Effects of Digital Oscilloscope Instruction on the Academic Achievement of Radio, Television and Electronics Students in Technical Colleges in the North East, Nigeria

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Abstract

The purpose of this study is to determine the effects of digital oscilloscope instruction on the academic achievement of Radio, Television and Electronics (RTE) students in technical colleges in the North East geopolitical zone. The study was guided by four purposes of the study and six hypotheses. The population for the study consisted of 160 students from the four science and technical colleges that offer RTE, from which 124 students were sampled and randomly assigned to either experimental group (Ge) or control group (Gc). A structured questionnaire titled; 'Achievement Tests' (AT) consists of 45 items and 'Retention Tests' (RT) consists of 45 items, were used for data collection, but the numbering of AT and RT varies to avoid reproduction of answers to earlier testing. The drafts of the AT, RT and a table of specification were given to six experts from two universities for validation. The test-retest method was employed for testing the reliability of the instrument. The reliability coefficient obtained was r = 0.78. Analysis of Covariance statistics was used for analysis. If the results indicated significant, the scheffe test was applied to determine contrast between pairs of means, otherwise this stage was not necessary. The findings include: there was 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 AT; and there were no significant gender effects during retention test. It was recommended among others that; due to its numerous advantages, digital oscilloscope should be purchased by all concerned and used to complement the traditional oscilloscope for teaching RTE and other related areas.

Keywords: Digital oscilloscope, Traditional oscilloscope, Achievement test, Retention test, Radio Television and Electronics

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 (2007) Radio, Television and Electronics Work (RTE) is among the trades offered at the technical college level. The general aim of RTE at science and Technical College level is to provide training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant. To achieve this goal, the curriculum is prepared in a module form. Each module has its General objective and the required teaching resources. In line with this, Osuagwu (2006) posited that practical work is essential where acquisition of skill is needed and that practical work demands technical

equipment. Medugu (2011), 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, 2007). 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:
a. 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 trouble-shooting 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 (Ezeanya, 2002). 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 need for production 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.

The word oscilloscope comes from the Latin "oscillare" mean to swing backwards and forwards. The Oscilloscope is basically a graph displaying device – it draws a graph of an electrical signal. Oscilloscope comes in two types: analog and digital. An analog Oscilloscope works by directly applying a voltage being measured to an electron beam moving across the oscilloscope screen. The voltage deflects the beam up and down proportionally, tracing the waveform on the screen. This gives an immediate picture of the waveform. In contrast, a digital oscilloscope samples the waveform and uses an analog-to-digital converter (or ADC) to convert the voltage being measured into digital information. It then uses this digital information to reconstruct the waveform on the screen (Kelly, 2001).

Digital in this sense, refers to an oscilloscope that displays in figures (Medugu, 2011). This is possible with the aid of 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 (2007) 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 (2005) 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

This study specifically:

I. Ascertained whether students taught using DO differ in mean scores from those taught using Traditional Oscilloscope (TO), as measured by achievementtest (AT)

i. Determined whether male and female students taught using DO, differ in mean scores from those male and female students taught using TO, as measured by AT

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

iv. Determined 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 RT

Hypotheses

The following six null hypotheses were tested at 0.05 level of significance.

H_{01}: 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 AT

H_{02}: There is no significant difference in gender mean effect as measured by AT

H_{03}: There is no gender - treatment interaction effect in the students' achievement in the AT

H_{04}: 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 RT

H_{05}: There is no significant difference in gender mean effect as measured by RT

H_{06}: There is no gender – treatment interaction effect in the students' performances in the RT

Methods and Materials

The study was undertaken in the North East Geopolitical zone. The zone is located in the Northern part of Nigeria, a total of 124 parts II Radio, Television and Electronics (RTE) students were randomly drawn from four technical colleges. The colleges were the only colleges, 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 group (Ge) or control group (Gc).

Two assessment instruments were constructed based on the NBTE (2007) approved curriculum. These instruments are achievement test and retention test. The contents of both instruments were same but numbering varies to avoid remembrance. The instruments have two sections each; section A, sought for personal data; while section B, contains 45 multiple choice items with four response options A – D. Each correct response attracted 2.22 marks. The draft of the instruments were submitted to six experts of varied years of teaching RTE from Modibbo University of Technology, Yola and University of Nigeria Nnsukka for their comments and suggestions. The instruments were later pilot tested at Government Science and Technical College, Takum, Taraba State; where 38 students from RTE class were involved in the exercise. The pilot test results produced a reliability coefficients of r = 0.78, and was found acceptable (Balogun, 1996)

The instructional devices were: Traditional oscilloscope, a teaching aid expected to be used for teaching and learning purposes at technical colleges but very expensive and very difficult to find in colleges; and Digital oscilloscope, a teaching aid used to teach experimental group. The digital oscilloscope requires the use of computer for it, to work.

The questionnaire was directly administered to the students after teaching. The chosen level of significance for hypotheses testing was 0.05. 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_{01} to H_{06}. In this case, the pretest scores were used as covariates for the achievement and retention test scores. A hypothesis was rejected if the calculated F-value was greater than the Table value of F at 0.05 probability level, but the hypotheses was accepted if the calculated value was less than Table F-value. If the results indicated significant, the scheffe test was applied to determine contrast between pairs of means. If otherwise, then this stage was not necessary.

Results

The result of the ANCOVA obtained using Statistical Analysis for Scientist (SAS) version 13.0 is presented in Tables 1 to 6.

H_{01}: 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 AT

Table 1: ANCOVA test result of treatment effects on AT and gender interaction

Sources	SS	DF	MS	F – Value	P < F
Pretest	643.56	1	776.77	4.44	0.0343
Gender	321.06	1	321.06	5.43	0.0214
Treatment	5544.43	1	4327.77	87.88	0.0001
Gender*treat.	184.25	1	184.25	3.12	0.0800
Explained	3534.95	3	1178.32	19.94	0.0001
Error	7091.14	120	59.09		
Corrected total	10626.09	123			

Table 2: Scheffe analysis of means for treatment in groups Ge and Gc, in AT

Treatment	No. of students	Mean%	Scheffe grouping
Ge	62	66.29	A
Gc	62	56.40	B

0.0001<0.05

Table 1 shows F-value of 87.88 with significant probability of 0.0001, which is less than 0.05 for treatment group. As a result, the hypothesis is rejected, meaning that, there is significant difference in the mean effect of treatment. 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.

$H_{02:}$ There is no significant difference in gender mean effect as measured by AT

Table 3: Scheffe analysis of means according to gender in AT

Gender	No. of Students	Mean%	Scheffe grouping
Male	65	62.95	A
Female	59	59.58	B

0.0214 < 0.05

From Table 1, 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 is a significant gender effect during the treatment. 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

$H_{03:}$ There is no gender - treatment interaction effect in the students' Achievement in AT

From Table1, 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. Hence, no need for post hoc test.

H_{04}: 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 RT

Table 4: ANCOVA test result of treatment effects on RT and gender Interaction

Sources	SS	DF	MS	F –Value	P < F
Pretest	543.46	1	374.57	6.54	0.0222
Gender	89.58	1	89.58	1.84	0.1777
Treatment	2543.33	1	4146.57	58.47	0.0001
Gender*treat	123.94	1	123.94	2.55	0.1130
Explained	9724.45	3	3241.48	66.65	0.0001
Error	5836.39	120	48.64		
Corrected total	15500.84	123			

Table5: scheffe analysis of means for treatment in groups Ge and Gc in RT

Treatment	No. of students	Mean%	Scheffe grouping
Ge	62	64.66	A
Gc	62	47.15	B

0.0001 < 0.05

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_{05}: There is no significant difference in gender mean effect as measured by RT

Table 6: Scheffe analysis of means according to gender in RT

Gender	No. of students	Mean	Scheffe grouping
Male	65	56.85	A
Female	59	54.86	A

0.1777 > 0.05

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 grouping letter A.
H_{06}: There is no gender – treatment interaction effects in the students' performances in the RT

From Table4, analysis of covariance on gender treatment effect shows that the F-calculated is 2.55 at a probability of 0.1130, which is greater than the expected value of 0.05. Therefore, the hypothesis is accepted. This means that there is no significant interaction effect of gender and methods of teaching.

Discussion of findings

The findings showed that significant difference existed between the mean scores of male and female students that were taught RTE in the achievement test .the finding of the study is inconsonance with Balogun (1996), Vero, Garcia and Pedro's (2006) and Osuagwu (2006) who reported significant differences between achievement of male and female students exposed to traditional and digital materials, in favour of digital materials. However, the result is out of phase with the finding of Mayer and Anderson (2005) who 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. These differences where male achieved better than female could be as a result of the boys were more computer literate than the girls and some of the boys were radio and television technicians. Similar reasons has been advanced by researchers such as Osuagwu (2006) and Vero etal (2006), they maintained that students that are computer literate are better than their counterpart when it comes to working with software that requires computer usage, hence all students are encourage to be computer literate, irrespective of their gender to be able to perform well in computer related lessons.

Concerning gender and treatment interaction effect during the performance test, it was observed that there was no significant interaction effect of gender and methods of treatment during the performance test. This means, given the treatment, gender did not affect how subjects learned RTE with the DO. This finding is similar to the study conducted by Osuagwu (2006) and Vero etal (2006) who all found out that, there is no gender and interaction effect in the students' performance exposed to Virtual and digital oscilloscope. This is an interesting finding of this study. It has given clue to an effective tool that can be used to reduce gender bias in teaching RTE, thereby providing a level ground for both genders to learn the subjects, hence, there is need to encourage the use of this tool in schools.

On the other hand, DO have demonstrated superiority over TO as the use of digital oscilloscope improve retention of what was learnt by both male and female students. The result supported the opinion of Balogun (1996) and Vero etal (2006). This superiority has further been confirmed by Linke, Bull and Logofatu (2003), Flether (2007) and Pico-Technology (2008) when they said the use of digital oscilloscope helps students to better understand and retained basic concepts used in Laboratory work. Similarly, in findings of Iheamacho (1997), Osuagwu (2006) and Vero etal (2006), instructional medium that are displayed on a larger screen or which uses projector to

improve students understanding and retention ability better than those that are not. This is because; they are ideal for demonstration purposes and can be used with projector where a large class of students could see real waveforms being monitored.

Conclusion

This study examined the effectiveness of a Digital Oscilloscope compared to Traditional Oscilloscope 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 longer what they have learnt.

Recommendations

The following recommendations were made based on the findings of the study:

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. Digital oscilloscope should be 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, ease of operation, among others.
iii. Teachers at the technical college levels should be encouraged to be computer literate, so as to effectively teach the subject, since nobody can give what he/she does not have.

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