

## **Effect of Using Fabricated Motor Generator Device in Teaching Energy Concepts on Basic Science Students' Achievement of Zamfara Central Education Zone**

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**Abstract:** *This research work investigated the effect of using a fabricated motor-generator device to teach energy concepts to Zamfara Basic Science Students' Achievement. The study adopted a quasi-experimental pretest-post-test design. The multi-stage sampling techniques were used to collect data from 101 students representing a sample size for a total population of 2,798 students. The instrument for data collection was developed by the researcher and validated by experts on the concepts of energy, types and forms of energy,. Two research questions and two null hypotheses guided the study. The two null hypotheses were tested at a 0.05 level of significance using analysis of covariance (ANCOVA). The research questions were answered using mean and standard deviation. An energy achievement test (EAT) was used for data collection, a split-half reliability method was used to determine the internal consistency of the instruments, and a reliability coefficient of 0.86 was obtained. The study revealed that the use of a fabricated motor generator in teaching energy concepts can improve achievement with female students performing better than male students. We recommended that teachers of basic science should use a fabricated motor generator when teaching energy concepts but with due consideration of gender preference that provides more attention to the male students..*

**Keywords:** *Basic Science, understanding, achievement, demonstration method, appraisal*

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### **1.0 Introduction**

Science has been regarded as the bedrock upon which modern-day technological breakthrough is built. Countries all over the world, especially the developing ones like Nigeria, are striving hard to develop scientifically and technologically. Science is an intellectual activity carried out by humans, designed to discover how information about nature can be organized to benefit the human race. Science Education deals with the sharing of science content with individuals who are considered to be scientifically illiterate (Eniayeju and Jibrin 2014). Many of the developed nations were able to achieve so much in science and technology because of science education. The potential contribution of science and technology to the development of educational objectives is widely recognized. Scientific and technological knowledge contributed perhaps more than any other factor to the economic growth of the developed countries as against the developing countries such as Nigeria.

Eniayeju and Jibrin, (2014) also stated that despite improved budgetary allocation to the education sector in Nigeria, the condition of the sector remains worrisome. The facilities are still far from being acceptable, partly due to previous underfunding and systemic corruption.

Education is an essential service that must be scrutinized, monitored, constantly evaluated and fully excised from the grip of corruption if the country is to attain the goals of education for all. In recent times there has been concern about the unsatisfactory achievement of students in science. This unsatisfactory achievement has been attributed to students' misconceptions of science. Science teachers will be surprised to learn that despite their efforts, students do not grasp the fundamental ideas covered in the class to the extent that some of the students give the right answers when asked a question on a concept in science but are only using correctly memorized words (Uzoечи and Otuka, 2014). When these students are questioned more closely their failure to understand fully the underlying concepts will be revealed especially at the middle class.

At the basic level, year two students are expected to study energy concepts but previous studies on teaching and learning science revealed that the student's understanding of key basic ideas concerning energy concepts is unprecedented and void of understanding (Duit and Haubler 1994; Nordine *et al.*, 2011). One of the proposed reasons for the failure may be how it is taught in the school (Heron, *et al.*, 2014). Therefore developing instructional resources to teach energy concepts is highly demanding and necessary. Despite several emphases on innovative approaches to the teaching and acquisition of basic science skills, energy concepts are still taught by traditional methods (Ewansiha and Omorogbe, 2013). The poor traditional methods of teaching and learning energy concepts in basic science constitute a problem for the learners in the

acquisition of functional knowledge. Ogwu (2014) observed that the poor achievement in basic science especially energy concepts is due to the teacher's non-use of appropriate methods as well as instructional materials whose operations used such as fans, electric motors and generators among others.

Electric motors and generators are devices that change mechanical energy to electrical energy (generator) and electrical energy to mechanical energy (motors) by electromagnetic means such as ceiling fans. 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's Law. Two magnets will be suspended inside two solenoids (coil wire). The solenoid is connected. The moving part of the magnets 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) 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 the production of heat energy example tape recorder motor. Batteries will be used 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 of Energy concepts in basic science. The researcher's interest in the study is informed by personal observation, the possible application of Motor-Generator Device to teach energy concepts in Basic science. The choice of this research is to find out if the use of a motor generator can improve the perception and understanding that will lead



to improved academic achievement of Energy concepts Basic Science and Technology.

Ewansiha and Omorogbe (2013), defined achievement as an important indicator of academic content students learned in a determined period. Achievement is also regarded as an act of completion and attainment of a task with success. It subsumes anything won by exertion, a feat, a distinguished and successful action. Achievement intends to measure systematic education and training in school subjects. Ogwu (2014) defined achievement as the scholastic standing of students at a given moment. It has to do with the successful accomplishment of goals. The purpose of testing achievement is to help the teacher and the student evaluate and estimate the degree of success attained in learning and more importantly, reveal whether similarity or discrepancies in scores between male and female students exist (gender).

Gender is one of the factors that affect academic achievement, especially in Basic Science. Gender is the range of physical, biological, mental, and behavioural characteristics differentiating between the feminine and masculine (females and males) population (Oludipe and Daniel, 2012). The importance of examining achievement on gender is based primarily on the socio-cultural differences between girls and boys. Given the expectation that student's gender may have an impact on their academic achievement, as seen in the relationship between gender and academic achievement being examined by scholars, such as Nenty (2010), Kyei (2011), Awofala and Amosun (2011), Apatal (2011), Awoala (2012), Adeniyi and Nneji (2012), Dania (2014),= and Agbaje and Alake (2014). Some of these researchers pointed out that there is no significant gender effect on students' academic achievement while others found out that there is a significant difference among gender with either boys or girls performing better.

Results of the Basic Education Certificate Examination (BECE) obtained from Zamfara State Ministry of Education from 2015 to 2019 showed a consistent decline in achievement by students which is always below or close to average. This situation poses a major concern for educators, parents and other stakeholders in education.

Therefore, this research work is designed to find out the effect of using an improvised Motor Generator Device as an instructional resource in teaching Energy Concepts to Zamfara Basic Science Students' Achievement

### **1.1 Purpose of the study**

The purpose of this study is to investigate the effect of using an improvised Motor Generator device in teaching Energy concepts on Zamfara Basic science student achievement. Consequently, the study intends to:

- (i) Determine the effect of using a fabricated generator device on Zamfara Basic Science students' achievement in Energy concepts.
- (ii) Find out the influence of gender on students' achievement when taught Energy concepts using a fabricated motor generator.

### **1.2 Research Questions**

The following research questions guided this study:

- (i) What are the mean achievement scores of students taught Energy concepts using fabricated motor generators and those taught using the lecture method?
- (ii) How does gender affect the achievement scores of students when taught Energy concepts using a fabricated motor generator?

### **1.3 Hypotheses**

The following hypotheses were tested at 0.05 level of significance

**H<sub>01</sub>:** There is no significant difference in the mean achievement scores of students taught Energy concepts using



fabricated Motor-Generator and those taught using the lecture method.

**H<sub>02</sub>:** There is no significant difference in the mean achievement scores between male and female students taught Basic Science Energy concepts using a fabricated Motor Generator.

**2.0 Materials and Method**

A quasi-experimental Pretest-posttest research design was employed for the study. This means that the design involved two instructional groups: the experimental group – Learning with the fabricated motor Generator and the Control group learned through the conventional approach (Lecture method). The samples were drawn from Basic Science 2 students from public junior secondary schools of Zamfara State Central Education Zone. Multi-stage sampling was used to draw the sample. First, the zone was stratified into 4 local governments. From the four local government areas, two local governments were randomly selected using the lucky dip with replacement method. Secondly, the two local governments were stratified into schools; schools were selected from each local government sampled. A pretest was administered to determine the equivalence of

the group to be sampled. Thirdly, two schools, one from each local government having equivalent pretest scores were selected as samples for the study. Fourthly, a toss of a coin was used to assign the school selected to experimental and control groups. The head was assigned as the experimental while the tail was assigned as the control group, total of 101 participants were used for the study 55 males and 46 females. The Energy Achievement Test (EAT) was developed as an instrument for data collection with 30 multiple-choice items with option A-D developed by the researcher from selected concepts of Energy, types of Energy, Applications of Energy and Transfer of Energy. EAT was validated by five experts in Science teaching and a reliability coefficient of 0.866 was obtained. Mean and standard deviations were used to answer the research questions and analysis of covariance was used to analyze the hypotheses at 0.05 level of significance.

**3.0 Results and Discussion**

**3.1 Research Question One**

What are the mean Achievement scores of students taught Energy concepts using fabricated Motor-Generator devices and those taught using the lecture method?

**Table 1: Mean and Standard Deviation scores of Students Taught Energy Concepts using a Motor-Generator Device and those Taught using the lecture Method.**

Group	N	Post-test		Mean Gain
		Mean X	SD	
Experimental	65	26.25	2.59	1.65
Control	36	24.60	2.36	

Table 1, indicates the mean achievement scores of the posttest of 26.25 for the experimental group who were taught using a Motor-Generator Device while the control The group had mean achievement scores of 24.60 and were taught using the lecture method. The

mean gain between the experimental and group was 1.65.

**Hypothesis 1:H<sub>01</sub>**There is no significant difference in the mean achievement scores of students taught Energy concepts using fabricated Motor-Generator and those taught using lecture method



**Table 2: ANCOVA result of Students taught Energy Concepts Using the Fabricated motor generator device and those Taught Using the Lecture Method.**

Source	Type sum of squares	Df	Mean square	F	Significance
Corrected	151.109 <sup>a</sup>	2	75.555	9.113	0.000
Intercept	1698.151	1	1698.151	204.813	0.000
Group	121.211	1	121.211	14.619	0.000
PRETEST	27.874	1	27.874	3.362	0.069
Error	945.199	114	8.291		
Totale	60601.000	117			
Corrected Total	1096.308	116			

Table 2 shows the ANCOVA result of students taught using the fabricated Motor-Generator device and those taught using the lecture method. The result revealed that there is a significant difference between those taught Energy concepts using Motor-Generator and those taught using the lecture method at 0.05 level of significance. This shows that the null hypothesis is rejected indicating that there is a

significant difference in the mean Achievement score of students taught Energy concepts using fabricated Motor Generator Devices and those taught using the lecture method.

**Research Question Two:** How does gender affect the mean Achievement scores of students taught Energy concepts using the fabricated motor generator?

**Table 3: The Posttest Mean Scores of Male and Female Basic Science Students Taught Energy Concepts using Fabricated Motor-Generator and Those taught Using lecture Method**

Group	Gender	N	Post-test		
			Mean X	SD	Mean Gain
Expt. Group	Male	36	26.41	2.46	7.94
	Female	29	26.11	2.78	8.73
Cont Group	Male	19	24.37	2.50	6.79
	Female	17	24.41	2.53	6.65

Table 3 shows the mean and standard deviation scores of male and female students taught Energy concepts using the fabricated motor generator and those taught using the lecture method. The mean gain achievement score for males was 7.94, while the female students had a mean gain achievement score of 8.73 in the experimental group. in the control group, the

male students had a mean gain achievement score of 6.79, while the female students had a mean gain achievement score of 6.65.

**Hypothesis Two: Ho2** There is no significant difference in the mean Achievement scores of students taught Energy concepts using fabricated Motor-Generator devices based on gender.





**Table 4: ANCOVA Result of Male and Female Students Taught Energy Concepts Using Fabricated Motor-Generator Device.**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	86.355 <sup>a</sup>	16	5.397	.710	.776
Intercept	5033.593	1	5033.593	662.543	.000
Gender	.274	1	.274	.036	.850
Pre-Test	85.674	15	5.712	.752	.725
Error	638.180	84	7.597		
Total	66834.000	101			
Corrected Total	724.535	100			

Table 4, shows the ANCOVA scores on the achievement of male and female students taught Energy concepts using a fabricated Motor-Generator device. The Table indicates that the difference in the achievement of male and female students taught using the fabricated Motor-Generator device is not significant at a 0.05 level of significance. This is from the fact the significance value of 0.850 obtained is greater than 0.05, Therefore the null hypothesis is not rejected indicating that there is a significant difference between the mean retention scores of males and females taught using the Motor-Generator device.

**The findings of the study were discussed based on the issues in the study:**

(i) Effect of using fabricated Motor Generator to teach Energy concepts on Zamfara students’ Achievement. The findings reveal that students taught using the fabricated motor generator achieved higher than those taught using the lecture method. This is consistent with the findings of Iwuji (2012), Christogonus and Okechukwu (2014) who agreed that learning resources promote Achievement.

(ii) Effect of using fabricated Motor Generator device on male and female Achievement. The findings show that female students achieved and performed better than their male counterparts when taught Energy concepts using a Motor-Generator Device, This is in

contrast with the findings of Eriba (2013) and those of Thomas and Igwebuikwe (2012) who reported findings that male students performed and Achieve higher than the female students but it is in agreement with the findings of Godspower and Ihenko (2017).

Therefore using a Fabricated Motor Generator to teach Basic science students is much better at improving students’ achievement in Energy concepts than the lecture method. The observed improved achievement can be linked to the activity and discovery nature of the use of fabricated Motor Generator devices.

**4.0 Conclusion**

It is clear from the result obtained that the use of a fabricated Motor Generator to teach Energy concepts to Zamfara Basic Science students achievement has a significant impact. It is therefore concluded that using a fabricated motor generator to teach energy concepts in basic science improves achievement and gender plays a role where female students achieved higher than their male counterparts. Based on the findings of this study, the following recommendations were made:

- (i) Teachers of Basic Science should expose their students to the use of fabricated Motor Generator when teaching energy concepts in Basic Science since it promotes and encourages learning by imitation and



learning by doing which at the end enhance achievement.

- (ii) Basic Science Teachers should consider gender as a significant factor in students' achievement; hence special treatment should be given to male students since female students perform better when a Motor Generator is used.

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**Compliance with Ethical Standards  
Declarations**

The authors declare that they have no conflict of interest.

**Data availability**

All data used in this study will be readily available to the public.

**Consent for publication**

Not Applicable

**Availability of data and materials**

The publisher has the right to make the data public.

**Competing interests**

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**Authors' contribution**

The work was designed by SI while sampling, data processing and reporting were done by YI.

