

Effectiveness of Locally Constructed Amplifier on Secondary School Physics Students' achievement and Motivation towards Learning Energy Concept in Minna, Nigeria

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Abstract

Secondary school physics students in Minna, Nigeria perceive physics to be a difficult subject probably because physics teachers have not been using appropriate resources in the teaching of abstract physics concepts. This study was therefore carried out to determine the effectiveness of locally constructed amplifier and physics students' motivation towards learning energy concept when taught using the constructed amplifier. The research was an experimental research adopting a pretest, posttest experimental and control groups design. Three research questions were raised and one hypothesis was tested. Thirty secondary school one (SSI) physics students from two government-owned schools in Minna metropolis were randomly sampled for the study and assigned to experimental and control groups. Students in the experimental group were taught energy concept using the constructed amplifier while students in the control group learnt the concept using conventional lecture method. Physics Achievement Test (PAT) and Physics Students' Motivational Questionnaire (PSMQ) were used for data collection. PAT consisted of 10 multiple choice objective question items on the concept of energy while PSMQ consisted of 15 items using a four point Likert Rating Scale. Both PAT and PSMQ were validated by experts and the reliability of a pilot study carried out yielded 0.87 for PAT using KR-21 formula and 0.89 for PSMQ using Cronbach Alpha's formula. Data collected from the administration of the research instruments were analyzed using percentage and t-test statistics in SPSS 16.0 version. Findings revealed that there was significant difference between the mean achievement scores of students in the two groups ($t(58) = 1.465, p < 0.05$) in favour of the group taught using the constructed amplifier. Also, 86.44% of the responses to the questionnaire revealed that students had positive motivation towards learning energy concept using the constructed amplifier. Based on these findings, it was recommended that physics teachers should encourage the use of locally constructed resources in the absence of commercial ones in order to facilitate students' understanding of physics and positively motivate them towards learning abstract physics concepts.

Keywords: Achievement, Amplifier, Construction, Energy, Motivation, Physics

Introduction

Science is the foundation upon which the bulk of present day technological breakthrough is built. It comprises of basic disciplines such as physics, chemistry, biology, and mathematics. Physics has proven its benefits to mankind as almost every human activity and virtually every profession involves some element of physics (Gambari, 2010). The inclusion of the subject in the Nigerian secondary school curriculum is to build strong technological foundation upon which future careers in medicine, engineering, communication technology, architecture, geophysics, biophysics, material sciences, nuclear physics, agronomy among several others can be built (Falode & Ajala, 2014). Physics as a science subject is activity-oriented because the mastery of its concepts cannot be fully achieved without the use of learning and instructional materials (Onasanya & Omosewo, 2011).

Despite its importance, secondary school students' performance in physics at the Secondary School Certificate Examinations (SSCE) in Nigeria is not encouraging (Gambari, 2010;

Owolabi, 2004). Some key factors responsible for students' unsatisfactory performance in the subject physics are incompetence of teachers in the development and utilization of needed learning and instructional materials and students' lack of interest in the subject because it is perceived to be abstract and difficult (Aina, 2012; Falode & Ajala, 2014).

Energy concept is one of the topics in Nigerian secondary school physics curriculum that students perceived to be abstract and difficult (Bamigbala, 2000; Salami, 2003). Teaching and learning of energy concept therefore require the use of instructional materials. Onasanya and Omosewo (2011) in a study on the effect of improvised and standard instructional materials on secondary school students' academic performance in physics in Ilorin, Nigeria found that the use of instructional materials improved students' performance in the physics concepts treated.

Motivation is one of the most important psychological concepts in education whose attributes entice students to learn as well as to complete learning activities (Green & Sulbaran, 2006). Psychologists believe that motivation is a necessary ingredient for learning as they are of the view that satisfactory school learning only takes place in the presence of sufficient motivation to learn (Biehler & Snowman, 1986; Fontana 1981). In a study by Tella (2007) on the impact of motivation on students' academic achievement and learning outcomes in mathematics among secondary school students in Nigeria, findings revealed that highly motivated students performed better academically than the lowly motivated students.

Purpose of the Study

The main purpose of this study was to investigate the effectiveness of locally constructed amplifier on secondary school physics students' achievement and motivation towards learning energy concept in Minna, Nigeria. Specifically, the study determined:

- (i) the effects of a locally constructed amplifier on secondary school students' academic achievement in energy concept; and
- (ii) whether students were motivated towards learning energy concept using the constructed amplifier.

Research Questions

The study provided answers to these research questions.

1. Is there any difference in the mean achievement scores of secondary school physics students taught energy concept using locally constructed amplifier and those taught using conventional lecture method?
2. Do secondary school physics student shave positive or negative motivation towards learning energy concept using locally constructed amplifier?

Research Hypothesis

Ho₁ There is no significant difference in the mean achievement scores of secondary school physics students taught energy concept using locally constructed amplifier and those taught using conventional lecture method.

Methodology

The research design adopted for this study was a quasi-experimental design of pretest, posttest, non-equivalent, non-randomized experimental and control group design. Both experimental and control groups were given the pretest and posttest. Students in the experimental groups were instructed using the locally constructed amplifier while students in the control group were taught using conventional lecture method.

The population of the study consisted of all Senior Secondary School One (SS1) students

offering physics in Minna. Simple random sampling procedure was employed to select two public secondary schools while intact classes of 30 SS1 physics students in each of the two selected schools were sampled for the study.

The amplifier was constructed using locally available materials such as speaker, transformer, capacitor, rectifier, regulator, vero board, casing, light emitting diodes, soldering lead, switch, microphone jack and power cable. Physics Achievement Test (PAT) and Physics Students' Motivational Questionnaire (PSMQ) were used to collect data. PAT was adapted from senior secondary school examination past questions conducted by National Examinations Council from 2006-2012 and consisted of 10 multiple choice objective questions on the concept of energy with four options (A-D) from where students are to tick the correct option. The PSMQ was a researcher-designed questionnaire on students' motivation toward learning energy concept using the constructed amplifier. It consisted of 15 items using four-point Likert Rating Scale of Strongly Agree, Agree, Disagree and Strongly Disagree. The instruments were validated by two physics teachers, two educational psychology experts, one test and measurement expert and two Electrical-Electronic specialists. Both PAT and PSMQ were pilot tested once on 20 SS1 students from a public school in the study area and Kuder-Richards on KR-21 formula yielded a reliability coefficient of 0.87 for PAT while Cronbach Alpha formula yielded 0.89 for PSMQ. Data collected from the administration of research instruments were analyzed using descriptive and inferential statistics. Research question one was tested under the hypothesis while research question two was answered using percentages.

Results

To test for the hypothesis, the data were analyzed using t-test statistics in Statistical Packages for Social Sciences (SPSS) 16.0 version at 0.05 alpha level. To analyze the pretest data, the mean scores of the experimental and control groups were computed and compared. Table 1 presents the mean, and the result of the t-test for the two groups before treatment was administered.

Table 1
t-test pre-test analysis on achievement scores of experimental and control groups

Group	N	Mean	df	t-value	p-value
Experimental	30	1.533	58	0.515 ^{ns}	0.776
Control	30	1.433			

ns: not significant at 0.05 level

Table 1 shows the t-test pre-test analysis on achievement scores of experimental and control groups before treatment was administered. The average mean scores of experimental and control groups were 1.533 and 1.433 respectively. The t-value of 0.515 was not significant at 0.05 level. This indicates that there was no significant difference between students in both groups at pre-test ($t(58)=0.515, p>0.05$). Hence, the two groups were equivalent and comparable.

Research Hypothesis:

There is no significant difference in the mean achievement scores of secondary school physics students taught energy concept using locally constructed amplifier and those taught using conventional lecture method.

Table 2
t-test post-test analysis on achievement scores of experimental and control groups

Group	N	Mean	SD	df	t-value	p-value
Experimental	30	7.800	0.92476	58	1.465*	0.018
Control	30	3.067	0.94443			

*: significant at 0.05 level

Table 2 shows the t-test post-test analysis on achievement score of experimental and control groups after treatment was administered. The average mean scores of experimental and control groups are 7.800 and 3.067 respectively. The t-value of 1.465 was significant at 0.05 level. This indicates that there was significant difference between students in both groups at post-test in favour of the experimental group ($t(58)=1.465, p<0.05$). Hence, the hypothesis was rejected.

Research Question two: Do secondary school physics students have positive or negative motivation towards learning energy concept using locally constructed amplifier?

Table 3
Responses of physics students on their motivation towards learning energy concept using the constructed amplifier

S/N	Statement	N	SA	A	D	SD
1	I enjoy learning energy using constructed amplifier	30	15	10	4	1
2	Learning energy using constructed amplifier is interesting	30	14	10	5	1
3	I believe I can master the knowledge in energy when taught with constructed amplifier	30	12	17	1	0
4	I prefer being taught with instructional material when learning energy	30	16	12	1	1
5	I understand energy better when taught with constructed amplifier	30	15	12	1	2
6	I am confident I will do well in the physics test	30	14	14	2	0
7	Learning energy is more interesting when taught with constructed amplifier than when taught without it	30	18	12	0	0
8	Being taught energy with constructed amplifier make learning energy less complex	30	15	9	3	3
9	Energy is no more as abstract as I thought when taught with constructed amplifier	30	14	10	4	2
10	Constructed amplifier is a preferable instructional material for teaching energy	30	10	10	4	6
11	I am confident that I will earn a better grade in the physics test	30	12	14	3	1
12	The use of constructed amplifier in teaching energy makes it easy for me to understand energy conversion concepts better	30	16	9	2	2
13	It will be easier to remember knowledge of energy concepts when taught with constructed amplifier	30	12	16	2	0
14	It was easier to attempt the physics test when taught energy with the constructed amplifier	30	15	8	0	7
15	Learning energy with constructed amplifier aroused my interest in physics as a subject	30	18	10	2	0

Table 3 shows the responses of physics students on their motivation towards learning energy concept using the constructed amplifier. 15 items were presented in the table and 30 physics students responded Strongly Agree, Agree, Disagree or Strongly Disagree to each of the statements.

Table 4
Percentage analysis of physics students' positive and negative motivation towards learning energy concept using the constructed amplifier

S/N	Statement	Positive Motivation (SA+A)	% Positive Motivation	Negative Motivation (D+SD)	% Negative Motivation
1	I enjoy learning energy using constructed amplifier	25	83.33	5	16.67
2	Learning energy using constructed amplifier is interesting	24	80.00	6	20.00
3	I believe I can master the knowledge in energy when taught with constructed amplifier	29	96.67	1	3.33
4	I prefer being taught with instructional material when learning energy	28	93.33	2	6.67
5	I understand energy better when taught with constructed amplifier	27	90.00	3	10.00
6	I am confident I will do well in the physics test	28	93.33	2	6.67
7	Learning energy is more interesting when taught with constructed amplifier than when taught without it	30	100.0	0	0.00
8	Being taught energy with constructed amplifier make learning energy less complex	24	80.00	6	20.00
9	Energy is no more as abstract as I thought when taught with constructed amplifier	24	80.00	6	20.00
10	Constructed amplifier is a preferable instructional material for teaching energy	20	66.67	10	33.33
11	I am confident that I will earn a better grade in the physics test	26	86.67	4	13.33
12	The use of constructed amplifier in teaching energy makes it easy for me to understand energy conversion concepts better	25	83.33	4	13.33
13	It will be easier to remember knowledge of energy concepts when taught with constructed amplifier	28	93.33	2	6.67
14	It was easier to attempt the physics test when taught energy with the constructed amplifier	23	76.67	7	23.33
15	Learning energy with constructed amplifier aroused my interest in physics as a subject	28	93.33	2	6.67
Average % of Positive or Negative Motivation			86.44		13.56

Table 4 shows the percentage analysis of physics students' positive and negative motivation towards learning energy concept using the constructed amplifier. The average percentage of positive and negative motivation of students to learning energy concept was 86.44% and 13.56% respectively. This indicates that students were positively motivated towards learning energy concept using locally constructed amplifier. Figure 1 shows the graphical representation of

students' positive and negative motivation towards learning energy concept using the constructed amplifier.

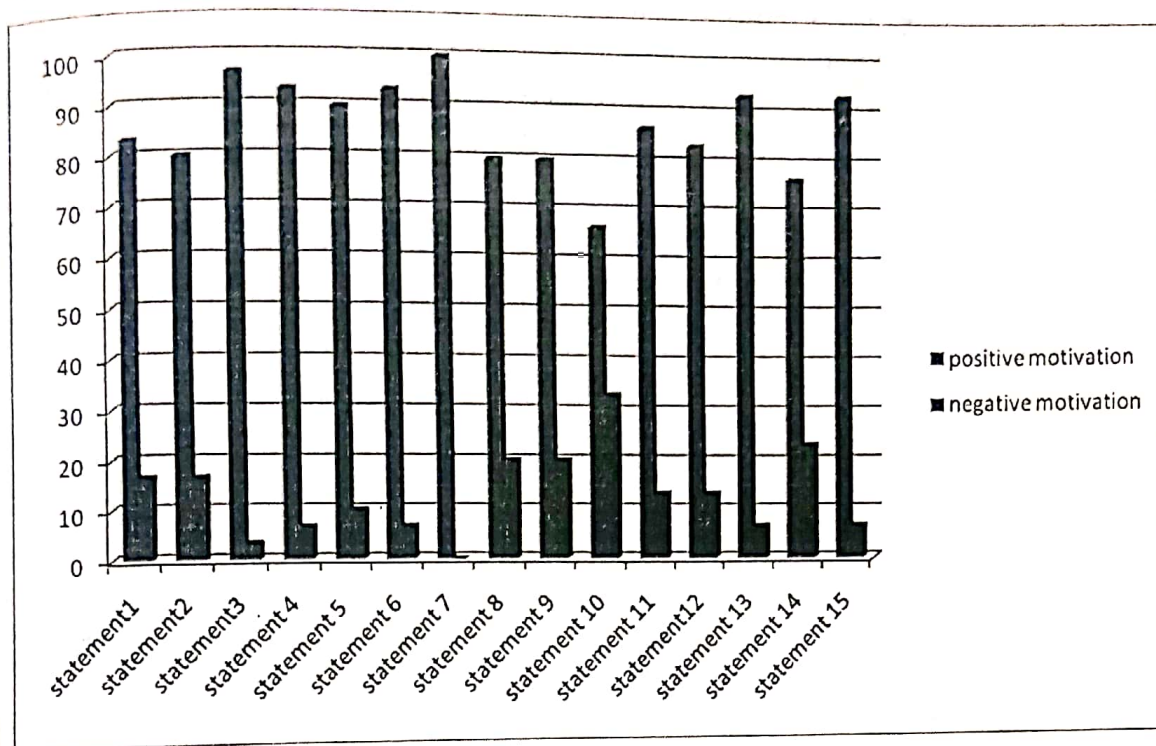


Figure 1: Graphical representation of physics students' positive and negative motivation towards learning energy concept using locally constructed amplifier

Discussion of Findings

It can be deduced from this finding that the use of locally constructed amplifier improved the performance of physics students in energy concept better than conventional lecture method did. This finding is in agreement with the earlier finding of Onasanya and Omosewo (2011) who found that improvised and standard instructional materials improved secondary school students' academic performance in physics.

The findings of this study also revealed that students were positively motivated towards learning energy concept using a locally constructed amplifier. This finding does not contradict the earlier findings of Tella (2007) who found that the use of instructional materials motivate students to learn and enables them to academically perform better than the lowly motivated students.

Conclusion

The use of locally developed or improvised instructional materials facilitates learning of abstract concepts. In view of this, an amplifier was constructed to teach the concept energy in Nigerian secondary school physics curriculum. The result obtained from the data gathered and analyzed in this study indicated that the locally constructed amplifier improves students' academic achievement in energy concept and that secondary school physics students were positively motivated towards learning the concept when the constructed amplifier was used. The constructed device can therefore be used in absence of commercial or imported ones to enrich students understanding of energy concept.

Recommendations

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

1. Physics teachers should encourage the use of instructional materials in order to facilitate students' understanding of abstract physics concepts;

2. Government and school administrators should regularly organize workshops and seminars which bother on production of learning and instructional materials that can be used to enrich students' understanding of abstract concepts in Nigerian secondary school physics curriculum; and
3. Physics teacher should ensure they use instructional materials that can capture students' interest and motivate them positively towards learning abstract physics concepts.

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