



ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2019; 5(7): 444-448
www.allresearchjournal.com
Received: 03-05-2019
Accepted: 07-06-2019

Nja Cecilia Obi
Department of Science
Education, University of
Calabar, P.M.B 1115, Calabar,
Cross River, Nigeria

Obi JJ
Department of Science
Education, University of
Calabar, P.M.B 1115, Calabar,
Cross River, Nigeria

Effect of improvised instructional materials on academic achievement of SS1 chemistry students in cross river State Nigeria

Nja Cecilia Obi and Obi JJ

Abstract

This study investigated the effects of instructional materials on academic achievement of SS1 chemistry students in Cross River State Nigeria. Two hypotheses guided the study. Experimental research design was adopted in the study. The population of the study was made up of all the Chemistry students in the 17 secondary schools in Calabar Municipality. The sample size was made up of 100 SS I chemistry students. The instrument used for data collection was the Chemistry Achievement Test (CAT) constructed by the researcher. The instrument was tested for internal consistency using Pearson product moment; reliability coefficient of 0.79 was obtained. The high value shows that the instrument was reliable. The data collected using the CAT instrument was analyzed using descriptive statistics and analysis of covariance (ANCOVA) at an alpha level 0.05 was used in testing the hypotheses that guided the study. The result of the study indicated that those students taught Acids and Bases using improvised materials performed better than those taught without them. Gender effect when students were taught using improvised instructional materials was not significant. Based on the findings, it was recommended that Teachers should be trained on how to improvise alternatives to real objects to enhance teaching and learning. The teacher should make use of only instructional materials that are relevant to their lesson content. Learners should be actively involved in sourcing for materials. The government, non-governmental organizations (NGOs) and the PTA should contribute financially to the promotion of improvisation of instructional materials in secondary schools.

Keywords: Improvisation, gender, academic achievements, teaching and learning

1. Introduction

Chemistry education is a systematic process of acquiring the fundamental knowledge about the universe. With the indispensable richly acquired, man can shape and reshape the world for his benefit. Chemistry education is the vehicle through which chemical knowledge and skill reach the people who need capacities and potential for development. It also addresses the social objective of sustain development as education is now one of the primary means for empowerment, participation, cultural preservation, social mobility and equity (Emmanuel, 2013) [2].

Chemistry is the study of matter, energy and the interaction between them. Chemistry is everywhere in the world around you! It is in the food you eat, clothes you wear, water you drink medicines, air cleaners, you name it (Helmenstine, 2011) [4]. Chemistry sometimes is called the "central science" because it connects Physical sciences which includes Chemistry, with the life Sciences and applied Sciences such as Medicine and Engineering (en.wikipedia.org, 2019).

In as much as chemistry education and chemistry is important, Nigerian students have had a persistence poor scores in both external and internal Chemistry examination. It was reported that the performance of the candidates was below average and was worse than WASSCE for School Candidates, 2017 with a raw mean score of 47.0 and standard deviation of 16.0 compared to raw mean score of 29.0 and standard deviation of 13.78 for WASSCE for School Candidates, 2018. (waeconline.org.ng, 2019).

The ugly trend in students' poor performance in external examinations is a serious indicator that all is not well in Nigeria's educational system especially at the secondary level. A lot of assertions and empirical findings have been made about why this poor performance exists.

Correspondence
Nja Cecilia Obi
Department of Science
Education, University of
Calabar, P.M.B 1115, Calabar,
Cross River, Nigeria

Science education at all levels of education in Nigeria is in a deplorable state from the primary, secondary and to the tertiary institutions. There is a problem of dearth in science resources and this contributes to students' poor academic performance in Chemistry at the secondary school level (Nkanu 2009; Opera 2008; Nbina and Obomanu 2011)^[9, 15, 8]. The current dearth of scientific materials for instruction and the problems associated with production in scope and range that would meet the needs of the various categories of students contribute to student's underachievement in sciences (Uche & Umoren 1998)^[17]. Science being an activity, has been designed such that it be taught through a series of activities in schools (Ifeakor, 2006)^[5]. The National Policy on Education (2004) has demanded a complete integration of both theory and practical in Science teaching at school. Although efforts appear to be made in building science laboratories and supplying science equipment, these have not matched demands of schools in any satisfactory manner (Oriade, 2008)^[16].

Teaching chemistry in crisis means teaching and learning of chemistry in austere economy. The austere condition may arise because of following (i) war time (ii) population explosion in schools (iii) economic recession and (iv) high cost of science materials (Omiko, 2016).

Teacher made resource (instructional) materials refer to improvisation. Omiko (2007) stated that improvisation in austere period is very fundamental and crucial because it reasonably reduces cost of procuring new and imported materials. Students learn the working principles in the improvised materials they make or help teachers to make; it creates and develops technological awareness in the students.

1.1 Strategies of Improvisation

There are seven strategies of improvisation

- 1. Trust:** For a group of teachers to be successful and productive, the members of the group, referred to as "Players", must trust one another.
- 2. Acceptance:** This is the "Golden Rule" of improvisation (Gessell, 1997)^[3]. Teachers must be willing to accept a new idea to explore its possibilities. Teachers must offer to improvise using ideas, words or movement and must build on it. In other words, teachers must say yes, accept the offer, build on it, contribute and discover new ideas. It is this process that harnesses the power of collaboration. The brainstorming that occurs can lead to innovative solutions (Koppett, 2001)^[7].
- 3. Attentive listening:** Teachers must be aware of the partners with whom they are co-creating to increase their understanding of each other and to be able to communicate effectively.
- 4. Spontaneity:** This allows teachers to initiate words and actions, building trust with the other teachers. This enhances co-creation in the moment, without the opportunity to revise (Keefe, 2002)^[6].
- 5. Storytelling:** This strategy often results in memorable content, when teachers develop the ability to create a story on their dialogue.
- 6. Nonverbal communication:** This involves the use of facial expressions and body language to help communicate attitude, character, and trustworthiness.
- 7. Warm-ups:** They are strategies that provide

opportunities to develop trust and safe environments, where the teachers can feel free to explore the world of improvisation. These activities focus on changing teachers into an improvisational mode to allow them to improvise verbally and physically (Koppett, 2001)^[7].

The chemistry teachers ought to know the procedures for constructing alternative instructional materials with which they can help their students to visualize whatever topic.

In view of the afore mentioned benefits of improvisation, the researcher therefore sought to investigate the effect of improvised instructional materials, on the teaching of Chemistry concept on students' academic achievement. Thus, the need for this study.

1.2 Theoretical framework

Gagne's cognitive theory

Gagne (1977) maintains that new learning occurs through the combining of previously acquired and learned entities as well as upon their potentials for transfer (Oladele 1998). Because of that, the rate of cognitive development does not depend on innate factors of maturational readiness only, but also on the mastery of simpler pre-requisite resources or materials around us. Gagne proposed five different kinds of learning and proceeded further to delineate how instructions may be used to facilitate the acquisition of each.

The Implication of Gagne's theory of instruction to the study is that: Teachers must always state their learning objectives in clear behavioral term. This helps the Chemistry teacher to be focused and it also guides him to know the right resources in the kitchen to use in his teaching/learning process. When this is done, it may bring about meaningful learning outcome.

Learning units or tasks must be duly analyzed to identify their relevant components. When the relevant components are identified and arranged in a hierarchical form and relevant improvised instructional materials selected, it may bring about high academic performance of students.

The arrangement of relevant component should be in a manner that would ensure easy comprehension, effective and meaningful learning. This arrangement when backed-up with resources that are drafted from the learner's environment (improvisation) may increase their academic performance.

Gagne's theory of instruction can be of tremendous importance to the teacher teaching Chemistry. The objectives of the lesson must be stated in clear and behavioral form to guide the teacher on what to teach and in selecting material for improvisation. Materials to be presented to learner's need to be broken down into relevant components and teaching is to be in a hierarchical order. Theories of instruction and learning reviewed provide the necessary frame work on which part of this study which has to do with academic achievement of SS1 Chemistry students is supported.

1.3 Purpose of the Study

This study aimed at investigating the effect of improvised resources on the teaching of Chemistry in secondary schools in Calabar, Nigeria. Specifically, this study sought to:

1. Determine the effect of improvisation of instructional materials on SS1 Chemistry students' academic achievement.

- Determine the effect of gender on SS1 Chemistry students when taught Chemistry using improvised of instructional materials.

1.4 Hypotheses

The following null hypotheses were formulated to guide the study. The null hypotheses were tested at the alpha level 0.05 of significance.

H01: There is no significant difference between the academic performance of SS1 Chemistry students taught Acids and Bases with improvised instructional materials and those taught without.

H02: Gender does not significantly affect the academic achievement of SS1 Chemistry students taught Acids and Bases with improvised instructional materials.

2. Methodology

2.1 Design of the study

This study undertook a quasi-experimental design type of research, which involved a non-randomized pretest posttest control group. The study was carried out in Calabar Municipality of Cross River State. The population of this study was all the SS1 Chemistry students in the 17 Public secondary schools in Calabar Municipality of Cross River State Nigeria. The sample was made up of (100) Senior Secondary School Chemistry students from four schools. A break-down of this figure showed 50 students each in the experimental and control groups respectively. The experimental group had 25 students from public school and 25 students, from private school while in the control there were 25 public students and 25 students from private school. The experimental groups were taught using improvised instructional materials. The control groups were taught using normal science without improvised instructional materials

2.2 Research instrument

The instrument used for the study was Chemistry achievement test (CAT). The Chemistry achievement test

was divided into two main sections; section A and B. Section A sought information on the personal data of the respondents. While section B contains twenty (20) items with four (4) options multiple choice objective test which was developed by the researcher based on the topics taught using the standard and improvised materials. Hence, the responses to the questions were to ascertain the effects of either standard or improvised materials in teaching some chemistry concepts. The CAT was administered, collected and collated by the researcher.

2.3 Reliability of the instrument

The reliability of the instrument was tested for internal consistency using 50 SS I students from another secondary school within Calabar Municipality of Cross River State. Results collected were analyzed using Pearson Product Moment formula and reliability co-efficient of 0.79 was obtained. This showed high reliability value.

2.4 Experimental procedure/data collection

The research topic taught, and the lesson note on the topics were made and used in teaching both the experimental and control groups for a period of 3 weeks for 3 periods per week. The experimental group was taught with improvised materials, while the control group was taught with standard materials.

2.5 Method of data analysis

The chemistry achievement test (CAT) developed by the researcher was used for data collection. And the data collected were analyzed using analysis of variance (ANOVA) at an alpha level of 0.05 significance. Results The results of this study are presented in tables. The analysis of the data collected from the study was presented in tables according to the research hypotheses.

3. Results

Table 1: Mean, standard deviation and summary of 2x2 analysis of covariance of effect of treatment and gender on SS2 Chemistry students' academic performance in Acids and Bases.

Treatment	Gender	Mean	Std. deviation	N		
Experimental	Male	27.12	7.88	25		
	Female	26.06	8.64	25		
	Total	27.67	8.19	50		
Control	Male	16.03	4.26	25		
	Female	13.64	6.07	25		
	Total	14.83	5.40	50		
Total	Male	21.62	15.72	50		
	Female	18.51	16.66	50		
	Total	31.25	16.35	100		
Sources of variation	Sum of squares	DF	Mean squares	F	Sig level	Partial Eta square
Corrected Model	32155.92	4	11251.993	138.663	.000*	.613
Intercept	23242.512	1	23242.512	330.237	.000*	.501
Pretest	1014.441	1	1014.441	21.352	.000*	.132
Treatment	32152.012	1	32152.012	7015.110	.000*	.613
Gender	110.386	1	110.386	1.114	.101	.006
Treatment X Gender	10.012	1	10.012	.121	.302	.001
Error	10041.014	183	330.121			
Total	21123.000	100				
Corrected total	61231.000	123				

R. squared = .613, F-critical = 3.94 * P>.05

Hypothesis 1: There is no significant difference between the academic performance of SS2 chemistry students taught Acids and Bases with improvised instructional materials and those taught without.

Hypothesis 2: There is no significant difference between the academic performance of SS2 male and female chemistry students taught Acids and Bases with improvised instructional materials.

Examination of Table 1 showed that in the experimental group, the male students had a higher mean score 27.12 than their female counterparts mean of 26.06 in the same vein; the males taught Acids and Bases with improvised instructional materials had a higher mean of 16.03 than female students mean of 13.64. Male students taught with improvised instructional materials had a higher mean score (27.12) than males in the control group (16.03). Females in the experimental group also had higher mean (26.06) than female in the control group (\bar{x} =13.64). Students taught Acids and Bases with improvised instructional materials had higher mean score 27.67 than students taught Acids and Bases with improvised instructional materials 14.83.

Table 1 was also used to find out if the means were statistically significant.

That same Table 1 indicated that treatment was significant ($F=7015.110$, $P<.05$); gender was not significant ($F=1.114$; $P>.05$); interaction of treatment and gender was not significant ($F=0.121$, $P>.05$). The first null hypothesis was rejected, and the second null hypothesis was retained.

4. Discussion

The first Hypothesis sought to find out if there was a significant difference between the academic performance of SS1 Chemistry students taught Acids and Bases with improvised instructional materials and those taught without. This study showed that treatment was significant ($F=7015.110$, $P<.05$); the importance and significant role played by improvised instructional materials on students' academic performance, especially in Chemistry. It had a positive influence in Chemistry achievement. This explains why a subject like Chemistry will require real objects and activities/experiment that can convert topics that seem imaginary to concrete for students' understanding. It was therefore observed that improvised instructional materials made teaching and learning real. It allowed students to interact better in their lesson. It made students to use their intellectual ability during the learning and teaching process. This finding agreed with that of Nja and Kalu (2013) ^[11] whose study used showed that kitchen resources (improvisation) enhanced the performance and retention level of high and low reasoning ability level of students exposed to kitchen resources during the teaching of Thermochemistry. According to Ogwu (2005) ^[12] chemical principles and processes which relate to local activities place pupils on familiar grounds, help to maintain interest in the subject and create scientific awareness. Omiko and Oketa (2017) ^[14] investigated the effect of improvised and standard instructional materials on student's achievement in chemistry in secondary schools and the result of the study indicated that those students taught chemistry using improvised materials performed better than those taught without them.

The second hypothesis sought to find out if there was significant influence of gender on SS1 Chemistry student's achievement when taught Acids and Bases using improvised instructional materials. The result of the 2x2 Analysis of Covariance in gender and treatment as shown in Table 1 earlier revealed that, there was a non-significant interaction effect of gender and treatment on academic performance of SS1 Chemistry students. The critical F-value of 3.94 was higher than the calculated F-value of 0.121. This implies therefore that gender do not interact with treatment to affect SS1 Chemistry students when taught Acids and Bases using improvised instructional materials. The implication of this study is that, irrespective of gender student's academic achievement taught Acids and Bases using improvised instructional materials was profitable. Improvised instructional materials can be used to teach both male and female students.

Gender was not significant according to this study. Nja and Hope (2013) ^[10] carried out a study on Kitchen Resources, School Location and Academic Achievement of SS2 Chemistry Students in Calabar. Findings showed a non-significant difference in relation to school location and gender when students were taught using kitchen resources (improvisation). This implies that both male and female students achieved equally under the same condition during learning and teaching process. This is so since performance has to do with mental and intellectual ability and not gender. This finding in respect to treatment main effect and the interaction of treatment and gender was consistent with the findings of Agommoh & Nzewi (2004) on effect of video-taped instruction on secondary school student's achievement in physics in Umuahia. The result showed that gender was not significant.

5. Conclusion

The study showed the importance and significant role played by method of presenting lesson on students' achievement, especially in Chemistry. This explains why a subject like Chemistry will require real objects and activities/experiment that can convert topics that seem imaginary to concrete for students' understanding. Improvised materials should not only be used or encouraged as useful models where application depends on change and circumstances but should be justified as strategy in such difficult times. But it should be available integral part of teaching even when the school budget is sufficient to cater for standardized materials. It allowed students to interact better in their lesson. It made learning exciting and fun. It encouraged active participation, bringing learning homewards and often improved and enhanced students' performance.

6. Recommendations

From the results obtained from the data collected in this work, the researcher recommends that:

1. Teachers should be trained on how to improvise alternatives to real objects to enhance teaching and learning.
2. The teacher should make use of only instructional materials that are relevant to their lesson content.
3. Learners should be actively involved in sourcing for materials.
4. The government, non-governmental organizations (NGOs) and the PTA should contribute financially to

the promotion of improvisation of instructional materials in secondary schools.

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