Effects of Electronics Prototype Device on Technical College Student’s Retention ability, in Borno State, Nigeria

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Abstract: The study was undertaken on the effects of Electronics prototype devices on students’ academic retention ability in applied electricity at two technical colleges in Borno State. The study was guided by two research questions and two hypotheses. The study considered only experimental groups, consisted of the 42 students from two technical colleges in Borno State. Three instruments were involved for data collection, they are; pretest, posttest and retention test. The latter two instruments were, re-arrange in numbering to avoid remembrance. The instrument is made of 50 multiple choice items developed based on a table of specification. The validated instruments were trial tested; using Pearson’s Product moment correlation coefficient and reliability of 0.73 was obtained. The findings include among others; there was no significant difference between male and female students in the posttest achievement test and there were no significant gender effects during retention test. It was recommended among others that; teachers at technical college level, should be encouraged to be acquainted with the skills of design and construction of electronic devices to teach practical work and to complement the most frequent chalk and talk teaching style.

Keywords: Technical College, Prototype device, Retention ability, Applied Electricity

I. INTRODUCTION

Technical and Vocational Education and Training are offered for the purpose of producing skilled manpower required for the nation’s economic and technological development [Federal Republic of Nigeria (FRN, 2014)]. In the Nigerian Education System, applied electricity (A.E.) is one of the trade related subjects that is offered at technical college to offer basic scientific knowledge. Skills in A. E. formed a practical base for trade courses. Following the Federal Government reform in Education and the need to attain the Millennium Development Goals (MDGs) and the critical targets of National Economic Empowerment and Development Strategies (NEEDS), the Nigerian Educational Research and Development Council (NERDC) mandated to develop curricula for use at all levels of the educational system in Nigeria (Egwu, 2017). The National Council on Education (NCE) at its meeting in Ibadan in December 2015, directed NERDC to review and re-align all the existing curricula in senior secondary education (science and technical) to meet the targets of the education reform in the context of MDGs and NEEDS which was summarized as; value-reorientation, poverty eradication, job creation, wealth generation and using education for self-reliance to empower the people.

The reviewed version of the curriculum in Applied Electricity was necessitated by the need to bring the curriculum up to date in line with not only developments in the field of electrical engineering but also, be in line with National needs and aspirations (Gabasa, 2015). NERDC recommended that, for the teaching of the basic subject, topics should be activity based to enable the students acquire practical skills as well as the required knowledge. In considering these developments, the needs for the provision of tools, equipment, instructional facilities, like improvised object/device, use of prototype devices for teaching/learning for all school’s students’ academic achievements need to be actualize for skills disposition after graduations, were all considered.

A prototype is a sample or model built to test a concept or process or to act as a thing to be replicated or learned from it. It is a term used in a variety of contexts, including semantics, design, electronics, and software programming (Medugu, 2011). A prototype is designed to test and try a new design to enhance precision by system analysts and users. In Electronics, Prototyping means building an actual circuit to a theoretical design to verify that it works, and to provide a physical platform for debugging. The prototype is often constructed using techniques such as wire wrap or using Veroboard or breadboard, that create an electrically correct circuit, but one that is not physically identical to the final product. A prototype is a human-made object that is used as the standard of measurement. However, these needs can also be hardly overemphasized to facilitate teaching and enhance students’ academic achievement and retention to meet some of the requirements of education reform bodies. Ambursa (2012)
showed that student examinations achievement is a major yard stick for job placement and evaluating school performance and teaching methods. Ambursa (2012) further, observed it as a clear manifestation that lack of suitable teaching approaches resulted to low academic achievement of the learners’ in schools especially, female in Technical colleges. In the same view, Ahmed (2014) reported that during the pre-accreditation resources inspection of two technical colleges in Borno state that is: Government Technical College Bama and Government Girls Technical College Damboa by experts from (NBTE), they clearly, specified in clear terms the rate of poor performance of students in academic achievement in Borno State. Ahmed (2014), further revealed that only, one thousand nine hundred and seventy-nine (1,979), about 26% of the seven thousand five hundred and seventeen (7,517) students that, sat for West African Examination Council (WAEC) and NABTEB examinations in 2012/2013 session, scored five credits for admission into the universities and other degree awarding institutions. The percentage pass was too low especially that of the female, that even parents have started withdrawing their female students for early marriage and this trend seem not to have change. The probable reason for this poor performance could be, lack of trained teachers, instructional materials among others. According to NABTEB (2014 AND 2015) CHIEF EXAMINERS Report, the poor performance in Electronics related courses was poor response to practical questions by candidates. This situation constitutes serious problems that require urgent action by those concerned (Gabasa, 2015).

It is therefore, based on this background that this research is designed, to determine the effects of prototype devices on students’ academic achievement in technical colleges of Borno State.

Research Questions

The following research questions guided this study:

1. What is the mean achievement of male and female students taught AE, using prototype devices in Technical colleges of Borno State?
2. What is the mean retention of male and female students taught AE, using prototype devices in Boys and Girls technical colleges of Borno State?

Hypotheses

Based on the research questions, the following two null hypotheses were formulated to guide the study at 0.05 level of significance

- HO1: There is no significant difference between the mean achievement of male and female students taught AE, using prototype devices
- HO2: There is no significant difference between the mean retention of male and female Students taught AE, using prototype devices

Significance of the Study

The prototype will provide opportunities for technical teachers to exploit a new tool with which to conduct practical classes with their students. However, the research base for exploiting this tool as well as examples of good professional practice is at gestation stage and requires considerable thought and empirical investigation. The findings of this study will provide the needed data to justify expenditure in this new tool for technical education.

The prototype can present the essential information in a variety of ways. It would stimulate and encourage students to have interest in Electronics, as it would assist the students in their practical examinations. Electronic prototype device can be used in laboratory, offices and even at home. These features make it functional for use anywhere, anytime.

II. THEORETICAL FRAMEWORK

This study centered on theory of model-centered instruction, which was Dick and Carey (1978) instructional design model. The theory stated that learners construct mental models as they process information they have acquired through observations of or interactions with objects, events, and environments. The Dick and Carey theory commonly used for creating instructional materials, analyzing learner characteristics, developing learning objectives, developing instructional materials, implementing the instruction and evaluating the desired goals. The Dick and Carey theory refers to set of procedures and techniques that an instructional designer should employ to develop/construct model, evaluate, and revise instruction. According to Dick (2006), the Dick and Carey model is one of the important aspects of model that emphasis on performance objectives, which are based on learners, context, and the tasks to be performed. Based on this set of criteria selected, existing materials must include instructor’s guides, student modules, tools and resources that are necessary for the learning tasks. However, if the learner is to acquire new skills that are not applicable to the environment in which they expected to perform, then the transfer of the newly acquired skills will be ineffective (Dick, 2006).
Therefore, in line with this skills development, the theory of Dick and Carey is related to the present study, because in this study instructional prototype were produced, objectives were developed for analyzing learner’s characteristic as well as to evaluate learning outcomes. According to ogwu (2017), in learning environments, prototype are considered as technique that enhances students’ achievement, and also provides experience for extended exploration for learning technique; in which students learn through help, and under the guidance of a teacher.

The works of Medugu (2011) and Garba (2015), in the production of equipment and materials for teaching were particularly useful. But, very little or no work was found in the literature on Electronic prototype devices that were experimented in the class to teach Electronics trades in Borno state. This study, intends to fill this gap.

MATERIALS AND METHODS

The study was conducted in Borno State of Nigeria. The population of the study consisted of forty-two (42) National Technical Certificatel (NTC I) students; this includes, 27 boys from Government Technical College Bama and 15 girls, from Government Girls Technical College Damboa. The entire intact classes were used for the study. Hence there was no sample and sampling technique employed for the study. The draft of the instruments was submitted to six experts of varied years of teaching experience in applied electricity from Modibbo Adama University of Technology, Yola and Abubakar Tafawa University, Bauchi for face and content validation. The instruments were latter pilot tested at Government Science and Technical College Damagum, Yobe state, Nigeria using 23 Electronics students. The pilot test results produced a reliability coefficient of 0.73. Students in each group were assigned to experimental groups in each technical college and pretested. This is in line with Sambo (2005) and Uzuagulu (2011) who all stated that, at the beginning of the experiment, the researcher ensures the equality of the groups.

Data was collected through a researcher made achievement Test of 50 test items. 50 questions of Multiple Choice Achievement Test instrument (MCAT) were developed based on themes and reviewed version of NERDC applied electricity Curricula, NABTEB past question papers and NBTE (2016) (NTC I) syllabus for engineering trades and trade related subjects. Pre-test instrument achievement test was used to ascertain the entry behavior of the group’s and to ensure that the students are equal before the beginning of the experiment. Where Post-test instrument (Achievement test) was the same questions used in the pre-test, it was controlled by Re-arranging the questions’ numbering, to avoid remembrance. Similarly, Retention test instrument, was the same as that of achievement test instrument, the numbering sequence were also changed and re-administered to both experimental groups to ascertain their retention ability after two weeks intervening period. This is in line with the view of researchers such as Iheamach (1997) and Gbasa (2015). They all reported that, two weeks after instruction is sufficient enough to test students’ retention ability.

Prototype Devices were used for teaching applied electricity to experimental groups as:

i). Amplifier model

ii). (DC-AC) Luminous inverter model

The prototype devices were used to teach on the topic amplifier to explain the concept and principles of amplifier, types of amplifiers, function and behavior of transistor as an amplifying device. The device also used to investigate the d.c requirements of a common emitter (CE) amplifier for proper operation and to investigate the a.c characteristics of a CE amplifier circuit.

Mean and Standard deviation were used to answer the research questions, t-test statistic was employed to test the two null hypotheses. Each hypothesis was tested at a level of 0.05. Hypotheses were rejected when the t calculated values were greater than the table values otherwise, the hypotheses will be accepted. Below is the prototype.

Material Required for the Prototype Building

Components

- NPN transistor type BC 107 or equivalent.
- Resistors 4.7KΩ, (2Nos) 5.6KΩ (all 0.5w rated)
- Capacitors 22µF (2Nos)
- Connection leads

Equipment

- Stabilized d.c power supply
- Oscilloscope
- Sine/square oscillator
- Digital voltmeter or AVO-meter
Figure 1: A luminous Inverter prototype circuit

Figure 2: Luminous inverter prototype

III. RESULTS

Research Question one: What is the mean achievement of male and female students taught AE, using prototype devices?

Table 1: Mean achievement of Male and Female students in the two technical colleges

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>27</td>
<td>Male</td>
<td>52.77</td>
<td>12.72</td>
</tr>
<tr>
<td>Experimental</td>
<td>15</td>
<td>Female</td>
<td>50.21</td>
<td>8.62</td>
</tr>
</tbody>
</table>

Data analysis on table 1 shows that, male students who were taught AE, using prototype devices had a mean score of 52.77 with SD 12.72 and female students that were taught AE, using prototype devices had mean score of 50.21 with SD of 8.62.

Research Question Two: What is the mean retention of male and female students taught AE using prototype devices?

Table 2: Mean retention of Male and Female Students exposed to Prototype Devices in Technical Colleges

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>27</td>
<td>Male</td>
<td>66.05</td>
<td>6.33</td>
</tr>
<tr>
<td>Experimental</td>
<td>15</td>
<td>Female</td>
<td>62.73</td>
<td>2.19</td>
</tr>
</tbody>
</table>
Table 2 shows that, male students who were taught AE, using prototype devices had mean score of 66.05 with SD of 6.33. While female students that were taught AE, using prototype devices had a score of 62.73 and SD of 2.19

Hypothesis I: There is no significant difference between the mean achievement of male and female students taught Applied Electricity, using prototype devices

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t-cal</th>
<th>t-crit.</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Male</td>
<td>27</td>
<td>52.77</td>
<td>12.72</td>
<td>40</td>
<td>1.75</td>
<td>2.02</td>
<td>Accepted</td>
</tr>
<tr>
<td>Experimental</td>
<td>Female</td>
<td>15</td>
<td>50.24</td>
<td>18.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that, the calculated t-value is 1.75. This value is less than t critical value of 2.02, hence, the null hypothesis is therefore accepted, and that significant difference does not exists between the mean scores of male experimental group and female experimental group students on their achievement test in technical colleges when taught with prototype devices

Hypothesis II: There is no significant difference between the mean retention of male and female students taught AE, using prototype devices

Table 4 shows that, calculated t-value is 1.10. Since t- calculated value is less than the t-critical value of 2.02. This means, there is no significant difference between the mean retention of male and female, students exposed to prototype devices.

Findings of the study

i. It was observed that the male students had a mean of 52.77, while the female had a mean of 50.24 in the achievement test. This shows, the male had a slight higher score.

ii. The male students had a mean score of 66.05, and the female had 62.73, again, the male had a slight higher mean than the female students

iii. There was no significant difference between male and female students in the posttest achievement test

iv. There were no significant gender effects during retention test

v. This instrument aid retention, all the student performed well in the retention test

Discussion of findings

Table 1 presents the results of male and female students taught Applied Electricity (A.E) using prototype. The data indicated that male students had a mean of 52.77 while, the female had 50. 21. The results further show that the male students had a slight higher score than the female. This finding is in disagreement with Gabasa (2015) who is of the opinion that male students perform better than female at technical colleges

In table 2, the results show gender effect in treatment on retention test. The male students had a mean of 66.05, while the female had 62.73. The results further show that, no further much difference was observed. Although, the male had a higher mean score, but the difference is not significant. Therefore, this is in-line with similar research work conducted by Medugu (2011), that both male and female students can equally have performed well and retained what they learnt using an appropriate instructional material.

These analyses were also in agreement with the findings of Ogundola and Oke (2010) where those results have showed no significant difference yielded on treatment effect on students’ academic achievement, the effect of gender was eliminated, as such no significant difference exists in gender mean effect on treatment. This implies that when appropriate stages of delivering instruction are employed and relevant instructional materials were used the learners could actually acquire the best in whatever lesson or course of study irrespective of sex difference. Sex appears to be no determinant of achievement in the technical colleges, it was clear from the result that most of the females were as competent as most males.

IV. CONCLUSION

Based on the analysis, interpretations and discussion of the findings of the study, the study revealed that, significant difference was not found at 0.05 levels, that is:

a) Significant difference does not exist between the mean achievement of male and female students taught AE, using prototype devices

b) There is no significant difference between the mean retention of male and female students taught AE using prototype devices

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Limitations of the Study
In the course of this work, the researcher encountered the following problems which might have affected the findings of this study:

i). Lack of components and equipment like, Transistors, Capacitors, Oscilloscope, Signal Generators, Sine square oscillators, among others in the colleges involved in the study, compelled the researcher to be moving with all of this equipment.

ii). This study was conducted in the insurgency areas (i.e. Boko Haram), this reduced the number of both male and female students in these colleges, as most of the students have left those areas with their parents, because of the insurgency.

Recommendations
Based on the findings of the study, the following recommendations were proffered:

i. Teachers at technical college level should be encouraged to be acquainted with the skills of design and construction of electrical and electronic instructional devices to teach practical work, to complement the most chalk to talk teaching style.

ii. Workshop should be organized at the technical college level to introduce the use and the importance of Prototype devices, since it does not discriminate gender.

iii. Generally, male students performed better in the entire test. The probable reason could be that, the male students are friendlier with practical than their female counterpart. Female students should be encouraged, both at home and in school to embrace technical education.

Suggestion for further study
Electronics is a subject that majority of the students are scared of due to the practical’s involve in the subject, especially the females. This study should therefore be replicated using other related subjects such as Metal work, Electrical Installation, among others with more students of both sexes, so that the effects of the prototype across Vocational and Technical subjects and the sexes can be better inferred.

V. REFERENCES

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