (2001) had earlier stated that the popularity of basic science subjects among Nigerian youths was in the order of biology, chemistry, physics, and mathematics. This is probably due to the contribution of chemistry to technological development. Studying chemistry, therefore, assists the development of knowledge, skills, and attitudes, which enrich people's lives and allows them to be scientifically capable members of society (Babalola, 2015).

Despite the importance of chemistry and its educational value which is relevant to the need of the individual learner, economic and technological breakthroughs of a nation, and the efforts of researchers to improve on its teaching and learning, the performance of students in the subject is not still encouraging.

In a survey on student's achievement in chemistry, Olorundare (2014) found that the level of achievement is not encouraging and he asserted that student's achievement dwindles every year. The implication of this is that securing admission into chemistry-related courses like medicine, nursing, agriculture, pharmacy, geology, physical sciences, science education, and engineering in the higher institutions will experience fluctuations.

Also, such poor achievement at the Senior Secondary School Examinations will deplete the enrolment of students who would want to study courses that can lead invocations like health services, pharmaceuticals, petroleum and petrochemical industries, food processing and teaching services among others that are needed for the industrial and economic development of a nation. This poor result calls for serious concern and this concern has been expressed by parents, teachers, employers of labour and the entire society. A result like this can engender societal ills like disappointment and frustration on the part of the students, anxiety, and apprehension in parents, examination malpractice, and serious implication for technological development.

Students' poor academic achievement in chemistry has been blamed on poor instructional strategies (Lamidi, Oyelekan & Olorundare, 2015); wide range of syllabus (Babalola, 2015) low numerical ability (Fatoke, Ogunlade & Ibidiran, 2013), negative attitude (Bamidele, Adetunji, Awodele & Irinoye, 2013). Equally, a lack of interest has been identified as responsible for the failure (Jegede, 2007).

The finding of Alade & Ogbo (2014) revealed that the cause of widespread poor performance and negative attitudes towards chemistry by secondary school students in Nigeria has largely been attributed to the teaching problem. Several studies have been undertaken on the aspect of the role of the classroom teacher in achieving quality in school (Fatoke, Ogunlade, & Ibidiran, 2013; Matthew & Onyejegbu, 2013). Yazachew (2014) pointed out the instructional and management roles of the teacher. Huitt (2005) added planning to it while Akiri & Ugborugbo (2009) identified high failure rates and the poor quality of the students as a reflection of the instructional quality in schools.

Other problems which students encounter in chemistry include: balancing redox reactions, coming to the classroom with erroneous beliefs from earlier schools and past learning experiences, language problems which include unfamiliar or misleading vocabulary or familiar vocabulary which changes its meaning as it moves into chemistry and the use of high sounding language which compounds learning. Others include the conceptual nature of chemistry (Turk & Calik, 2007). Researchers such as Mondal (2013) stated further that, the nature of chemistry concepts (macroscopic, microscopic, and representational) and the way the concepts are presented make chemistry difficult to learn because according to him the methods in which students learn conflict with the nature of chemistry itself. Hence, learning by rote which many students are used to, from the elementary and the constant interplay between the macroscopic and microscopic level of thought presents a significant challenge to learners.

Researchers such as (Bamidele, *et al* 2013 & Omiko, 2017) have shown that certain chemistry concepts in the senior secondary school chemistry curriculum have been identified as difficult. Some of these perceived difficult concepts according to them include organic chemistry, mole concept, calculations in electrolysis and volumetric analysis, energetic and redox equilibria, rates of chemical reactions, non-metals, and their compounds among others.

The Chief Examiner's report on candidates' performance in the West African Examinations Council (WAEC, 2012) noted that many candidates avoided questions involving organic chemistry, and those who attempted the questions recorded very low marks (Bamidele *et al*, 2013). This is why in this study, the concept of hydrocarbons which is a

basic bedrock for understanding organic chemistry will be examined. The instructional strategy that would be used in this study is the advance organizer strategy.

Advance organizers are instructional strategies that enable learners' to connect new information to already known material and also construct their ideas (Omondi, Keraro & Anditi, 2018). It is information that is presented before learning and that can be used by the learner to organize and interpret new incoming information. According to TanveerUzZaman, Farkhunda & Arshad (2015), advance organizers place the most general and comprehensive ideas at the beginning of a lesson and progress to more structure and detailed information.

Kigo, Okere & Maghanga (2018) identified the following as varieties of advance organizers: Expository, framing, narrative, graphic, skimming, concept webbing or mapping, and comparative, advance organizers that build schema by providing new information are called expository organizers (Karmes, 2005). Igwe (2002) describes the framing organizer as a teaching strategy where main ideas are differentiated to sub-concepts and are arranged in a matrix in such a way that interrelationship between concepts is shown. The narrative organizer is the anecdote that connects personal experiences or real-world events to the new concept to be presented. Enekwechi (2016) opined that graphic organizers provide a visual representation of facts and concepts and their relationship within an organized frame. The author further added that graphic organizers can exist in many forms like flow charts, story maps, Venn diagrams, sequence chain, tables, and matrix. Examples of graphic organizers like KWLs (ask students to write a list of what student know before the lesson (K), what they want to learn in the lesson (W) and what they learned (L), flow charts and other visual tools can tap into prior knowledge or imply the scope and organization of new content.

Expository organizers provide a conceptual structure to which the learner can relate the new material. It is noted for providing a general subsumer for a new class, subclass, and species before more limited subsumers are provided for the particular subclasses or species. It is a description of a new concept to be presented, highlighting important content (Kigo, Okere & Maghanga, 2018). Omondi *et al* (2018).

The conventional or traditional method on the other hand, is an approach that places no emphasis on students constructing their ideas and it is a method in which the teacher delivers the lesson to students with little or no active participation by the students Nwagbo & Obiekwe (2010). In the view of Ibitomi, Adefila & Aina, (2018) conventional method of teaching used by secondary school teachers in teaching chemistry and other science subjects has been identified to be responsible for producing learners who can verbally explain and demonstrate scientific concepts but are not able to translate the knowledge gained from such scientific concepts into usable technology. It is very pertinent therefore to search for an approach for the teaching of chemistry that aims at understanding rather than juggling facts (Oloyede, 2011). TanveerUzZaman, Choudhary & Qamar (2015) revealed that advance organizers serve three purposes: which are to: direct the attention towards the importance of the coming material, highlight ideas and create relationships amongst the ideas and, remind students about important information they already have.

The teaching of hydrocarbons is chosen in the present study because of chief examiner's reports in WASSCE of 2013, 2015, and 2017 that revealed a low percentage in the number of those that attempted questions related to organic chemistry as reported by Omiko (2017). Another reason for selecting hydrocarbon is based on the fact that the researcher is saddled with the responsibility of teaching the freshers introductory organic chemistry at both N.C.E. and undergraduate levels, It is hoped that the expository advance organizer developed would be useful in imparting knowledge to the students.

Another variable of interest in this study is gender. Gender inequality in science, mathematics, and technology is very common in the most non-Western environment in which

socio-cultural factors contribute to driving further a wedge between the achievement and attitudes differential of boys and girls in the subjects. There have been many studies conducted to determine gender influence on student's academic achievement. The results of such studies differ since while some favour males and other females. Gender influence is thus yet unsettled.

The study of Njoku & Akwali (2016) revealed that schoolboys and girls are influenced differently in their effort to learn chemistry; mainly due to teacher-related personality factors and classroom environment factors. Their study found gender differences in these two factors to be strongly significant. In an earlier study Eze (2002) stated that the study of gender is not just mere identification of the male and female sexes, according to this author, researchers had gone further to identify responsibilities assigned to opposite sexes and to analyze conditions under which these responsibilities are assigned.

Also, students' scoring academic ability level has been discovered as important factors influencing students' achievement in science. Many studies have been carried out to determine how the differences in scoring level and academic ability can affect student knowledge of science concepts. Yusuf & Afolabi (2010) investigated the effects of computer-assisted instructional package on secondary school students' performance in Biology, it was discovered that students' scoring ability influence their performance in biology. However, the low ability group of students gained most followed by the high ability group. The study of Lamidi, Oyelekan & Olorundare (2015) on effects of mastery learning instructional strategy on senior secondary school students' achievement in mole concepts showed that there is a significant covariance in the achievement between scoring level and group.

Advance organizers are a concept developed and systematically studied by Ausubel in 1960. He was influenced by the teachings of Piaget (Geier, 1999). It is a device or a mental learning aid to help students get a grip on anew information. It could be considered as a means of preparing the learner's cognitive structure for the learning experience about to take place. Ausubel (1963) defined advance organizers as information presented at a higher level of abstraction, generality, and inclusiveness than the information to be learned. It is information that is presented before learning which can be used by the learner to organize and interpret new incoming information according to Mayer, (2003). Woolfolk (2001) describes an advance organizer as a statement of inclusive concepts to introduce and sum up materials that follow. These definitions generally agreed that advance organizers are a cognitive instructional strategy designed to promote the learning and retention of new information. It is a method of bridging and linking old information with something new.

According to Ausubel (1960), the advance organizer represents one strategy to address what he described as subsumption theory. The subsumption theory suggests that learning is based upon the kinds of superordinate, representational, and combinational processes that occur during the reception of information. When new knowledge is created that is substantive and not – verbatim and is related to existing knowledge, retention, and learning are primed. Forgetting according to him occurs when new knowledge becomes integrated into existing knowledge and loses its identity.

Since the advent of advance organizers, research has been able to prove that these work best when there is no prior knowledge involved because an advance organizer becomes the students' prior knowledge before learning the new material. If prior knowledge is available, advance organizers do not facilitate learning well in students (Mayer, 2003). Ausubel's advance organizers can best be classified as a deductive method. The deductive method or reasoning provides the rule to follow then the example leading to the correct answer or learning. This, according to Mayer (2002), is distinct from the inductive method that provides the examples to follow, then the rule.

Advance organizers are highly useful in the process of transferring knowledge. Mayer (2002) believes that the effect of advance organizers should be most visible for tests that involve creative problem solving or transfer to a new situation because the advance organizer allows the learner to organize the material into a familiar structure. This is because the mind arranges and stores information in an orderly fashion. New information about a concept is filed into an existing framework of categories called schemas that contain specific information about a concept. So when prior knowledge is retrieved, this schema provides a framework on which to attach new knowledge.

Generally, Ifamuyiwa (2011) stated that an advance organizer helps to organize new material by outlining, arranging, and sequencing the main idea of the new material based on what the learner already knows. It uses familiar terms and concepts to link what the student already knows to the new information that will be presented in the lesson which aids in the process of transferring knowledge and creatively applying it in new situations. This process helps to embed the new information into long term memory. Advance organizers do not have to be lengthy or complex but must be clearly understood and related to the material.

Novak & Canas (2008) used concept maps in two different psychology courses taught at different levels. In one group, concept maps were used as advance organizers for lectures, and the learner constructed and modified some group maps short text sessions. In the second group, students constructed concept maps of each text chapter as part of the course assessments. It was discovered that students engaged more meaningfully with maps which engaged them in problems and topics. Besides, constructing maps that were evaluated was beneficial.

Uchenna & Okafor (2014) investigated the comparative effectiveness of the expository and concept mapping on academic achievement of slow learners in biology, the results of the study indicated that the group taught with concept mapping instructional strategy performed significantly better than their counterparts taught with the conventional method.

Jack (2014) determined the effects of individual and collaborative concept mapping learning strategy on chemistry students' anxiety and academic achievement. The design of the study was quasi-experimental pre-test – post-test – delayed post-test control group design. The sample of 100 students was drawn from co-educational secondary schools in Taraba North senatorial district. The Chemistry Achievement Test for Students (CATS) and Chemistry Anxiety Scale (CAS) with the reliability of 0.79 and 0.86 respectively were the main instruments, Descriptive Statistics and Analysis of covariance were used to analyze the data collected. The findings revealed that the use of concept mapping had a positive effect on learning and a significant difference in estimated retention between students who were taught with the traditional method.

Hudson & Keraro (2009) conducted a study on using advance organizers to motivate students' in learning pollution. The research design used was quasi – an experimental design where the non- randomized Solomon four groups were adopted. The sample comprised of 166 forms, three students. Data were collected by using the Students' Motivation Questionnaire (SMQ). A t-test one- way ANOVA and ANCOVA statistical techniques were used to analyze data. Their findings indicate that students taught using advanced organizers had a higher level of motivation than those taught using conventional teaching methods.

Domin (2008) used an advance organizer about the nature of the science aspect of the role creativity plays in science. The findings indicate that a relatively small change in instructional design can advance improvement in achieving the nature of science learning outcomes within a large – scale content-based science course when the advance organizer is used. Oloyede (2011) investigated the effect of pictorial and written advance organizers on

students' achievement in the concept of energy change in chemistry. 138 senior secondary school two chemistry students constituted the sample. The results showed that advance organizers enhance the achievement and retention of the learning materials in chemistry by the students. On the whole, the pictorial organizer was found to be more effective in facilitating students' achievement and retention in chemistry than the written organizer in teaching the concept of energy change.

Ugbe & Worlu (2012) examined the relative efficacy of advance organizers teaching strategy on learning the concept of electrochemistry in the senior secondary school chemistry. A total of 60 senior secondary schools two were used in the study. A quasi-experimental pretest-posttest control group design was used for the study. The instruments used in gathering data for the study were Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT) and the t-test was used in the analysis of data. The findings showed that students taught the concept of electrochemistry using advance organizers' teaching strategy performed significantly better than those taught with the conventional method.

Wachanga *et al* (2013) investigated the effects of advance organizers' teaching approach on students' achievement in chemistry. The quasi-experimental design was employed. 3540 form three secondary schools were used as samples for the study. Chemistry Achievement Test (CAT) was used for data collection. The CAT was administered to groups E_1 and C_1 before the teaching started. The experimental groups were taught using the advance organizers' teaching approach while the control groups were taught through the conventional method. Statistical Package for Social Science (SPSS) was used for data analysis. Descriptive statistics (mean, percentages, and standard deviation) and inferential statistics (ANOVA, ANCOVA, and t-test) were used for data analysis. The study found out that students who were taught a mole concept using the advance organizer teaching approach achieved better in chemistry than those who were taught through regular teaching methods.

There has always been a differential interest among boys and girls as regards the choice of course. Yazachew (2014) stated that girls' capabilities are undermined by sex-role stereotypes in many cultures intimating that females are not as able as males especially in disciplines such as mathematics and science. Certain vocations and professions such as medicine, engineering, and architecture among others have traditionally been regarded as men's while nursing, catering, and typing are regarded as women's (Oludipe, 2012). The study of Awofala (2011) revealed that there is a difference in interest among boys and girls. It was found that males showed more positive attitudes toward mathematics and science and performed better on achievement measures than their female counterparts. Similarly, a survey of 11 years old students in England carried out by Spencer (2001) in Ogunleye and Babajide (2011) indicated that girls are more interested in food, child development, germs, and illness while boys were interested in how the car works, stars & planets, volcanoes & earthquake and how transistors work.

Akinbobola and Afolabi (2010) found out in their study on constructivist problem-based learning technique and the academic achievement of a physics student with low ability level in secondary schools that there exists no significant difference in the achievement of male and female physic students taught with guided discovery, demonstration and expository teaching approaches and corresponding exposure to a pictorial organizer. Similarly, Ogunleye & Babajide (2011) observed no significant effect of gender on students' achievement in and attitudes toward science and mathematics thus concluding that gender differences in attitudes and achievement might be disappearing. Lamidi, *et al* (2015) stated that gender had no significant effect on the achievement of chemistry students taught using the mastery learning instructional strategy.

In contrast to the study of Akinbobola, Afolabi Jegede (2007) found out that female students show higher anxiety towards the learning of chemistry in secondary schools than male students. Also, the study of Okereke & Onwukwe (2011) revealed that male students achieved better than female students. In the same vein, Ezeudu (2013) found out that male students achieved significantly better than female students in both urban and rural schools. Also, Adeneye & Awofala (2013) revealed in their study that male students had stronger attitudes toward mathematics than their female counterparts.

Adesoji & Kenni (2013) stated that gender does not determine one's potentials. Also, that boys and girls are equally intellectual and the differences observed in the interest of boys and girls in mathematics and science could be due to socialization. In the same vein, Udoh (2011) asserted that there is no significant difference in the achievement of male and female students in chemistry when taught using the reformulation of knowledge and expository teaching methods. The comparable performance of the males and females observed indicated that gender is not a strong determinant of students' academic achievement in chemistry. Also, Achor & Kurumeh (2010) found that gender was not a significant factor in students' achievement in number bases with the use of the Dienes Block approach.

Besides, Nwagbo & Obiekwe (2010) stated that there was no significant difference between the achievement of male and female students taught ecological concepts using a constructivist instructional approach. The study of Achor, Kurumeh & Orokpo (2012) showed that male and female student's performances in a test of theoretical knowledge in chemistry do not significantly predict their performance in MOCK – SSCE chemistry theory examination and male and female students' SATPKC score could not significantly predict their performance in MOCK – SSCE mean practical scores. These indicate that the issue of gender in chemistry achievement has not yet been resolved.

Despite all the curricular innovation and other efforts aimed at promoting science teaching in schools, not a great success has been achieved in chemistry and consequently, the problem of students 'poor achievement in chemistry in Nigerian secondary schools continues to linger. This could probably be due to the methods of teaching and the materials available for teaching; teacher questioning style and students' participation in chemistry lessons.

Gender differences have become critical issues of concern and the World most especially to educators and researchers. Therefore this study is expected to examine the effects of Advance Organizer teaching strategy on Students' Gender in Secondary School Chemistry in Ekiti State, Nigeria. And also to explore whether or not the strategy has interactive effects on the moderating variable such as students' score level and gender.

Research Hypotheses

The following hypotheses were formulated and were tested in this study:

HO_1: There is no significant difference between the academic achievement of male and female students when taught hydrocarbons with expository advance organizers.

HO_2: There is no significant difference in the interaction effect of the use of expository advance organizer, score level, and gender on students' academic achievement in chemistry.

Research Method

The study is a quasi-experimental type which adopted non-randomized, non-equivalent pre-test and post-test control group design. Quasi-experimental was adopted to determine whether an intervention treatment (expository advance organizer) will reveal the intended effect on the student's performance. The design involves two major components: independent and dependent variables. The independent variables are an expository advance

organizer and conventional method while the dependent variable of the study will be students' achievement in chemistry.

The population of the study comprised of all senior secondary class two (SSII) students offering chemistry in Ikere, Ekiti State, Nigeria. The sample for the study comprised 97 senior secondary schools two drawn from intact classes of two co-educational senior schools in the study area.

The preference for involving only SSII students is because:

i. The students would be expected to have been exposed to considerable knowledge of chemistry in their Senior Secondary School (SSI).
ii. The topic "introduction to organic chemistry" to be taught are offered at Senior Secondary School II (SSS II) according to the new senior secondary school curriculum (NERDC, 2009, NPE, 2013).

The Instructional Study Package (ISP) was used for experimental control group and, the instrument: Chemistry Achievement Test on the topic hydrocarbons (CAT) was also used for the study. The instrument (CAT) is a researcher-made test used for data gathering and comprised of two sections (A and B). The bio-data of the respondents (students) made up section A, while section B consisted of fifty multiple-choice objective items based on the topics i.e. hydrocarbons were collated and used for both pre-test and post-test during data collection. The CAT was given to three experienced secondary school chemistry teachers who have been teaching the subject in the last ten years in three secondary schools in Ikere. Each question consisted of four options labeled (A – D) in which one is the correct option. Aside from data gathering, the content of the CAT was also used as the pre-test and post-test to ascertain students' prior knowledge before the treatment and their performance after the treatment. Lesson notes were developed and used for lesson presentation for the treatment and control group. The lesson presentation of the treatment group will be conducted using an expository advance organizer.

To ensure face and content validity of the instrument, CAT (Fifty multiple choice objective questions) were given to three experienced secondary school chemistry teachers who have been teaching the subject for the past ten years; chemistry experts. The ratings and assessment of these validators were used in fashioning out the final instruments for the study along with the approval of the researcher's supervisor. The expository advance organizer lesson note was also validated by experts in test and measurement.

Also, the content validity of (CAT) was established using a table of specification in which questions will be distributed to align with three Bloom's taxonomy lower-order cognitive skills namely knowledge, comprehension, and application. Thereafter, (CAT) was trial-tested by administering it on students' in an intact class in a school in Ikere-Ekiti which is not part of the sample but within the population scope of the study. The scores gathered were analyzed using Kuder-Richardson 21 (KR-21) to establish its reliability at 0.05, Alpha level of significance. The reliability coefficient of 0.86 was obtained which was considered reliable enough for the study.

The researcher sought the students' consent to participate in the study through an informed consent form signed by their parents. The chemistry teachers' of the sampled schools were also given a consent form to solicit their involvement as research assistants during the experiment. The selected students were allowed to participate voluntarily in the study in conformity with the ethical practices of research. The names of the participating schools as well as the identity of the respondents or students were not disclosed at any point in this study. The researcher treated students' contributions with optimum discretion for the study alone. The total period for the research was three (3) weeks. The research assistants assisted the researcher in the aspects of administering the pre-test, post-test, and treatment to

the experimental group and teaching the control group. The researcher visited the schools before treatment to train the chemistry teacher who used an expository advance organizer for the experimental group.

The teaching of hydrocarbons in both the experimental and control groups took place during the periods scheduled for chemistry lessons and it was not exceeded the time frame scheduled for the topic on the school scheme of work to avoid disrupting normal school routine. The chemistry teachers that were involved as a research assistant taught the control group using conventional instructional strategy and the experimental group using advance organizer lesson note respectively for double lesson periods.

The two groups labeled groups A and B. Group A was assigned an experimental group while group B was the control group. Group A was exposed to an expository advance organizer while group B which is the control was exposed to the conventional method.

The research procedure was in two stages; the pre-treatment stage and the treatment stage (two weeks), and the post-treatment stage (one week), making a total of three weeks for the study.

(i) The researcher trained the teacher to be used for group A on how to administer the treatment. The teachers of the two groups were provided with the topics and the lesson notes each required for the teaching of the topics. The researcher went through the lesson notes with the teachers to ensure compliance with the objectives and the mode of presentation of the lessons. During the first period of the first week the pre-test (CAT) will be administered on the students.

(ii) Thereafter, as from the second period in the first week the two groups A and B were exposed to its respective treatment expository advance organizer and conventional method respectively.

(iii) During the post-treatment stage in the third week; the content of CAT was reshuffled and administered to the respondents as a post-test to determine the students' performance.

The data obtained from the four research questions raised were subjected to frequency count, mean and standard deviation. Also, inferential statistics were employed to test for hypotheses. Hypotheses 1 & 2 were tested using one way ANCOVA using the Statistical Package for Social Sciences (SPSS) software version 25.

Results and Discussion

Hypotheses Testing

Hypothesis 1: There is no significant difference between the academic achievement of male and female students when taught hydrocarbons with expository advance organizer.

Table 1: Analysis of Covariance (ANCOVA) of gender difference in the academic achievement of students when taught hydrocarbons using expository advance organizer

Source	SS	df	MS	F	Sig.
Corrected Model	1951.765[a]	3	650.588	35.153	.000
Intercept	78087.785	1	78087.785	4219.235	.000
Treatment	1951.444	1	1951.444	105.440	.000
Gender	.737	1	.737	.040	.842
Treatment * Gender	6.479	1	6.479	.350	.555
Error	1721.204	93	18.508		
Total	90374.000	97			
Corrected Total	3672.969	96			

Table 1 shows that (F=0.350 p=0.555 at 0.05 level) of significance. The null hypothesis was not rejected. This implies that the interaction effect of treatment and gender was not statistically significant. Similarly, the main effect of gender was not statistically significant (F=0.040, p=.842). However, the main effect of treatment was statistically significant (F=105.440, p<0.05). Therefore, there was no significant difference between the academic achievement of male and female students when taught hydrocarbons with expository advance organizer.

Hypothesis 2: There is no significant difference in the interaction effect of the use of expository advance organizer, score level, and gender on students' academic achievement in chemistry.

Table 2: Analysis of Covariance (ANCOVA) of the interaction effect of the use of expository advance organizer, score level, and gender on students' academic achievement in chemistry.

Source	SS	df	MS	F	Sig.
Corrected Model	2103.869[a]	9	233.763	12.961	.000
Intercept	49246.044	1	49246.044	2730.486	.000
Treatment	526.786	1	526.786	29.208	.000
Gender	5.097	1	5.097	.283	.596
Score level	55.155	2	27.577	1.529	.223
Treatment * Gender	.347	1	.347	.019	.890
Group * Score level	52.792	1	52.792	2.927	.091
Gender * Score level	46.220	2	23.110	1.281	.283
Treatment * Gender * Score level	14.369	1	14.369	.797	.375
Error	1569.100	87	18.036		
Total	90374.000	97			
Corrected Total	3672.969	96			

Table 2 shows that (F=0.797 p=0.375 at 0.05 level) of significance. The null hypothesis was not rejected. This implies that the interaction effect of treatment, score level, and gender was not statistically significant. Similarly, the main effect of score level (F=1.529, p=.223) and gender (F=0.283, p=.596) was not statistically significant respectively. However, the main effect of treatment was statistically significant (F=29.208, p<0.05). Therefore, there was no significant difference in the interaction effect of the use of expository advance organizer, score level, and gender on students' academic achievement in chemistry.

Discussion

Based on the results of the findings, it was discovered in table 1 that there was no significant difference between the academic achievement of male and female students when taught hydrocarbons with expository advance organizer. This implies that variance in the performance of male and female students was insignificant irrespective of the method of instruction. In line with this finding, Udoh (2011) found that there is no significant difference in the achievement of male and female students in chemistry when taught using the reformulation of knowledge and expository teaching methods. Lamidi, *et al* (2015) who found no significant effect of gender on the achievement of chemistry students taught using the mastery learning instructional strategy further corroborate this finding.

It was discovered from Table 2 that there was no significant difference in the interaction effect of the use of expository advance organizer, score level, and gender on students' academic achievement in chemistry. The implication is that students' initial ability couple with their gender stereotype was never a condition for students' performance in Chemistry when exposed expository advance organizer.

Conclusion

Based on the outcome of this study, it is concluded that the use of expository advance organizers improves the performance of students in Chemistry more than the conventional method of instruction. However, the gender classification of students does not influence their academic achievement when exposed to the expository advance organizer. Advance Organizer teaching strategy is not gender bias.

Recommendations

Based on the findings and conclusion from the study, the following recommendations were made:

1. The use of advance organizer should be adopted for the teaching of Chemistry as innovative tools to facilitate effective teaching and learning in secondary schools.
2. Regular seminars and workshops should be organized for Chemistry teachers in other to broaden their knowledge on the effective method of using advance organizer instructional strategies in Chemistry classrooms and laboratory.
3. The teacher while using advance organizer teaching strategy should not be gender bias.

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