

Impact of 5Es Learning Model on Academic Performance in Chemical Equations Concept among Secondary School Students, Katsina Metropolis, Nigeria

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Abstract

The study investigated the Impact of 5Es Learning Model on Academic Performance in Chemical Equation Concept among Secondary School Students, Katsina Metropolis, Nigeria. It employed a Quasi-experimental pretest and posttest control group research design, featuring two groups (Experimental and Control group). The experimental group was exposed to 5Es learning model in the concept of balancing chemical equations while the control group was taught using lecture method. The study sampled eighty one (81) SS 2 chemistry students, from two secondary schools in Katsina Metropolis drawn from population of 753 students. The instrument developed and used to collate data for the research was the Balancing Chemical Equation Performance Test (BCEPT) with reliability coefficient of 0.79. Two research questions were formulated to guide this study, which includes; what is the difference between the mean academic performance scores of Chemistry students exposed to 5Es learning model and those taught with lecture method? And two null hypotheses were also formulated for testing at a significant level of $P \leq 0.05$, among which; there is no significant difference between the mean score of Chemistry Students academic performance, when exposed to the 5Es Learning Model and those taught with lecture method. The data collated were analyzed using t-test statistic. The result obtained showed that student in the experimental group performed significantly better than those in control group. And the treatment in relation to gender was found to be gender friendly. Based on the findings, it is recommended among others that the State Government, institutions and professional bodies such as National Teachers Institution, Science Teacher Association of Nigeria and National Union of Teachers, should organize seminars, workshops, in-service and re-training programmed for teachers on the effective use of Activity- based, students-centered teaching strategy that focus on constructivist learning approach and others, in the teaching of Chemistry.

Keywords

5Es Learning Model, Academic Performance, Chemical Equations

1. Introduction

Chemistry is one of the basic science subjects needed for sustainable development. Its knowledge provide a natural link between home and school and the means through which student understand the world around them and explore the wider implications of science in relation to man. The main objectives of teaching chemistry in secondary schools are to

enable the students to develop their knowledge and skills in chemical science and project their efforts in education so as to be useful to themselves and the society in general.

Several studies have been conducted in and outside of Nigeria to investigate the causes of students' under-achievement in Chemistry and other science subjects and the most recurring factor in all the reports is the inefficient teaching strategy employed by secondary school teachers, which is the conventional teaching strategy (lecture method).

[1] identified some factors hindering students understanding and achievement in science subject, among these factors is the use of inappropriate and non-effective teaching methodology. [2] advised that for effective teaching to occur, the teacher should get the learners involved as much as possible in activities that will enable them to develop the needed process skills and attitudes relevant to scientific life. Chemistry teaching is supposed to be result oriented and student-centered, and this can be achieved when teachers are favorably disposed to using the appropriate methods and resources in teaching the students, [3]. [4] suggested the use of Cooperative/Collaborative, Demonstration Method and Guided Inquiry-Based Learning Strategy.

Inquiry based instructional learning is a student-centered and teacher guided instructional approach that requires students to find out things for themselves. It is an important constructivist instructional approach and a good model for this approach is the 5Es learning model, which is an instructional model for designing a series of experientially rich lessons that are conceptually linked and developmentally sequenced to support the ongoing, progressive refinement in student understanding as it develops over time [5].

5Es learning model by [6] was adopted. In this model, each step with "E" refers to help students' learning by the experience of linking prior knowledge to new concepts. It is seen that 5Es learning model is especially effective in the elimination of alternative conceptions (misconceptions), [7] This is because; constructivist learning theory claims that learning is an interaction between new knowledge and pre-existing knowledge [6] and people construct their own knowledge by using their existing knowledge. It requires the instruction of five discrete elements:

(1) Engagement: It refers to drawing students' interest to concept(s), revealing their prior knowledge, and making them aware of their own knowledge about the concept(s). This stage is a kind of warming action phase to make students ready to learn. For this reason, students are not expected to give the correct explanations.

(2) Exploration: Students are very active in this stage. They apply their own knowledge by making observations and gaining experiences about the concepts. They try to explore scientific knowledge by working in groups. At this stage, teacher guides students to study in videos, computers, and so on to solve problems.

(3) Explanation: At this stage, teacher is the most active. Students share and discuss their own experiences with each other. Students are encouraged to compare their prior knowledge with the new knowledge and explain the relationship between the two concepts. Teacher(s) could benefit from different methods such as animations, educational card games, simulations, analogies, discussions, and videos.

(4) Elaboration: Students are encouraged to adapt and associate the new knowledge with their daily life. Work sheets, model preparation and activities, drawing, and problem situations can be used to improve students' thinking skills. Questions are used to reinforce the relationship

between the concept and the daily life.

(5) Evaluation: Students examine and make an inference about new knowledge of concept(s) learned during the previous four stages. Eventually, they check out their own improvement, [30].

The influence of gender on students' academic achievement has for a long time been of concern to many researchers but no consistent result has been established. [8] and [9] opined that gender issues in Science Education as it affects performance remains unsolved. For instance, [10] and [11] reported that gender has no effect on student achievement in science. [12] observed that boy perform better than girls on activities that require manipulations and also boys are more mechanically and scientifically inclined than girls. [13] and [14] in their separate studies found out that there were no gender differences in academic performance among science students. However, some instructional strategies are gender bias while some are gender friendly; the degree of gender related differences in learning vary from one method of instruction to the other. In the light of these, this study was conducted to investigate the impact of 5Es learning model on chemistry students' academic performance and gender.

2. Purpose of the Study

The purpose of this study is as follows:

1) To find out the effect of 5Es learning model on chemistry students' academic performance in teaching balancing chemical equations at Senior Secondary School level.

2) To investigate the effect of 5Es learning model on academic performance in relation to gender among Senior Secondary School chemistry students.

3. Research Questions

The following research questions are formulated to guide this study.

What is the difference between the mean performance scores of Chemistry students exposed to 5Es learning model and those taught with lecture method?

What is the difference in the mean performance score of male and female students exposed to 5Es learning cycle model?

4. Research Hypotheses

The following null hypotheses are formulated and tested at 0.05 level of significance.

HO₁: There is no significant difference in the academic performance of SSS chemistry students when exposed to 5Es learning model and those exposed to lecture method in balancing chemical equations.

HO₂: There is no significant difference in the academic performance of male and female SSS chemistry students when exposed to 5Es learning model in balancing chemical equations.

5. Method of Data Analysis

The research employed a quasi-experimental-pretest and posttest control group design. The study involves control and experimental groups consisting of both male and female study subjects. A pre-test was administered to the groups, before the treatment, to determine the group comparability. The experimental group was taught the concept of balancing chemical equations using 5Es learning model, and the control group was taught the same concept using lecture method for a period six weeks. At the end of the treatment period, a posttest was administered to both groups of students in order to determine the effectiveness of the treatment in balancing chemical equation on senior secondary school chemistry students.

The population of this study comprised all the Public Senior Secondary II Chemistry students (SS II) in Katsina metropolis of Katsina State, Nigeria (Single sex and co-educational schools). This comprised two (2) male, two (2)

female and six (6) co-education schools with a total of 753 students [15]. 81 students sampled using the simple random approach participated in the study (39 in the experimental and 42 in the control groups). One validated instrument tagged “Balancing Chemical Equations Performance Test (BCEPT)” was used to collected data for the study. BCEPT had a reliability of 0.79 when subjected to the Pearson Product Moment Correlation (PPMC).

6. Results and Findings

The research hypotheses tested using the t-test at $P \leq 0.05$. The analysis was done by the aid of Statistical Packages for Social Sciences (SPSS version 23).

HO₁: There is no significant difference in the academic performance of SSS chemistry students when exposed to 5Es learning model and those exposed to lecture method in balancing chemical equations. The result of t-test analysis is as shown in Table 1;

Table 1. t-test Analysis of Academic Performance Scores of Experimental and Control Groups.

Variable	N	Mean	SD	SE	df	t-value	p-value	R
Experimental	39	15.11	3.04	0.33	79	5.04	0.001	S
Control	42	12.87	2.61	0.29				

*Significant at $P \leq 0.05$

Table 1, it is evident that the calculated p-value of 0.001 is less than 0.05 level of significance, which implies that the treatment with 5Es learning model significantly enhanced the academic performance of the students in the experimental group compared to their counter-part in the control group. Therefore, the null hypothesis of no significant difference is

rejected.

HO₂: There is no significant difference in the academic performance of male and female SSS chemistry students when exposed to 5Es learning model in balancing chemical equations.

Result is presented on Table 2.

Table 2. t-test Analysis for Male and Female Students Academic Performance Score Exposed to 5Es Learning Model.

Variable	N	Mean	SD	SE	Df	t-value	p-value	R
Male	24	8.11	1.59	0.33	37	1.56	0.097	NS
Female	15	7.96	1.67	0.30				

*Significant at $P \leq 0.05$

From Table 2, the p-value obtained is 0.097 which is greater than 0.05 p-level of significance at df of 37. This result indicates that there is no significant difference in the academic performance of male and female students when taught chemistry using 5Es learning model. By implication, 5Es learning model which was used for treatment on the experimental group is gender-friendly. Thus the null hypothesis is therefore failed to be rejected.

7. Discussions

From the finding in Table 1, the experimental group performed significantly better than the control group. This shows that 5Es learning cycle model is effective in enhancing the acquisition of high order skills and cognitive process on the subjects under study, stimulating them to explore, to inquire and to get experience of their own. This is in line

with the findings of [16]. [17], [18], [19] and [20], which revealed that 5Es learning model is effective in enhancing the acquisition of high order skills, academic performance and cognitive process on the subjects under study, stimulating them to explore, to inquire and to get experience of their own. The suitability of 5Es learning model as a means of promoting high order thinking skills and academic performance may be attributed to the nature of the instruction which is inquiry based and student-centered and thus provides a wide range of activities for the students to control, take responsibility for their action in the process of learning and form their own idea from already existing facts [21]. This result supports the observation by [22], that teaching methods affects the response of students and determine their interest level, motivation and involvement in the lesson. This was an indication that constructivist based approach as opined by [23] is effective in enhancing meaning learning

among chemistry students. However, it has the ability to increase students' levels of high order thinking skills.

The relatively poor performance of the subjects in the control group is an indication that the lecture method adopted in teaching science by science teachers is not effective in promoting cognitive processes in students in Senior school as observed by [24], [25] and [26] that subjects do not acquire cognitive skills unless concerted effects are made to identify and used instructional strategic that promotes its development and lecture method does not as it is not student centered.

From the finding in Table 2, the academic performance of chemistry students in relation to gender when treated with 5Es was noticed to be gender friendly. This result supports the observation by [27] that learning cycle enhances students' achievement and it also favours both male and female, giving credence to the learning cycle as a gender friendly and sensitive approach. And is in agreement with the report of [12], [13], [28], [29] who independently reported that male and female students perform the same academically when exposed to activity based teaching method.

8. Conclusion

From these findings, the following conclusions are drawn that 5Es learning model has potentiality for enhances higher order thinking skills, promotes better academic performance and gender friendly. Therefore 5Es learning model is viable and has potential of enhancing senior secondary school chemistry students' academic performance. This also revealed that lecture method commonly used by teachers in secondary schools is not quite suitable for meaningful teaching and learning of science concept as it is not a student centered approach.

Recommendations

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

Teachers should be encouraged by the Ministry of Education to use student-centered teaching strategy evolving models such as 5Es learning in the teaching of chemistry and other science based subjects.

The State government, institutions and professional bodies such as National Teachers Institution (NTI), Science Teachers Association of Nigeria (STAN), Teachers' Registration Council of Nigeria (TRCN) and National Education Research Department Council (NERDC) should organize seminars, workshops, in-service and re-training programme for teachers on the effective use of Activity- based, students-centered teaching strategy that focus on constructivist learning in the teaching of chemistry.

Abbreviations

NERDC: National Education Research Department Council

NTI: Teachers Institution

STAN: Science Teachers Association of Nigeria
TRCN: Teachers' Registration Council of Nigeria

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