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Effects of constructivist learning approach on academic achievement of senior secondary school chemistry students in rivers state

Gift Allen Ogologo[1], Chinda Worokwu[2]
[1] Department of Integrated Science, Faculty of Natural and Applied Sciences, Ignatius Ajuru University of Education, Port Harcourt, Nigeria
[2] Department of Chemistry, Ignatius Aguru University of Education, Rumuolumeni, Port Harcourt, Nigeria

Abstract
This study was designed to investigate the effect of constructivist 7-E learning approach on academic achievement of senior secondary school chemistry students in Rivers State. The design of the study was quasi-experiment of pre-test and post-test control group. The population consist of one hundred senior secondary school two students from two schools in Port Harcourt local government area of Rivers state. The research instrument, Chemistry achievement test (CAT) was used to collect data for both pre-test and post-test. Mean and standard deviation were used to answer the research questions while analysis of covariance [ANCOVA] was used to test hypotheses at alpha level of 0.05. The findings revealed that students taught with constructivist approach achieved better than those taught with traditional teaching method.

Keywords: achievement; chemistry; constructivist

Introduction

Chemistry is the science that systematically study chemical composition, properties of inorganic and organic substance and various elementary forms of matter (Nnoli, 2011) [11].
Adejo (2015) defined Chemistry as the study of interaction of chemical substance that is composed of atoms, protons, electrons and neutrons. Chemistry as a subject is vital for effective living in the modern age of science and technology following its application in chemical industries and other related profession. However, chemistry education is designed to build confidence in situations in scientific and technological oriented society. Science is for development of a nation, it is this realization that chemistry curriculum had to adjust her education system and diversified the curriculum to incorporate academic knowledge, technical and vocational skills at the primary school educational level as to enhance students to acquire the necessary skills for engaging in productive work.
Igoegwu & Ikokwu (2012) [7] specified the objectives of chemistry curriculum as follows:

1. It provides a course which is complete for pupils not proceeding to higher education while it is at the same time a reasonably adequate foundation for a post-secondary chemistry course.
2. Provides the students with basic knowledge in chemical content and sequencing.
3. Shows chemistry in its inter-relationship with other subjects
4. Shows chemistry and its link with industry, everyday life benefits and hazard.

According to Sunday (2009) [15] chemistry plays an active role in the advancement of humanity. The implication is that the support of chemistry education and research in the country is vital because it generates basic knowledge and provides trained personnel required to take advantage of scientific advances of discoveries (Sylvanus, 2017) [16]. Teaching and learning od science have significant roles toward technological development in developing nation science chemistry is embedded in our life and society (Hofstein & Lunnetta, 2011) [6].
Maduabum, (1992) states that science teachers used a number of traditional instructional strategies in science teaching and learning such as lecture, discussion, demonstration, project, field trip, Inquiry, cooperative and expository learning methods.
Teaching methods are always used in teaching and learning and to indicate the pattern of the activity in which the tutors and the students will be involved during instructional delivery process. It is basically a description of learning aims and objectives oriented activities and the flow of information between the teachers and learners (Ugwu, 2014). According to O'baron (2002) teaching method are categorized into different approaches namely; teacher and student centred approach. Teacher centred approach methods are grounded in behaviourism and include the various teaching method that see the teacher as possessor of knowledge. These methods include; lecture, expository, demonstration, discussion. recitation whereas the student centred method are grounded in constructivism and includes all the instructional method that underscore teachers as decision makers and problem solvers but rather as a guide in the learning process.
Chemistry are taught as abstract subject without laying emphasis on practical experiences (Ghassan, 2007) [5]. This has resulted to learner's poor acquisition of various processing skills in science which had led to poor academic achievement in external examinations (Jack, 2017) [8]
This research targets to compare the difference between the conventional Lecture Strategy with constructivist approach. The constructivist teaching approach is based on constructivist learning theory.

Piaget, Dewey and Vygotsky amongst others provides historical precedents for constructivist learning theory. Learning science is complex and slow process; learners have difficulty in understanding some of the concept in chemistry and other related science subjects. However in science subjects learners are encourage in thinking, asking questions, testing ideas and explain phenomena which can be achieved by constructivist learning approach.

Constructivist is a theory of learning based on the idea that knowledge is constructed by the learner based on mental activity. Constructivism is key to modern teaching strategies because it simply says that we learn y doing, reflecting, adapting, problem solving, application of knowledge and foster critical thinking, since teaching from constructivist theory aims at applicability of knowledge in situations.

According to Kant (1940) emphasized the power of patterns of learners thinking and regarded ideas as regulative principles in their experiences.

The following are principles binding constructivism:

1. Teaching and learning should precede with issues that learner are actively involved in trying to construct meaning.
2. Meaning demands understanding of chemistry concepts as whole as well as parts that must be understood in the contexts of wholes.
3. The mental model that learners perceive the world and assumptions used to support them should be well understood.
4. The reason of teaching and learning is for individual learners to construct their own meaning and not just memorizing the correct answer or someone else meaning.
5. However, there are basically two major strategies applied in educational studies which are social and radical constructivism (Steffe & Gale, 1995) [14].

Social constructivism focus on shared cultural meaning making process in social interaction of knowledge construction whereas radical constructivism placed emphasis on individual meaning making process of knowledge construction, however, is key to infuse the two strategies in teaching practices to enhance construction of knowledge. However, becoming a constructivist instructor from conventional strategies demands a paradigm shift and willing abandonment of familiar perspectives and practices and adoption of new ones

(Brooks & Brooks, 1993) [3].

According to them, the following are the characteristics of a constructivist teacher:

1. Become one of the several resources that chemistry student may learn from and not the primary source of information.
2. Engage chemistry students in experiences that challenge initial conception of their existing knowledge mainly on previously covered topics in chemistry.
3. Permit learners responses to drive lessons and seek elaboration of student previous responses.
4. There should be use of cognitive terms such as create, classify, analyse amongst others which is framing task. These are science process skills which are applied in chemistry.
5. The learner's autonomy and initiative should be encouraged.
6. The idea of questioning on chemistry topics by asking thoughtful open-ended question should be highly encourage.
7. The use of raw data such as observation, experiment and primary source along with manipulative interactive physical materials.

Lecture method of teaching is where the teacher cast himself/herself in the role of being a master of the subject matter. The teacher is looked upon by the learners as an expert or an authority. The learners are presumed to be passive and copious recipients of knowledge from the teacher. The traditional teacher view is that the teacher causes learning to occur (Novak, 1998). According to Awodi (2001) [2] the lecture method is mainly teacher-centred with recipients. Lecture method is mostly employed by science teachers because of its advantage as; it saves time, permit flexibility, requires less rigid space requirement, it can also be used to teach a large class which is a prominent feature in most Nigerian Secondary and tertiary institutions.

Statement of the problem

It has been observed that effective teaching may facilitate learning and make it more meaningful (Maduabum, 2001). According to Sander (2001) effective teaching helps the learner to acquire more understanding on the subject matter, while poor teaching would naturally lead to poor learning and consequently poor academic achievement. Ayemi (2008) defined achievement as the scholastic standing of a student at a given moment. It has to do with the successful accomplishment of goals. The poor achievement in science as shown by various empirical studies (Ferdinard (2007), Omole (2003), Betiku (2001) respectively have attracted the concern of all stakeholders including the researchers, subsequently many factors have been identified and regarded as being responsible for the dwindling trend in the performance of students. These factors amongst others include school teachers related characteristics, teaching methods, untrained teachers Ogunkola (2008). These suggest that if the aforementioned factors are put into serious consideration students will do better.

Omole (2003) opined that poor achievement in chemistry and other related science courses is due to teachers use of ineffective strategies in teaching science subjects which among other factors have contributed to the student poor achievement and interest in science. The purpose of testing an achievement is to help the teacher and the students evaluate and estimate the degree of success attained in learning a given concept. It is also useful in testing the retention of information and skill. It is equally appropriate in determining the efficiency of instruction. One of the issues common in education in these contemporary times is student's achievement measure in relation to teaching and the overall success of learning outcome.

Gender refers to the socially and culturally constructed characteristics and roles which are described to males and females in any society (Okeke, 2007). The arbitrary assigning of roles and expectation to males and females within the Africa society has given rise to perceiving science and technology as masculine in nature on male domains, consequently female up bring tends to shape them away from science and technology. However, the reports on

gender as a factor in student achievement in science are mixed, while some findings indicated no significant effect on gender in chemistry achievement. Some researchers finding indicates significant influence of gender on academic achievement.

This study therefore aims to investigate the effects of constructivist approach on academic achievement of senior secondary school chemistry students in Rivers State.

Purpose of the study

The study intends to determine the

1. Mean achievement of secondary school chemistry students taught chemistry using constructivist approach and student taught chemistry using traditional teaching methods.
2. Mean achievement of male and female students taught chemistry using constructivist strategy.

Research Questions

To enhance a successful conduct of the study, the following research question guided the study;

1. What are the mean scores of students taught chemistry using constructivist learning strategy and student taught chemistry using traditional teaching methods.
2. What is the difference in mean scores of male students taught chemistry using constructivist learning strategy and female student taught chemistry using traditional teaching method.

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance in other to make necessary decisions.

Ho_1 There is a significance difference in the mean score of students taught chemistry using constructivist learning strategy and students taught chemistry using traditional teaching methods

Ho_2 There is a significance difference in the mean scores of male and female students taught chemistry using constructivist learning strategy.

Research design

The design adopted in this study was quasi experimental pre-test, post-test and control group design to determine the effects of constructivist learning strategy on academic achievement of senior secondary school chemistry students in Rivers State.

Area of study

The study was conducted in senior secondary schools in Port Harcourt local Government area of Rivers State.

Population

This study comprises of senior secondary two (2) Chemistry students in all the public secondary schools in Port Harcourt Local Government Area of Rivers State. However, a total of 2084 students in 2019/2020 academic session made the population.

Sampling/Sampling technique

The sample consisted of 100 senior secondary two (2) Chemistry students. Random sampling technique was used to select two schools for the experimental and control group.

Research Instrument

The research instrument used to collect data for the study was chemistry achievement test (CAT). However a 30 item multiple choice objective test question with option from A to D where developed by the researcher.

Validation

The test instruments used in the study were validated by chemistry teachers at Ignatius Ajuru University, Rumuolumeni and two chemistry teachers from the selected schools as to meet both content and task specification.

Significance of the study

This study will be of great benefit to chemistry teachers, students, curriculum planners and Government. The outcome of this study will expose chemistry teachers to more effective techniques of promoting learning which help to minimize student's poor achievement in the subject area. For the student it will enhance creativity and their ability to advance in scientific knowledge. They will also develop self-confidence and positive attitude to chemistry through this research. In addition, the finding will furnish curriculum planners with useful information on how to help teachers develop appropriate instructional approach and to enable the government to sponsor researchers on investigating the effectiveness of other teaching strategy.

Scope of the study

This research will examine the effects of constructivist learning strategy on academic achievement of senior secondary school chemistry students in Port Harcourt Area Local Government of Rivers State. To ensure proper and satisfactory conduct of the study chemistry lessons were developed on some selected topic in chemistry using constructivist 7-E learning strategy and traditional method of teaching was used in the treatment of the subject which served as the experimental group and control group respectively.

Presentation and Analysis of Data

Research question 1

What is the difference in mean scores of students taught chemistry using constructivist learning strategy and students taught chemistry using traditional teaching method.

Table 1: Descriptive analysis showing the achievement of chemistry students exposed to constructivist strategies and traditional teaching methods

Method	N	Mean	Std. Deviation
Constructivist	50	41.60	5.73
Lecture	50	29.00	6.35

The data on students' achievement in table I revealed that students taught chemistry using constructivist method had mean score of 41.60 with standard deviation of 5.73 while the mean achievement score of students taught with conventional lecture method was 29.00 with standard deviation of 6.35. This indicates that constructivist strategies have a better method for enhancing students' performance than the traditional teaching method.

Research question 2
What are the mean achievements of male and female students taught chemistry using constructivist Strategy.

Table 2: Descriptive analysis showing the male and female student taught chemistry using constructivist strategy teaching method.

Gender	N	Mean	Std. Deviation
Male	30	45.00	4.15
Female	20	36.50	3.59

Data in Table 3 revealed mean achievement score of 45.00 with standard deviation of 4.15 for male students, while the female students had mean achievement score of 36.50 with standard deviation of 3.59. Male students therefore, performed better than their female counterparts in chemistry.

Research Hypotheses 1
Ho_1: There is significance difference in the mean score of students taught constructivist learning and students taught chemistry using traditional teaching method.

Table 3: Ancova for mean achievement scores for Research question 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4233.490[a]	2	2116.745	61.705	.000
Intercept	2073.910	1	2073.910	60.456	.000
Pretest	264.490	1	264.490	7.710	.007
TM	3348.781	1	3348.781	97.620	.000
Error	3327.510	97	34.304		
Total	132170.000	100			
Corrected Total	7561.000	99			

a. R Squared =.560 (Adjusted R Squared =.551)

Table 3 indicates a statistical main effect for method F_{cal} (1, 97) = 97.620, p<.05. Therefore the null hypothesis was rejected, showing that there was a significant difference in the mean scores of students taught chemistry using constructivist strategies and those taught with traditional teaching method.

Research Hypotheses 2
Ho_2: There is significance difference in the mean score of male students taught chemistry using constructivist strategies and female students taught chemistry using traditional teaching method.

Table 4: ANCOVA for male and female student taught chemistry using constructivist strategy and traditional teaching method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	961.012[a]	2	480.506	34.692	.000
Intercept	2630.930	1	2630.930	189.948	.000
Pretest	94.012	1	94.012	6.787	.012
Gender	855.921	1	855.921	61.796	.000
Error	650.988	47	13.851		
Total	88140.000	50			
Corrected Total	1612.000	49			

a. R Squared =.596 (Adjusted R Squared =.579)

Table 4 revealed that a statistical main effect for gender F_{cal} (1, 47) =61.79, p<.05. Hence the null hypothesis was rejected indicating that there was a significant difference in the mean scores of male and female students taught chemistry using constructivist strategies

Discussion of Results
The result from table 1 revealed that students taught chemistry using constructivist learning approach performed better when compared to students taught chemistry using traditional teaching method**.** This finding is in agreement with the opinion of Samaresh (2017) where it was established that chemistry students taught constructivist teaching strategies performed better compared to students taught with conventional teaching method.
The result from table 2 showed that male student taught chemistry performed better using constructivist learning strategies when compare to female student taught chemistry using traditional teaching method. This result is in consonance to Mandore (2002) [9] who observed that there was significant difference between student performance scores according to gender when taught chemistry using constructivist learning approach and traditional teaching method.

Conclusion
Based on the findings of this study, the following conclusions were made:
1. Constructivist teaching approach yield better performance of the learners when compared to those taught using conventional teaching approach
2. The male students taught chemistry using constructivist teaching approach performed better than the female students taught chemistry using conventional teaching approach.

Recommendations
The following recommendations were made by the researcher:
1. The ministry of education should organize at interval workshop, seminars for chemistry teachers as to expose them to constructivist approach of teaching and learning.
2. The constructivist teaching approach should be emphasized in science teacher's educations.

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