

Research Article

Effect of using Fabricated Motor – Generator Device to Teach Energy Concepts on Basic Science Students' Achievement and Retention in Kaduna State, Nigeria

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Abstract: This study investigated the Effect of using Fabricated Motor – Generator device to teach Energy Concepts on Basic Science Students' Achievement and Retention in Kaduna State, Nigeria. Two research questions and two hypotheses guided the study. The study employed quasi-experimental research design. The population for the study was 3741 JS2 students in North Senatorial District, Kaduna State, Nigeria. The sample of the study comprised 113 JSII students randomly sampled from two intact classes selected from public coeducational schools in North Senatorial District, Kaduna State, Nigeria. The instrument used for data collection was the Energy Achievement test (EAT). The reliability coefficient of the (EAT) was 0.86. Means and Standard Deviations were used to answer research questions while the Analysis of Covariance(ANCOVA) was used to test the hypotheses at a significance level of 0.05. The findings of this study reveal that the use of the fabricated Motor-Generator to teach Energy Concepts in Basic Science enhanced students' achievement and retention than the conventional method. Based on the findings of this study, the following recommendations were made: Basic science teachers should be adequately trained on using the fabricated Motor-Generator device in the teaching through workshops and seminars. Curriculum planners like NERDC should incorporate the use of the fabricated Motor-Generator device to teach Energy concepts in Basic science.

Keywords: Achievement, Basic Science, Energy, Fabricated Motor-Generator Device, Retention

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INTRODUCTION

Science education is a veritable instrument for social change which brings about socio-economic development and empowerment all the world. The application of scientific knowledge to real life problems is the most powerful instrument for enabling society to face global challenges and innovations in education. Basic science is the cumulative approach to scientific study that synthesizes the perspective of individual disciplines such as biology, physics and chemistry and aspect of the environment to be one (Eze, 2010; Osokoya, 2013). Basic Science is the newly developed version of science education normally studied at the beginning of the science which is now offered at the basic level of education in Nigeria. Energy concepts are some of the scientific topics which are central in school science and often perceived alternatively and scientifically different by the students. As core content, Energy concepts cover reasonable part of the Basic Science syllabus of Basic level of education in Nigeria. Noticeably, Energy both from the Basic Science syllabus and classroom practice is presented in the

physical perspective. In the syllabus, emphasis of Energy is placed on definition, types and forms of Energy and Mathematical formulations; little is related to student's perception about the Energy concepts. This makes it difficult for students to learn and apply Energy in their everyday lives.

The current mode of teaching Energy in Basic Science is based on students' ability to memorize definitions and other concepts for classroom and examination purpose. Outside classroom the students perceive Energy differently and often do not apply the concepts correctly (Iwuji, 2012). The concepts of Energy as contained in basic science syllabus in Nigeria are usually presented under four sub-concepts such as; definition of Energy, types and forms of Energy, applications of Energy and conversion and transfer of Energy. Therefore, a man, an object or a thing may be said to have energy if it possesses the ability to do work. Energy comes in different forms such as heat, electrical, chemical. Nuclear and Gravitational but all of the forms can be grouped into two major types; potential and kinetic Energy.

Electric Motors and Generators are devices used to change mechanical energy to electrical energy (Generator) and electrical energy to mechanical energy (Motors) by electromagnetic means e.g Ceiling fan. Motor-Generator is a dual function device that changes mechanical energy to electrical energy and vice versa. The device is relatively inexpensive and easy to construct. It also provides a clear and compelling demonstration of Faraday's Law of electromagnetic induction and Lorentz Law. Two magnets will be suspended inside two solenoids (coil wire). The solenoid is connected. Moving one of the magnet induces a current in the solenoids, this current flows to the other solenoid where a force is generated on the other magnet causing it to move and produce an effect (Lorentz 1834). He further added that when stationary the device possesses potential energy and when moving, kinetic energy is possessed in the process of working the device is likely to produce heat which indicates production of heat energy. Example is tape recorder Motor. Batteries will be use in the operation of the device which demonstrates conversion of chemical energy to electrical energy. It is against this backdrop that the research is designed to determine the effect of the application of the device (fabricated Motor-Generator) as an instructional resource on the achievement and retention of the concepts of Energy in Basic Science. The purpose of this research is to find out if the use of Motor-Generator can improve the academic achievement and retention of Energy concepts in Basic Science and Technology.

Instructional resources are educational inputs which are vital to the teaching and learning of science subjects at all levels of education (Ndem & Ubana, 2013). Well planned instructional resources in a lesson do much in vanishing apathy, supplement inadequacy of books as well as arouse students' interest by giving them something to see and do at the same time. This helps to train them to think for themselves (Jekanyinfa, 2010; Heron, Merisa & Alberto, 2014). Omiko and Anthony (2015) added that different instructional resources of the teacher are necessitated by the fact that learners have their differences; learning is more effective if it takes place through the five senses of hearing, seeing, tasting, touching and smelling. The greater the number of senses involved in teaching and learning process, the higher the level of learner absorption and participation. The persistent poor achievement and weak retention ability of basic science students demand for the development of learning resources that may assist in improving their achievement and consequently improve retention of Energy concepts in basic science, such as a Motor – Generator device.

LITERATURE REVIEW

Sirajo (2019) investigated the" Effect of using Fabricated Motor – Generator Device to teach Energy

concepts on Zamfara Basic Science Students' Achievement and Retention. The findings revealed that the use of fabricated Motor-Generator device significantly improves students' academic achievement and retention of Energy concepts in Basic science. Similarly, a study conducted by Eriba (2013), on the effects of concepts mapping strategy on students' achievement in chemistry (mole, energy, chemical equilibrium, etc). Students taught using concept mapping strategy achieved higher and significantly better than those taught using conventional method. Igwebuike and Thomas (2012) conducted a research on the effect of conceptual change pedagogy on achievement by high ability integrated science students on energy concepts.

The study found that the conceptual change pedagogy which is rooted in constructivism epistemology has the potency to bring about meaningful learning. Akinbobola and Ikitde (2008) investigated the facilitating effect of models, realia and charts on students' attitude in teaching the concept of heat energy in Nigerian senior secondary school physics. The result showed that models were the most effective in facilitating students' attitude toward learning physics. Followed by realia while charts were found to be the least effective in facilitating students' attitude toward learning physics.

Objectives of the Study

The purpose of this study was to investigate the Effect of using Fabricated Motor – Generator device to teach Energy Concepts on Basic Science Students' Achievement and Retention in Kaduna State, Nigeria. Specifically, the study:

1. Determined the effect of fabricated learning resource on students' achievement in Energy concepts.
2. Found out the effect of fabricated learning resource on student's retention of Energy concepts in Basic science.

Research Questions

The following research questions guided this study:

1. What are the mean achievement scores of students taught Energy concepts using fabricated Motor-Generator and those taught using conventional method?
2. What are the mean retention scores of students taught Energy concepts using fabricated Motor – Generator and those taught using conventional method?

Hypotheses

The following hypotheses were tested at 0.05level of significance

H₀₁: There is no significant difference in the mean achievement scores of students taught Energy concepts using fabricated Motor –

Generator and those taught using conventional method.

H₀₂: There is no significant difference in the mean retention scores of students taught Energy concepts using fabricated Motor – Generator and those taught using conventional method.

METHODOLOGY

The study employed quasi-experimental research design. The population comprised 3741 JS2 students in North Senatorial District, Kaduna State, Nigeria. The sample of the study comprised 113 JSII students randomly sampled from two intact classes randomly selected from public coeducational schools in North Senatorial District, Kaduna State, Nigeria. Experimental group (n=46) was taught using Fabricated Motor – Generator device and control group (n=67) was taught using conventional method. Motor-Generator device was constructed with the aid of Faraday theory of Electromagnetism. Faraday explained the working principles of most electric motors, generators, electrical transformers and inductors. It also shows relationship between circuit and magnetic field. Materials for constructing the instrument include: 1.5vdry cells battery, two tape recorder Motors, flexible connecting wire, Vero board, switch, light emitting diode 6v, transparent rubber glass and liquid gum.

Motor – Generator was constructed by placing Vero board and two Motors on the table (this contained wire wound round a magnet) were placed on at a

reasonable distance on the board where a rubber band can join the two Motors. The two Motors were fixed on the Vero board using liquid gum and allowed to dry. Two wires were connected to the batteries and switch is then connected to the battery terminal which serves as power control. To the second Motor which will serve as the Generator another wire was connected that linked the light emitting diode and the Generator. The rubber glass was then cut to shape and gum appropriately to make casing that will protect the device. The device was test run to make sure it functioned as expected. The device obtained is the Motor – Generator.

The instrument used for data collection was the Energy Achievement test (EAT). The reliability of the (EAT) was determined to be 0.86. The scores generated from the pre-test, post-test and post-post test administered to the Basic Science students in the selected schools using Energy achievement test(EAT) was used for data collection during the research work. Means and Standard Deviations were used to answer research questions while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at a significance level of 0.05.

RESULTS

Research Question One

What are the mean achievement scores of students taught Energy concepts using fabricated Motor-Generator and those taught using conventional method?

Table 1. Mean and Standard Deviation of Students’ Achievement Scores taught using Motor-Generator Device and those Taught Using Conventional Method

Group	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Experimental	46	19.78	0.66	26.65	0.58	6.87
Control	67	17.78	0.52	22.90	0.58	5.12

Table 1 shows the mean gain score for the experimental group as 6.87 while that of control group was 5.12. This shows that the experimental group had a higher mean achievement gain than the control group.

Research Question Two

What are the mean retention scores of students taught Energy concepts using fabricated Motor-Generator and those taught using conventional method?

Table 2. Mean and Standard Deviation of Students’ Retention Scores taught using Motor-Generator Device and those Taught Using Conventional Method

Group	N	Post test		Post Post-test		Mean Loss
		Mean	SD	Mean	SD	
Experimental	46	26.65	0.58	22.71	0.70	3.94
Control	67	22.90	0.58	18.84	0.53	4.06

Table 2 shows the mean loss for the experimental group as 3.94 while that of control group was 4.06. The lower the mean loss, the higher the retention and the higher the mean loss, the lower the retention.

Hypothesis One

There is no significant difference in the mean achievement scores of students taught Energy concepts using fabricated Motor – Generator and those taught using conventional method.

Table 3. ANCOVA Result of Students’ Achievement Scores taught using Motor-Generator Device and those Taught Using Conventional Method

Source	Type III sum of squares	Df	Mean square	F	Significance
Corrected model	211.181 ^a	2	83.812	11.003	0.000
Intercept	324.151	1	324.151	197.210	0.000
Group	201.131	1	201.131	24.015	0.000
Pretest	29.554	1	29.554	93.012	0.000
Error	549.009	109	9.282		
Total	1315.024	114			
Corrected Total	1315.026	113			

Table 3 shows that the F = ratio of 93.012 was obtained with associated exact probability value of 0.000. Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. This implies that there is significant difference between those taught Energy concepts using Motor-Generator and those taught using conventional method at 0.05 level of significance. Students taught using fabricated Motor-Generator

device achieved higher than those taught using the conventional method.

Hypothesis Two

There is no significant difference in the mean retention scores of students taught Energy concepts using fabricated Motor – Generator and those taught using conventional method.

Table 4. ANCOVA Results of Retention Score of Students taught Energy Concepts using the Fabricated Motor-Generator and those taught with the Conventional Method

Source	Type III sum of squares	Df	Mean square	F	Significance
Corrected model	114.102	2	121.212	34.104	0.000
Intercept	123.102	1	123.102	19.200	0.000
Group	38.218	1	38.218	8.012	0.001
Post test	105.034	1	105.034	26.001	0.000
Error	671.030	109	10.110		
Total	1051.483	114			
Corrected Total	1051.486	113			

Table 4 shows that the F = ratio of 26.001 was obtained with associated exact probability value of 0.000. Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. This implies that there is significant difference between those taught Energy concepts using Motor-Generator and those taught using conventional method at 0.05 level of significance. This indicates that the Students taught energy concepts using fabricated Motor-Generator device retained higher than those taught using the conventional method.

Motor –Generator retained better than those taught with the conventional Method. This is in agreement with the findings of Sirajo (2019); Omiko and Anthony (2015); Heron, Merisa & Alberto (2014); Ndem and Ubana (2013); Otor (2013); Igwebuike and Thomas (2012) who found out that students taught science using hands-on-minds-on materials achieve and retain concepts better than those taught with conventional methods. Therefore, using fabricated Motor-Generator device in teaching Energy concepts of Basic science enhances Achievement and retention.

DISCUSSION OF FINDINGS

The findings of the study clearly indicate that there was significant difference between the students that were taught Energy concept using fabricated Motor-Generator device and those taught using conventional method. Along the achievement and retention lines, the result for students taught Energy concepts using the fabricated Motor-Generator was slightly higher in the mean score as compared to that of the control group. Students in the experimental group which were taught Energy concepts using the fabricated

CONCLUSION

The findings of this study reveal that the use of the fabricated Motor-Generator to teach Energy Concepts Basic Science enhanced students’ achievement and retention than the conventional method. It is therefore concluded that using the fabricated Motor-Generator device significantly improves students’ academic achievement and retention of Energy concepts in Basic science.

Recommendations

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

1. Basic science teachers should be adequately trained on using the fabricated Motor-Generator device in teaching through workshops and seminars.
2. Curriculum planners like NERDC should incorporate the use of the fabricated Motor-Generator device to teach Energy concepts in Basic science.

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