Effects of digital oscilloscope instruction on the academic achievement of electronics students in technical colleges in North East, Nigeria

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The purpose of this study is to determine the effects of digital oscilloscope instruction on the academic achievement of electronics students in technical colleges in the North East geopolitical zone of Nigeria. The study was guided by four objectives and six hypotheses. The design of the study is pretest - posttest control group experimental design. The sample for the study was 124 students randomly selected from a population of 160 students from four science and technical colleges that offer Radio Television Electronics (RTE). The sample subjects were randomly assigned to either experimental (Ge) group or control (Gc) group. A 45 – item test titled; ‘researcher made achievement tests’ (RMAT) which has same contents but numbered differently with researcher made retention tests (RMRT) and having a test-retest reliability coefficient of \( r = 0.78 \) were used for data collection. Data was analyzed using ANCOVA. The findings showed a significant difference in the mean score of students in experimental groups, who were taught RTE with digital oscilloscope and control group, who were taught RTE using traditional oscilloscope as measured by RMAT, also there were no significant gender effects during retention test. It was recommended among others that; due to its numerous advantages, all hands must be on deck, to see that the digital oscilloscope is purchased or improvised by all concerned and used to complement the traditional oscilloscope for teaching RTE and other related areas.

Key words: Digital oscilloscope instruction, academic achievements, radio, television and electronics, vocational and technical education.

INTRODUCTION

The fundamental ingredient of all Vocational and Technical Education programme is skill development and subsequent utilization of the acquired skills. The skills are not just acquired in the open, they are rather developed in the workshop or laboratory equipped with the latest tools and other necessary facilities. According to the National Business and Technical Examination Board (NABTEB) syllabus (2003) Radio, Television and Electronics Work (RTE) is among the trades offered at the technical college level in Nigerian technical colleges.

Ikpeamaonwu (1991) posited that practical work is essential where acquisition of skill is needed and that practical work demands technical implements. Uzoagulu (1992), on the other hand warned that where equipment and tools are not functional or adequately provided technical training programmes will suffer and will lead to the production of highly unskilled personnel who shall be unemployable and unproductive. In spite of governments’ efforts in providing instructional materials, the achievement of some of the objectives for providing functional vocational and technical education has been elusive.

The implication is that most students who graduate from these colleges are not properly trained which is equally responsible for seventy percent (70\%) failure rate of the WAEC technical examination (NBTE, 2006). Similarly, the NABTEB 2007and 2008 chief Examiners Report stated that, the candidate’s weaknesses among others include:

i. The candidate’s response to practical questions was very poor

ii. Majority of the candidates had very poor knowledge of sketches and schematic diagrams.

The same document suggested the following:

Instructional materials should be provided by the schools
to help both teachers and the candidates in the teaching and learning processes.
b. The subject teachers should teach troubleshooting skill properly to the candidates.

The National Council on Education (NCE) has viewed with great concern, what they called unsatisfactory state of academic facilities in institutions (Olumese, 2004). It is known that one of the tragic consequences of inadequate supply and use of instructional materials is low educational standard. Hence, the need to look for alternative instructional materials in the face of dearth need cannot be over-emphasized. Therefore in such a situation, the improvisation and use of digital materials can hardly be over-emphasized in a developing country like Nigeria where manufactured ready – made instructional materials are not readily available or are too expensive to acquire.

Digital in this sense, refers to an oscilloscope that displays in figures (Medugu, 2011). This is possible with the aid of a developed software packages. According to Jega (2004), computer software is a set of programme that tells the computer what to do and how to do it. It is a coded instruction that the computer uses to accomplish specific tasks for the user.

Software can be downloaded from the internet free of charge or be bought for just a little money. According to Ohakwe (2004) computer prices are falling drastically. He cited an example that a fairly used Pentium IV can now be purchased at about N19, 500:00. Hence, the use of a computer as a Digital oscilloscope (DO) to teach students would be cheaper than buying an oscilloscope which is expensive and not easy to come by.

Various studies such as Adeyanju (2000), Ezeanya (2002) and Bill (2003) have been conducted on instructional materials in technical education. However, most of the studies centered on the need, problems and prospects of improvisation with little or no use of digital instructional materials, for teaching at the technical colleges. Therefore, this study used an oscilloscope card and software that can convert a computer to an oscilloscope, to determine various waveforms, measure voltage, detect signals injected into circuit and for trouble shooting.

**Purpose of the Study**

The purposes of this study were:

i. Ascertain whether students taught using DO differ in mean scores from those taught using Traditional Oscilloscope (TO), as measured by researcher made achievement test (RMAT).

ii. Determine whether male and female students taught using DO, differ in mean scores from those male and female students taught using TO, as measured by RMAT.

iii. Ascertain whether students taught using DO differ in their rate of retention from those taught using TO, as measured by the researcher made retention test (RMRT).

iv. Determine whether there is difference in the mean scores of male and female students taught using DO, from those male and female students taught using TO, in the RMRT.

**Hypotheses**

The following hypotheses were tested at 5 % level of significance:

HO1: There is no significant difference in the mean score of the students who were taught RTE with digital oscilloscope and those taught with traditional oscilloscope as measured by RMRT.

HO2: There is no significant difference in gender mean effect as measured by RMAT.

HO3: There is no gender - treatment interaction effect in the students’ achievement in the RMRT.

HO4: There is no significant difference in the mean score of students’ taught RTE with digital oscilloscope, and those taught RTE using traditional oscilloscope as measured by RMRT.

HO5: There is no significant difference in gender mean effect as measured by RMRT.

HO6: There is no gender – treatment interaction effect in the students’ performances in the RMRT.

**METHODOLOGY**

The study was undertaken in the North East Geopolitical zone of Nigeria. The zone is located in the Northern part of Nigeria, a total of 124 level II Radio, Television and Electronics (RTE) students were randomly drawn from four technical colleges within the zone. The colleges were the only college offering RTE trade in the Geopolitical zone. The design of the study is pretest - posttest control group experimental design. In each college an intact RTE class was individually randomly assigned to either experimental (Ge) group or control (Gc) group.

Two instruments were constructed based on the NBTE (2006) approved curriculum. These instruments are researcher made achievement test and researcher made retention test. The contents of both instruments were the same but numbering varied to avoid remembrance of questions by subjects. The instruments has two sections each; section A, seek for personal data; while section B, contains 45 multiple choice items with four options A to D. Each correct response attracted 2.22 marks. The draft of the instruments were submitted to six experts with
varied years of teaching experience of RTE from Modibbo University of Technology, Yola and University of Nigeria Nsukka for face and content validation. Their comments were used in producing the final instruments which were pilot tested at Government Science and Technical College Takum, Taraba State; using 38 students from the RTE for the exercise. The pilot test results produced a reliability coefficients of $r = 0.78$.

The equipment used consists of: Traditional oscilloscope; a teaching aid required to be used for teaching and learning purposes at technical colleges but very expensive and very difficult to find in colleges. Digital oscilloscope; a teaching aid used to teach experimental group. This teaching aid requires the use of computer for it, to work. This was constructed by one of the researchers (Medugu, 2011).

The questionnaire was directly administered to the students after teaching. The chosen level of significance for the study was 0.05. The simple mean and standard deviation were used to analyse the data for answering the research questions. Analyses of Covariance (ANCOVA) was employed to test $H_0_1$ through $H_0_6$. In this case, the pretest scores were used as covariates for the achievement and retention test scores. A hypotheses was rejected if the calculated $F$-value is greater than the table value of $F$ at 0.05 probability level, otherwise the hypotheses was accepted if the calculated value is less than the $F$-value on the table of values. If the results indicate significance, the Scheffe test was applied to determine contrast between pairs of means.

RESULTS

The result of the analysis of covariance (ANCOVA) obtained using statistical analysis for scientist (SAS) version 11.0 is presented in Tables 1 to 6.

$H_0_1$: There is no significant difference in the mean score of the students in treatment group Ge, who were taught RTE with digital oscilloscope and group Gc, who were taught RTE using traditional oscilloscope as measured by RMAT

Table 1, shows, F-value for treatment is 87.88 with significant probability of 0.0001, which is less than 0.05. As a result, the hypothesis is rejected, meaning that, there is a significant difference in the mean effect of treatment during the achievement test. To determine the direction of this difference, the Scheffe test was conducted.

Table 2, shows the result of the post hoc test. Subjects in group Ge had the higher mean score of 66.29%, followed by subject in group Gc, with 56.40%.

Since both groups have different grouping letters, A for Ge and B for Gc, then the differences in mean is significant and in favour of Ge.

$H_0_2$: There is no significant difference in gender mean effect as measured by RMAT

From Table1, the F-value for the effect of gender during the achievement test is 5.43 with probability of 0.0214. This value is less than 0.05; therefore, the hypothesis is rejected. This means that there are significant gender effects during the achievement test. A post hoc analysis was conducted using the Scheffe test. Table 3, shows that, female students had 59.58%, while male had 62.95%. The test shows that these scores are statistically significantly different. Hence, both gender groups were given different grouping letter, A for Ge, and B for Gc

$H_0_3$: There is no gender - treatment interaction effect in the students' Achievement in RMAT

From Table 1, analysis of covariance on gender - treatment effect shows that the F-calculated is 3.12, at a probability of 0.0800, which is greater than the expected value of 0.05. Therefore, the hypothesis is accepted. This means, there is no significant interaction effect of gender and methods of teaching.

$H_0_4$: There is no significant difference in the mean score of students' in treatment groups Ge, who were taught RTE with digital oscilloscope, and group Gc, who were taught RTE using traditional oscilloscope as measured by RMRT

Table 4, shows the F-value for treatment is 58.47 with significant probability of 0.0001, which is less than 0.05. This led to the rejection of the hypothesis 7, meaning, that there is significant difference in the mean effect of treatment during retention test. To determine the direction of the difference in their means, the scheffe test was performed.

Table 5, shows that students in group Gc had the highest mean retention score of 64.66%, while the Gc group had mean score of 47.15%. Since both groups have different grouping letters, A for Ge, and B for Gc, then the difference in mean is significant and in favour of group Ge.

$H_0_5$: There is no significant difference in gender mean effect as measured by RMRT

From the analysis on Table 4, the F-value for the effect of gender during the retention test is 1.84 at a significant probability of 0.1777. This value is greater than 0.05. Therefore, the hypothesis is accepted. This means that there are no significant gender effects during retention test. Post -hoc analysis using the Scheffe test on table 20 shows that female students had a mean retention test score of 54.86%, while male had 59.48%. The test shows that these scores are not significantly different from each other; hence both gender groups were given the same
Table 1. ANCOVA test result of treatment effects on RMAT and gender interaction.

<table>
<thead>
<tr>
<th>Sources</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F - Value</th>
<th>P &lt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>643.56</td>
<td>1</td>
<td>776.77</td>
<td>4.44</td>
<td>0.0343</td>
</tr>
<tr>
<td>Gender</td>
<td>321.06</td>
<td>1</td>
<td>321.06</td>
<td>5.43</td>
<td>0.0214</td>
</tr>
<tr>
<td>Treatment</td>
<td>5544.43</td>
<td>1</td>
<td>4327.77</td>
<td>87.88</td>
<td>0.0001</td>
</tr>
<tr>
<td>Gender*treat.</td>
<td>184.25</td>
<td>1</td>
<td>184.25</td>
<td>3.12</td>
<td>0.0800</td>
</tr>
<tr>
<td>Explained</td>
<td>3534.95</td>
<td>3</td>
<td>1178.32</td>
<td>19.94</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>7091.14</td>
<td>120</td>
<td>59.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected total</td>
<td>10626.09</td>
<td>123</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. ANCOVA test result of treatment effects on RMAT and gender interaction.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of students</th>
<th>Mean%</th>
<th>Scheffe grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ge</td>
<td>62</td>
<td>66.29</td>
<td>A</td>
</tr>
<tr>
<td>Gc</td>
<td>62</td>
<td>56.40</td>
<td>B</td>
</tr>
</tbody>
</table>

Table 3. Scheffe analysis of means according to gender in RMAT.

<table>
<thead>
<tr>
<th>Gender</th>
<th>No. of Students</th>
<th>Mean %</th>
<th>Scheffe grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>65</td>
<td>62.95</td>
<td>A</td>
</tr>
<tr>
<td>Female</td>
<td>59</td>
<td>59.58</td>
<td>B</td>
</tr>
</tbody>
</table>

0.0214 < 0.05

v. There were no significant gender effects during retention test.
vi. There was no significant interaction effect of gender and treatment during the retention test.

DISCUSSION OF FINDINGS

Table 1, shows the analysis of ANCOVA; determining whether there is no significant difference in gender mean effect as measured by RMAT (H0). From the table F-Value for the effect of gender during the achievement test is 5.43 with probability of 0.0214 < 0.05. Therefore, the hypothesis is rejected. This implies that significant difference existed between the mean scores of male and female students that were taught RTE in RMAT.

This result supported the finding of Balogun (1996), Vero et al. (2006) and Osuagwu (2006) who reported significant differences between the performance of male and female students exposed to traditional and digital oscilloscopes, in favour of digital oscilloscope.

However, the result does not agree with the finding of Mayor and Anderson (2001) where they reported that, significant difference was not observed between male and female students that were exposed to two different instructional materials at higher school level in electronics laboratory. Table 1, presents the analysis of whether; there is a gender treatment - interaction effect in the student’s
Table 4. ANCOVA test result of treatment effects on RMRT and gender Interaction.

<table>
<thead>
<tr>
<th>Sources</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F – Value</th>
<th>P &lt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>543.46</td>
<td>1</td>
<td>374.57</td>
<td>6.54</td>
<td>0.0222</td>
</tr>
<tr>
<td>Gender</td>
<td>89.58</td>
<td>1</td>
<td>89.58</td>
<td>1.84</td>
<td>0.1777</td>
</tr>
<tr>
<td>Treatment</td>
<td>2543.33</td>
<td>1</td>
<td>4146.57</td>
<td>58.47</td>
<td>0.0001</td>
</tr>
<tr>
<td>Gender*treat.</td>
<td>123.94</td>
<td>1</td>
<td>123.94</td>
<td>2.55</td>
<td>0.1130</td>
</tr>
<tr>
<td>Explained</td>
<td>9724.45</td>
<td>3</td>
<td>3241.48</td>
<td>66.65</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>5836.39</td>
<td>120</td>
<td>48.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected total</td>
<td>15500.84</td>
<td>123</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Scheffe analysis of means for treatment in groups Ge and Gc in RMRT.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of students</th>
<th>Mean%</th>
<th>Scheffe grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ge</td>
<td>62</td>
<td>64.66</td>
<td>A</td>
</tr>
<tr>
<td>Gc</td>
<td>62</td>
<td>47.15</td>
<td>B</td>
</tr>
</tbody>
</table>

Table 6. Scheffe analysis of means according to gender in RMRT.

<table>
<thead>
<tr>
<th>Gender</th>
<th>No. of Students</th>
<th>Mean %</th>
<th>Scheffe grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>65</td>
<td>56.85</td>
<td>A</td>
</tr>
<tr>
<td>Female</td>
<td>59</td>
<td>54.86</td>
<td>A</td>
</tr>
</tbody>
</table>

0.1777 > 0.05

performance in RMAT. ANCOVA test result of HO showed that there is no significant gender treatment interaction effect, this is because probability value of 0.0800 > 0.05. This result is similar to the finding of Osuagwu (2006) the finding here shows both male and female students learnt RTE using DO, and given the treatment, gender did not affect how subjects learnt RTE with DO.

This study is similar to the study of Osuagwu (2006) and Vero et al. (2006) who all found out that there is no gender and interaction effect in the students’ performance exposed to virtual and digital teaching materials.

Table 4, shows that hypothesis 6, was tested and analysis showed that there existed no significant interaction effect of gender, and treatment during the retention test. This result has shown that the use of digital oscilloscope improve retention of what was learnt by both male and female students.

The findings in table 4, demonstrated the superiority of DO over TO as opined by, Balogun (1996) and Vero et al. (2006). This superiority has further been confirmed by Linke et al. (2003), Fletcher (2007) and pico – technology (2008) when they said the use of digital oscilloscope helps students to better understand and retain basic concepts used in laboratory work.

Similarly, in their finding, Iheamacho (1997) and Osuagwu (2006) and Vero et al. (2006) maintained that, instructional medium that are displayed on a larger screen or which uses projector improves students understanding retention ability better than those that are not.

CONCLUSION AND RECOMMENDATIONS

This study examined the effectiveness of a Digital Oscilloscope (DO) compared to Traditional Oscilloscope (TO), when they are used to teach two different groups of Radio, Television and Electronics work (RTE) students at the science and technical college level. The purpose was to determine if DO would be effective to teach RTE students at the science and technical colleges. The second purpose was to determine whether DO would help the RTE students to retain what they have learnt longer.

i. Generally, male performed better in the Ge (DO) group than the female; the probable reason was that males are more literate in computer than their female colleagues as confessed by some of the female students. Female students should be encouraged, both at home and in school to be computer literate.

ii. All hands must be on deck to see that the Digital oscilloscope is purchased by all concerned and used to complement the Traditional oscilloscope for teaching RTE. This is due to its numerous advantages, which include; large screen, easier to operate, particularly, among others.
iii. Teachers at the technical college levels should be encouraged to be computer literate, so as to effectively teach the subject, because nobody can give what he/she does not have.

REFERENCES

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