



Effect of 7E Learning Strategy on Achievement in Chemistry among Senior Secondary School Students in Nguru Local Government Area, Yobe-Nigeria

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Abstract

The main objective of this study was to investigate the effects of 7E learning strategy on achievement in chemistry among senior secondary school students in Nguru Local Government Area, Yobe State-Nigeria. A pretest/posttest quasi-experimental research design was adopted for the study. A population of 433 and a sample of 161 SS II students were used for the study. Simple random sampling technique was used to draw two intact classes of 82 male and 79 females as sample. Two research questions were formulated and answered in the study. The Instrument used for the study called “Chemistry Achievement Test (CAT)” was developed by the researchers. The scale was validated by experts in the field; the reliability coefficients for the instruments was found to be 0.87 via test-retest procedure. The experimental and control groups were respectively pretested and thereafter, treatment (7E Learning Strategy) was administered on the experimental group while the later was taught with traditional method. Both groups were later on subjected to posttest using the CAT scale. Mean and standard deviation were used to answer the research questions. The results revealed that students taught chemistry using 7E learning strategy performed better than those taught using traditional method, it also shows that there is no significant difference of achievement scores between male and female students when taught chemistry using 7E learning strategy. Based on the findings, it was recommended that teachers should be encouraged to use 7E learning strategy in teaching Chemistry in senior secondary schools.

Keywords: 7E learning strategy, Achievement in chemistry, Senior secondary school students.

Introduction

Science is the foundation for sustainable national development by protecting human societies from ignorance, illiteracy, disease and poverty. For any nation to experience economic development there must be strong, stimulating growth in the teaching and learning of science (Nwagbo & Ovute, 2011). Science has been defined as a systemic enterprise of gathering knowledge about the world, organizing and condensing that knowledge into testable laws and theories (Hornby, 2010). According to Rao (2007), science is the system of knowing the universe through data collected by observation and controlled experimentation. Okoro (2013) defined science as a systematic investigation of nature with a view to understanding and harnessing to serve human needs and it consists of Biology, Chemistry, Physics, and Mathematics. Science is the investigation of matter with a view to understanding and harnessing to serve human needs (Okoro, 2013). The methods of producing true knowledge were those which distinguished science from other kinds of knowledge; observation, accuracy, induction, proofs, deduction, etc. are the



key terms of the debate. Aderonke and Victoria (2013) reported that the development of any nation is hinged on inventions and innovations due to science and technology as result emphases are put on science and technological learning, with each country striving towards providing more and better trained scientists and technologists, the foundations science and technology starts from science education. Aina (2013) sees science education as the process of getting scientific information to individuals from beginning to the end. He also defined science education as the study of science subjects (Biology, Chemistry and Physics) with teaching method in order to impart scientific knowledge to individuals or community. Science education deals with the teaching (2007), science education as a field of specialization is concerned with two (2) basic aims, which is the production of scientifically interactive society and technological manpower. Alhassan, Victoria and Danteni, (2013) reported that the science and technology related disciplines that will enable the students to have substantial knowledge of science and be able to apply it in solving problems in the changing society are Biology, Chemistry, Mathematics, Physics and others. Chemistry is a branch of pure science that deals with the study of matter in relation to energy. In addition, Danjuma (2008) stated that physics is the soul of science which plays a vital role in all human endeavour and serves as a pre-requisite for courses such as medicine, geology, agricultural science, pharmacy, forestry among others. It is one of the science subjects taught at the senior secondary level of Nigerian Educational system, it is closely related to other sciences such as chemistry and biology but is perceived generally to be difficult, vast mathematical and experimental (Torigoe 2008). Chemistry is one branch of sciences that was develop through the steps of observation, problem formulation, formulation of hypotheses and testing through experimentation, conclusion as well as the discovery of theories and concept. Chemistry learning has a very important role in order to establish a scientific attitude, analytical thinking, and foster the creativity of students (Ashiq, Muhammad, & Azra, 2011). To teach Chemistry effectively, teachers need to employ methods including student-centered methods that will enable the students to learn more, retain more and apply what is learned by engaging in significant and appealing activities, and 7E learning cycle may be good in this aspect. Learning strategy is a concept of how students learn from experience. A learning strategy has a number stages or phases, the last of which can be followed by the first. Learning cycle m s mental functioning model. The first version of the model included three phases initially called preliminary exploration, invention and discovery (Karplus & Their, 1969) but they were revised to exploration, concept introduction and concept application to increase the expressiveness (Hanley, 1997).

As the learning cycle started to be implemented and investigated over years, the model was modified regardless of the conceptual foundation of the approach (Bybee, Taylor, Gardner, Scotter, Powell, Westbrook & Landes, 2006). Educators and researches extended the phases of model to increase the emphasis on some issues and different versions of the model were emerged as 3E, 4E, 5E, 7E and 9E. Among them, 7E learning cycle instruction is the broad one encompassing seven phases each starting with the same letter; Elicit, Engagement, Exploration, Explanation, Elaboration, Evaluation, and Extension. In most cases, you will be existing concepts with other areas of real life and/or with other concepts/subjects to transfer the knowledge and skills they acquired (Gulsum, 2014).

Academic achievement is the extent to which learners have gained from a particular course of instruction. Academic Achievement is the measure of what a person has accomplished after



exposure to educational program as said by Lucy (2015). Studies conducted by Ezeudu (2013) and Okoye (2012) reported that active participation of students' academic achievement corresponds to their performance in school subjects as symbolized by a score on an achievement test (Jimoh, 2010). Teachers with good teaching strategy challenge students to work at higher intellectual level, attain sound academic achievement for better outcome. In this study, the researcher intends to prepare chemistry learning activities based on 7E teaching strategy and determines its ability and efficacy in enhancing students' achievements as regard to gender.

Gender is the socially/culturally constructed characteristics and roles which are associated to males and females in any society. The gender study in science education has been contradictory (Adeyemi & Ajibade, 2011). There have been a number of studies of gender on academic performance in science. Bichi (2002) defined gender as amount of masculinity or femininity in an individual. Researches on gender and academic performance such as that of Usman (2010), Ibrahim (2012), Olorukooba, Lawal & Jiya (2012), observed that boys achieved better than girls, but studies by Bichi (2002), Adedayo 2004, Atadoga (2005), Lawal (2009), Bunkure (2012) and Dahiru (2013) pointed out that girls achieved better than boys. Some studies (Okwara, Anyagh & Ikyaan, 2017; Omwirhiren, 2015) revealed that gender influences conceptual understanding of science subject in favor of boys. According to Okeke (2007), studies conducted by (Okoyefi, 2014; Okorei & Ezech, 2016) found that girls students performed better than their boys counterparts. Because of achievement with respect to gender in science subject especially chemistry; the researcher is inspired to conduct this study to observe academic achievement in chemistry. Thus, the study will use 7E teaching strategy to prepare chemistry learning experiences, teach experimental group and ascertain its effectiveness in chemistry instructions.

In line with the development theory of Piaget, knowledge construction in learning cycle instruction can be explained as following in the light of related literature (Abraham & Renner, 1986; Marek, Eubanks & Gallaher, 1990; Balci, Cakiroglu & Tekkaya, 2005). The first phase of the cycle, elicit phase, activates students existing knowledge and prepare students to construct connected knowledge structures. Following step is engagement phase which creates interest in the topic, captivates students' attention and promotes curiosity to focus on the content. Students assimilate the new concept in the exploration phase in addition to reevaluate their existing conceptions to be able to interpret the new phenomena. The cognitive conflict rose in students existing mental structures and new situation causes disequilibrium which the individual avoids to stay. To be able to reach equilibrium, they accommodate the concept in an environment that they are allowed to explain and discuss their ideas in the explanation phase based on the data obtained from the exploratory activities. This phase is the essential to allow students to accommodate through the discussion and interpretation of data. In the elaboration phase, both assimilation and accommodation occur since the students organize, apply and relate the newly developed concept to prior concepts or daily life applications. Evaluation phase make students to realize the change in their knowledge and assess their own conceptions to make necessary arrangements. Finally, extension phase prepare student to connect the acquired knowledge to following new phenomena.

According to Atadoga (2001) science and other sources of knowledge are built upon the foundation laid at the primary and secondary education levels. It is expected that it is from among the students at these levels that future scientists, doctors, engineers, technologist etc. would emerge. But if the foundation is weak at the primary and secondary levels, then the entire system is likely



to collapse. Mankilik and Inyang (2009) in their survey on the attitude of secondary school students towards chemistry in some schools in Nguru, Yobe state found out that, students generally considered chemistry a difficult subject. Among other handicaps that force them to drop the subject eventually is their lack of understanding of the subject because of the way it is taught. Chemistry as a subject is conceptual. Students learning chemistry at school level, or in colleges and universities, are taught about, and asked to master, a wide array of concepts. Concepts are central to understanding chemistry, and the understanding of chemical concepts is therefore a core concern in chemical education. Yet, learning chemical concepts is not straightforward. Students at all levels often do not understand; or only partially understand; or, indeed, misunderstand; key concepts they meet in their studies of chemistry. This is one of the core issues in chemistry education. This study, therefore, set out to investigate Academic Achievement in Nguru local government, Yobe-Nigeria.

Objectives of the Study

The main objectives of the research are to:

1. To determine the difference in achievement of chemistry student in secondary school when taught using of 7E learning strategy and conventional methods.
2. Examine whether there is gender difference among secondary school chemistry students' academic achievement when exposed to 7E learning strategy.

Research Questions

The research questions put forward for the purpose of this research are:

1. Is there any difference in secondary school chemistry students' academic achievement when taught chemistry using 7E learning strategy and conventional methods?
2. Is there any gender difference in the mean achievement score among secondary school chemistry students when exposed to 7E learning strategy?

Methodology

The study utilized quasi experimental and control groups design involving pretest and post-test. This is made of two groups; experimental and control. According to Creswell (2012), a quasi-experimental design is a type of experimental design that does not provides for full control of extraneous variables, primarily because of lack of random assignment of subjects to group. The design is considered appropriate for this study because intact classes will be used to avoid disruption of normal lessons. A pretest (O1) was administered to the two groups to determine the equivalence of performance of students prior to the treatment. The Experimental Group (EG) was exposed to 7E learning cycle, and the Control Group (CG) was also exposed to lecture method. This was followed by a posttest (O2) which was administered after the treatment for a period of six weeks to determine the 7E learning strategy academic achievement among secondary schools in Nguru local government Yobe State. The Target population of this study comprised of all government-own senior secondary schools SS II chemistry students, whose age ranges from 14 - 16 years, male and female students. According to Ministry of Education, Yobe State, there are six (6) public senior secondary schools in Nguru local government area. A total number of 433 students are considered as the target population.

The sample size of this study is 161 SS 2 chemistry students which comprised of 82 males and 79 females. Two (2) intact classes were selected from two co-educational secondary schools



in the local government area. The selected schools were ADSS Nguru and GHIC Nguru. An intact class from School GHIC Nguru was used as an experimental group in which some chemistry topics (Atoms, Molecules and Ions) were taught as a treatment using 7E learning strategy and one intact class from ADSS Nguru was used as control group in which same topics were taught as a treatment using conventional method of instruction. The simple random sampling technique was used to draw the sampled schools. The schools are Government Higher Islamic College Nguru and Army Day Secondary School Nguru, the two schools were assigned groups as experimental and control. This was done through simple random sampling technique. School ADSS Nguru serves as an experimental school and GHIC Nguru serves as control school and one intact class from each school.

The researcher use chemistry Achievement Test (CAT) as instrument of data collection in this study (Adopted from WASCCE 2015, 2016 and 2017) was used as a pre-test and post-test to determine the achievement levels. The instruments contained two parts. Part I consist personal data (e.g. gender, school) and part two of thirty multiple choice questions with four options to choose the correct option, only one will be correct and the remaining three served as destructors. These questions were selected from past West Africa Senior School Certificate Examination (WASCCE, 2015, 2016 and 2017. The items covered the units taught. The topics chosen were Atoms, Molecules and Ions. They were selected because they formed a good representation of major in chemistry. Examiners Reports 2015 2020 identified some difficult concepts in chemistry which include: atoms, molecules and ions. The following steps were followed in collecting the required data: Collection of Introductory Letter: The researcher collected an introductory letter from the department, visited the sampled schools and introduced himself to the principals and chemistry teachers because their assistance will be required for smooth movement of the study. The chemistry achievement tests (CAT) were administered as pre-test and Post-test. Exposure of the Study Subjects to Pre-test: Pretest was first be carried out on the students in both the groups to observe if there was any significant difference in their achievement scores. Treatment of Experimental Group with 7E learning strategy: The 7E learning strategy was used in this chase, where students in the experimental group were taught using the strategy for six weeks. Each lesson took 80 minutes.

In order to analyze the research questions, mean and standard deviation of pretest and posttest scores of the control and experimental groups were compared with the cut-off mean of 15.0. The mean difference obtained are used to answer the research questions.

Results

Research Question 1

Is there any mean difference in achievement between secondary school students taught chemistry with 7E teaching strategy and those taught with conventional method?

Table 1: Posttest mean scores of achievements in chemistry between experimental and control groups (Cut-off Mean=15.0)

Groups	N	Sum	Mean	Std. Deviation	Mean Difference
Experimental	81	2001	25.65	1.103	10.65*
Control	78	1326	16.37	1.229	1.37
Total	159	3327	20.92	4.799	5.92



*Mean score higher in experimental group than control group

Table 1 shows posttest raw scores with mean, standard deviation and mean difference of experimental and control groups exposed to 7E teaching strategy and conventional methods in chemistry instruction. The mean difference was obtained by comparing each group's mean score with the cut-off mean. Although, both groups' mean scores (20.92) exceed the mean threshold (cut-off=15.0), posttest mean score of experimental group (25.65) is however higher than that of the control group (16.37). In other words, experimental group's mean difference compared with the cut-off mean is 10.65 while the control group has 1.37. This indicates that the experimental group exposed to 7E teaching strategy performed better than the control group taught with the conventional method.

Research Question 2

Is there any difference in achievement between male and female secondary school students exposed to 7E strategy in chemistry teaching?

To answer this question, the mean and standard deviation of posttest scores of male and female participants in the experimental group were compared with the cut-off mean of 15.0 and result is presented in Table 3.

Table 2: Posttest mean scores of male and female participants in the experimental groups (Cut-off Mean=15.0)

Gender	N	Sum	Mean	Std. Deviation	Mean Difference
Male	43	1737	21.18	4.753	6.18*
Female	35	1590	20.65	4.863	5.65
Total	78	3327	20.92	4.799	5.92

*Mean score is marginally higher in male group than female

Table 2 shows posttest raw scores with mean, standard deviation and mean difference of male and female participants in experimental group exposed to 7E strategy of chemistry teaching. The mean difference was obtained by comparing each group's mean score with the cut-off mean. Although, both groups' mean scores (20.92) exceed the mean threshold (cut-off of 15.0), posttest mean score of male participants in experimental group (21.18) is marginally higher than that of their female counterparts (20.65). In other words, male participants' mean difference compared with the cut-off mean is 6.18 while the female category has 5.65. This suggests that a marginal difference in achievement exist between male and female secondary school students in the experimental group exposed to 7E strategy in chemistry teaching.

Discussion of Findings

There are various results found in this research study which will be discussed in this section. Based on the findings from this research study, it was found that there is significant difference in the mean achievement scores between experimental group taught chemistry using 7E learning strategy and those taught using conventional method of teaching strategy in favour of those taught 7E learning method, this finding implies that use of 7E learning strategy in teaching chemistry facilitate the academic achievement of the participants. This also shows that, those who taught 7E learning strategy as teaching method are higher achievement than those who learnt through conventional teaching method. This finding coincides with Kanli and Yagbasan (2008) who



conducted an experimental study to compare the relative effectiveness of 7E learning cycle model based on laboratory approach and deductive laboratory approach on development of science process skills. The sample was composed of 81 freshman university students attending a physics laboratory course. Students were administered the Science Process Skills Test (Burns, Okey & Wise, 1985) at the beginning of the course. They were re-administered the same test after the completion of the course. During the treatment, students in experimental group allowed to design experiments, identify dependent and independent variables, formulate analysis, explain the collected data, construct data tables, and draw conclusions, without a previously presented theoretical instruction. On the other hand, comparison group students were followed the steps which provide an identified problem, experimental designs, method to analyze data, and other necessary explanations. The findings of the study revealed a significant difference between post-measurements scores in the favor of experimental group. The authors discussed that the deductive laboratory approach leads students to focus on finding the correct results instead of the scientific process. But in this researcher the researcher focused only on the effect of 7E learning strategy.

Similarly, Gulsum Gok (2014) conducted a study on the effect of 7E learning cycle instruction on 6th from public schools of Keçiören district on conceptual understanding of Human body system, self-regulations scientific epistemological beliefs and some process skill. The sample consisted of 185 sixth grade from intact class, among them, three classes were randomly assigned as experimental groups and the other three as comparison group. Skeletal System Conceptual Inventory, Circulatory System Conceptual Inventory, and Respiratory System Conceptual Inventory were administered to the participants as pretests, posttests, and then questionnaire. The design was a quasi-experimental design. The instruments used in the study were the Skeletal System Conceptual Inventory (SSCI), Circulatory System Conceptual Inventory (CSCI), Respiratory System Conceptual Inventory (RSCI), Motivated Strategies for (MSLQ), Epistemological Beliefs Questionnaire (EBQ), and Science Process Skills Test (SPST) Mixed between within subjects' ANOVAs and mixed between within subjects. The reliability coefficient of SSCI, CSCI and RSCI was found to be 0.57, 0.54 and 0.56 respectively. MANOVAs were conducted to compare the effectiveness of two instructions on collective variables as well as to investigate the relative effect of two instructions on development of collective variables. The results of the study showed that 7E-LCI is more effective than curriculum oriented science instruction in terms of acquiring conceptual understanding, retaining acquired knowledge and promoting self-regulation. The study was on biology, so this current research was based on chemistry.

The second finding of the study shows that a marginal difference in achievement exist between male and female secondary school students in the experimental group exposed to 7E strategy in chemistry teaching. The mean difference was obtained by comparing each group's mean scores with cut- off mean. Although, both group's mean scores (20.92) exceed the mean threshold (cut- off=15.0), posttest mean score of experimental group (25.65) is however higher than that of the control group(16.37). In other words, experimental group's mean difference compared with the cut-off mean is 10.65 while the control group has 1.37. This indicates that the experimental group exposed to 7E teaching strategy performed better than the control group taught with conventional method. This finding is in line with Muhammad (2015) who studied students' achievement in Biology using 7E instructional Model, Pretest posttest control group design was



used in the study. A total number of 122 ninth grade students (62 boys and 60 girls) from four classes of a biology course of two schools were purposively selected. Experimental group (61 students) and control group (61 students) were randomly assigned. The students in the control group were instructed with traditional instructional model, while the students in the experimental group were instructed with 7E Instructional model. A Subject achievement Test (SAT) and Integrated Science Process Skill Test (ISPST) were used to collect data. Three hypotheses were tested using t-tests and ANCOVA. Independent sample t-test examined that there was a significant difference in the scores of Integrated Science Process Skill Test (ISPST), hence it was used as a covariate. ANCOVA examined that there was a significant difference in the mean post test scores of the groups and gender in terms of Subject Achievement Test (SAT). It was concluded that the 7E instructional model was more effective than the traditional ins achievements. There is a significant difference between 7E learning strategy method of teaching and conventional method strategy in taught the science student in favour of experimental group.

Conclusion

Based on the findings of the study, the following conclusions were drawn.

The use of 7E learning strategy in teaching chemistry concepts improves students' academic performance as indicated there is significant difference in the academic achievement scores between experimental group and control group in favour of the experimental group. No significant difference was found in academic achievement of male and female students in chemistry taught using 7E students taught using 7E learning strategy.

Recommendations

The recommendations from the study are as follows:

1. Chemistry teachers should use 7E learning strategy so as to encourage students to actively participate in chemistry instructions.
2. Male and female secondary school students should be encouraged to adopt 7E learning strategies in better understand chemistry.

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