

Effect of Construction of a Radio Receiver on Students' Academic Achievement in Electronics Works in Technical Colleges in Rivers State

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Abstract

Electronics works in technical colleges involve the repairs, maintenance and construction of basic electronic systems. This study was centered on the appropriate method of carrying out the best teaching that will yield better academic achievement of students on electronics works in technical colleges in Rivers State. The study also examined the influence of location on students' academic achievement in electronics works. Two research questions guided the study and two hypotheses were tested at 0.05 level of significance. The design of the study was pre-test, post-test non-equivalent quasi-experimental study. A sample size of 112 students drawn from a population of 267 students in Rivers State technical colleges was used. To obtain the sample, two technical colleges were purposively selected and two intact classes were randomly selected and assigned to experimental and control groups. The Radio Receiver Achievement Test (RRAT) of 30 question items was the instrument developed for the study. The instrument was validated by three experts in technology and vocational education. A reliability coefficient of 0.673 was obtained using Kuder-Richardson 20 and another reliability coefficient of 0.668 was obtained using Pearson Product Moment Correlation. Data collected were analysed using mean with standard deviation to answer the research questions, while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Findings revealed among others that students taught with constructed devices achieved higher than those taught with lecture method in electronics works. Based on the findings, it was recommended among others that proper and regular seminars on electronic devices construction should be carried out for teachers in electronics works in order to create more awareness on the subject of construction.

Keywords: Construction, radio, receiver, students, academic, achievement, electronics, technical, colleges.

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I. INTRODUCTION

Considering the different approaches to knowledge development observed in many nations of the world today; it is obvious there is a paradigm shift to more skill oriented programmes. All over the world, technical education is one of the programmes that have been adopted directly or indirectly by many nations to achieve this skill oriented paradigm shift in knowledge development. Technical education is a programme that has to do with trainings on practically and theoretically based scientific skills and knowledge related to technology (Portraits, 2016). It equips the individuals with skills that involve the use of practical approaches and other physical instruments in executing projects. Nwachukwu (2006) defined technical education as an aspect of education designed to lead an individual to the acquisition of practical and applied skills as well as basic scientific knowledge in order

to get the individual adequately equipped for self-reliance or employment in the industries. In Nigeria, technical education programmes are offered at post primary level in technical colleges and other related vocational institutions.

Technical colleges are vocational training institutions that admit students at post primary levels, and are provided with full vocational courses for duration of between three to six years (Okoro, 2006). Technical colleges are regarded as the principal vocational institutions in Nigeria that provide craftsmanship training. They give full vocational training to prepare students for entry into specific engineering trades by offering several subjects that will enable the students' prepare for employment after graduation and one of such subjects is electronics works.

Electronics works in technical colleges involve the repairs, maintenance and construction of

basic electronics systems. It enables students in technical colleges to learn basic electronics theory that are needed to understand circuit designs in order to install, operate, maintain and repair electronic systems (Robinson, 2012). Electronics works as a subject also deals with the study of the properties and behaviour of electrons under different conditions, especially with reference to technical and industrial applications. This is because, components which are used in electronics systems, control the flow of electrons which emanates from atom. National Teachers Institute (2007) described electronics works as a technology subject which involves some scientific knowledge and practice to solve electronic problems. With the skills involved in electronics works, technical college students can work as members of an engineering team in the areas of installation, maintenance, manufacturing, product development and other applications of electronics products and devices. They can also work in the servicing industry in customer support and field engineering. Other industries such as utilities and telecommunications can also employ many electronics craft graduates from technical colleges. Electronics works in technical college consists of several topics that are used to assess students' academic achievement, and a radio receiver is one them.

In communication, a radio receiver also known as a receiver or simply a radio; is an electronic device that receives signal in the form of radio waves and converts the signal to a usable form. The radio receiver is usually connected to an antenna which receives the signal (radio waves) and converts some of the energy from the incoming radio wave into a tiny radio frequency AC voltage which is applied to the receiver's input (Olsen, 2013). The antenna typically consists of an arrangement of metal conductors which allows the oscillating electric and magnetic fields of the signal push the electrons in the antenna back and forth and thus creates an oscillating voltage. Usually the radio waves contains several signals present in it, but the receiver separates the desired radio frequency signal from all the other signals picked up by the antenna by using electronic filters. After the separation, an electronic amplifier is used to increase the power of the signal for further processing, and finally recovers the desired information through demodulation. The information produced by the receiver may be in the form of sound, moving images (television), or digital. A radio receiver may be a separate piece of electronic equipment, or an electronic circuit within another device. In technical colleges, the most familiar type of radio receiver is a broadcast radio receiver commonly called "radio", which reproduces sound transmitted by radio

broadcasting stations (Pizzi and Jones, 2014). However radio receivers are very widely used in other areas of modern technology, in television, cell phones, wireless modems and other components of communications, remote control, and wireless networking systems.

Electronics works is a skill oriented subject that requires adequate presence and use of instructional resources during teaching and learning processes. Aina (2000) opined that the adequate use of instructional resources in a technical college is the heart of craftsmanship training. This invariably means that instructional resources are very important in technical college training. The lack of adequate use of instructional resources will hinder the acquisition of sufficient practical skills which are the core objectives of the programme. Instructional resources are usually arranged to give occupational direction so that acceptable work habits and procedures are successfully executed. In electronics works, some of these instructional resources are circuit boards, rectifiers, power supplies, amplifiers, multivibrators, voltage stabilizers and radio receivers. Instructional resources are those educational apparatus that are curriculum oriented, audio-visuals, teaching and learning materials, and basic tools the teacher uses to assist learners in their learning process (Okujagu, 1992). They ensure that the learners see, hear, feel, recognize and appreciate learning, utilizing the five senses modalities at the same time. It is known that, no technical college programme can be functional without instructional resources being utilised during the classroom experience in order to inculcate technology skills for maximum national development (Idialu, 2007). However, with government crying daily for lack of funds to sponsor education generally and to provide instructional resources in particular, construction of electronic devices as instructional resources becomes inevitable. The fact remains that it is virtually impossible to acquire all the instructional resources required for sound and quality electronics works teaching in technical colleges. This makes it imperative for technical teachers to think of how best to make use of their manipulative skills; by constructing electronic devices as instructional resources in order to achieve their lesson objectives.

In electronics, construction of electronic devices refers to the interconnection of individual electronic components such as resistors, transistors, capacitors, inductors, diodes and integrated circuit; which are connected by conductive wires or traces through which electric current can flow to form a circuit. The combination of components and wires allows various simple and complex operations to be performed in the circuit,

hence becoming electronic devices. For instance, signals can be amplified, computations can be performed, and data can be moved from one place to another (Robinson, 2012). There are different ways of constructing electronic circuits depending on the tools available and how permanent a solution is required. When creating a new circuit it is common to first create a prototype using a breadboard or similar before the circuit is made permanent using solder. This allows any problems to be identified at an early stage where it is easier to change the design than removing soldered components. The final design is normally created onto something more permanent such as a printed circuit board, or strip-board. According to Kaplan and White (2003), constructed devices are important in teaching, and its use for the teaching of electronics subjects will help students to easily grasp basic rules and principles in electronics. However, the essence of construction of electronic devices in technical colleges is to enhance the teaching and learning processes by ensuring that the persistent problem of inadequacy of instructional resources will not seriously affect the academic achievement of students.

In electronics works, the onus of construction of electronic devices for a teaching and learning process lies on the shoulder of the teacher (Umah and Maaji, 2010). It is the teacher's responsibility to construct unavailable instructional resources that will best suit a teaching learning process. Similarly, Umar (2005) pointed out that, despite the inevitable need for the construction of electronic devices in technical colleges, the teachers' responsibility to construction is seriously lacking; this could lead to very poor students' academic achievement. According to Umar and Maaji (2010), lack of teachers' responsibility to the construction of electronic devices is becoming a persistent problem in the technical colleges. Apart from the problem of achievement in relation to construction, the issue of location of a school could have a significant effect on the academic achievement of students.

A location is a place of human settlement that could either be urban or rural area. Since there are human settlements in both urban and rural areas, schools are also located there. An urban area is a place of human settlement with high population density and good infrastructure, while a rural area is a place of human settlement with low population density and poor infrastructure. Nnachi (2008) stated that the location of a school (urban or rural) affects a child's ability to study and perform at the level expected of him/her. Jahun and Momor (2001) noted that a different aspect of school environment influences students' achievement. They stress that

the individual students' academic behaviour is influenced not only by the motivating forces of his home, scholastic ability and academic values, but also by the social pressure applied by the participant in the school setting. In Nigeria, rural based schools commonly lack good infrastructures which could serve as an inhibiting factor of a good academic performance. However, Umunadi (2009) stated that school location among other factors is not a necessary prediction in electronics works achievement. Similarly, Nnachi (2008) found school location to be a significant factor on student's difficulties in mathematics. Nnachi emphasises that students in rural areas have less difficulties in mathematics than their urban counterparts due to less distraction. However, Jahun (2001) reported that urban students performed better than their rural counterparts in Amhadu Bello University Mathematics Achievement Test (ABUMAT). The different opinions of several authors on location revealed differential performance between urban and rural students in virtually all subjects. The researcher therefore sees the need for a teaching technique that might improve the achievement of urban and rural students in electronics works.

In education, the academic performances of students in a test or examination are represented by a test score or grade that is usually called students achievement score or grade. According to Stumm, Hell and Chamorro-Premuzic (2011), academic performance is called achievement score because it shows more of the knowledge and skills gained by the student after being taught the course content upon which that examination is based. Bossaert, Doumen, Buyse and Verschuere (2011) stated that achievement score shows the degree of attainment of individuals in an academic task, course or programme in which they were sufficiently exposed to.

The problem of poor students' academic achievement is seen in their performances in various examinations and particularly the National Technical Certificate (NTC) and the National Business Certificate (NBC) examinations. From the chief examiners reports, electronics works have been recording high failure rates for many consecutive years. For instance, National Technical Certificate/National Business Certificate (NTC/NBC) examinations conducted by National Business and Technical Examinations Board (NABTEB) from May/June 2011-2013, recorded an average failure rate of 53 per cent in electronics works. Again from May/June 2014-2017, the NTC/NBC examinations conducted by NABTEB in electronics works recorded an average failure rate of 60 per cent.. These situations are quite disturbing and call for urgent attention in order to avoid total

depletion of students' enrolment in electronics trade in technical colleges.

Many reasons have been given for the poor state of electronics works. Some are of the opinion that teachers' incompetence is the factor, while others are of the opinion that teachers' use of conventional teaching technique is a major factor. Conventional teaching technique in this context refers to a talk-chalk method of teaching in which only the chalkboard is used for a teaching and learning process. It is a lecture method of teaching in which no constructed instructional resources was used during teaching and learning process in the absence of the real.

It is regrettable that many electronics works teachers prefer the use of the lecture method of teaching which is devoid of the use of instructional resources. Umah and Maaji, (2010) attributed teachers' preference for the use of the lecture method of teaching due to the persistent problem of inadequacy of instructional resources in the technical colleges workshops. Teachers have completely neglected the place of constructed electronic devices as a result oriented teaching technique in electronics works to a non result oriented teaching technique like lecture method of teaching. Hence, it is the view of the researcher that technical teachers' preference for the use of lecture method of teaching over result oriented one like the use of constructed electronic devices in teaching might be a major reason for students' poor academic achievement in electronics works. Therefore, the need arises to determine the effect of construction of a radio receiver on students' academic achievement in electronics works in technical colleges in Rivers State

Purpose of the Study

The main purpose of the study was to determine the effect of construction of a radio receiver on students' academic achievement in electronics works in technical colleges in Rivers State. Specifically the study sought to determine:

1. The mean achievement scores of the students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State.
2. The mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students when taught radio receiver using

constructed devices and those taught same topic using conventional method in technical colleges in Rivers State?

2. What are the mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State?

Hypotheses

The following null hypotheses (Ho) were tested at, 0.05 level of significance;

1. There is no significant difference in the mean achievement scores of students taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State.
2. There is no significant difference in the mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State.

II. METHODOLOGY

This study adopted a quasi-experimental research design. Specifically, the design is a pretest posttest non-equivalent control group quasi experimental group design. The population for the study consisted of 267 students. There are three technical colleges offering Electronics Works in Rivers State which are; Government Technical College Port Harcourt, Federal Science Technical College Ahoada and Government Technical College Tombia. The population for each college was as follows: Government Technical College Port Harcourt, 99 students; Federal Science Technical College Ahoada, 93 students and Government Technical College Tombia, 75 students. The sample for the study consisted of 112 students of Electronics Works, which represents 42% of the population. The sample was obtained using purposive sampling technique to select two technical colleges for the study considering location as a factor. There are two intact classes; the researcher randomly assigned these intact classes to experimental group (E) and control group (C) using balloting method. The experimental group had a sample size of 52 students, while the control group had 60 students.

The instrument used for data collection was the Radio Receiver Achievement Test (RRAT) which was constructed and developed by the researcher. It is a well-structured test from the content of Electronics Works in the NABTEB syllabus with five items for each selected sub-topic. The instrument contained a total of 30 items with

four-point multiple choice responses. The development of the instrument was based on a Table of Specification.

The instrument was subjected to face and content validation by three experts from technology and vocational education. Their observations were used to improve the instrument in content, grammar, spellings and language. The reliability indices of the instrument was determined by subjecting RRAT to internal consistency and stability using Kuder-Richardson 20 formula and Pearson's Product Moment correlation methods respectively. The average reliability coefficient for both was 0.67, which was considered adequate to be used for the study. The experiment took duration of six weeks.

A pretest was given to the students in each group a day before the teaching began using the Radio Receiver Achievement Test (RRAT). A

posttest was also administered on the sixth week during the revision of all taught sub-topics. The Research questions were answered using mean with standard deviation, while the Hypotheses were tested at 0.05 level of significance using one-way and two-way Analysis of Covariance (ANCOVA).

Presentation of Results

The analysis of data in relation to each of the research questions and hypotheses are presented as follows;

Research Question 1

What are the mean achievement scores of students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State?

Table 1: Mean Achievement Scores with Standard Deviations

Methods	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Constructed Devices	52	1.92	0.69	23.64	2.96	21.72
Lecture Method	60	2.40	0.81	18.59	1.95	16.19

Table 1 shows the mean achievement scores of the two methods of teaching. From Table 1, the pretest mean achievement scores for constructed devices and lecture methods are 1.92 and 2.40 respectively. Again from Table 1, the posttest mean achievement score for constructed devices (experimental group) was 23.64 with a standard deviation of 2.96 and the posttest mean achievement score for lecture method (control group) was 18.59 with a standard deviation of 1.95. This indicates that, the posttest mean achievement score for constructed devices was higher than the lecture method.

Similarly, the mean gains for constructed devices and lecture methods were obtained as 21.72 and 16.19 respectively. Indicating that constructed devices had a higher mean gain than the lecture method. It all implies that students taught with constructed devices achieved better than those taught with lecture method.

Research Question 2

What are the mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State?

Table 2: Mean Achievement Scores with Standard Deviations due to Methods and Location.

Methods	Urban (N=62)				Rural (N=50)				Urban MG	Rural MG
	Pretest		Posttest		Pretest		Posttest			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Constructed Devices	1.99	0.91	23.39	3.26	1.85	0.82	23.42	2.96	21.40	21.57
Lecture Method	2.64	0.96	16.55	4.00	2.16	0.88	18.74	3.33	13.91	16.58

Where MG = Mean Gain

Table 2 shows the mean achievement scores of the methods of teaching on location. From Table 2, the posttest mean achievement score of constructed devices (experimental group) for urban was 23.39 with a standard deviation of 3.26 while the rural posttest mean achievement score of constructed devices (experimental group) was 23.42 with a standard deviation of 2.96. The posttest mean achievement score of lecture method (control group) for urban was 16.55 with a standard deviation of 4.00 while the rural posttest mean achievement score of lecture method (control group) was 18.74 with a standard deviation of 3.33.

The mean achievement score of urban students taught with constructed devices was higher than those taught with lecture method. Similarly, the mean achievement score of rural students taught with constructed devices was higher than those taught with lecture method. This implies that the

urban students achieved better when taught with constructed devices than lecture method. The rural students achieved better when taught with constructed devices than lecture method. Again the mean gains of urban and rural students taught with constructed devices are 21.40 and 21.57 respectively, while the mean gain for urban and rural students taught with lecture method are 13.91 and 16.58 respectively. This also implies that rural students achieved better than urban students in each group.

Hypothesis I

There is no significant difference in the mean achievement scores of students taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State.

Table 3: One-way ANCOVA on Students' Achievement

Source	Type III Sum of squares	df	Mean Square	F	Sig.	Dec .
Corrected Model	30.984	6	5.164	28.065	0.000	
Intercept	3919.024	1	3919.024	21299.043	0.000	
Methods	11.764	2	63.826	346.880	0.000	S
Location	0.054	1	0.054	0.293	0.216	NS
Methods and Location	0.297	2	0.149	0.807	0.334	NS
Error	31.096	169	0.184			
Total	5070.000	172				
Corrected Total	83.332	173				

Where S = significant, NS = Not significant

Table 3 shows students achievement with respect to methods of teaching. For methods of teaching, the SPSS F – value of 346.880 was found significant at 0.000 level of significance, which is less than the 0.05 level of significance. Therefore, method of teaching is significant. The null hypothesis one is rejected. This means that there is significant difference in the mean achievement scores of students taught radio receiver using constructed devices and those taught same topic

using conventional method in technical colleges in Rivers State.

Hypothesis 2

There is no significant difference in the mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State.

Table 4: Two-way ANCOVA on Students' Achievement due to Methods of Teaching on Location

Source	Type III Sum of squares	df	Mean Square	F	Sig.	Dec.
Corrected Model	30.984	6	5.164	28.065	0.000	
Intercept	3919.024	1	3919.024	21299.043	0.000	
Methods	11.764	2	63.826	346.880	0.000	S
Location	0.054	1	0.054	0.293	0.216	NS
Methods and Location	0.297	2	0.149	0.807	0.334	NS
Error	31.096	169	0.184			
Total	5070.000	172				

Table 4 shows students achievement with respect to location. For location, the SPSS F – value of 0.293 was found significant at 0.216 level of significance, which is higher than the 0.05 level of significance set for the research. Hence, location is not significant. The null hypothesis two is not rejected. This means that there is no significant difference in the mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State. On interaction for hypothesis two (methods and location), the SPSS F – value of 0.807 was found significant at 0.334 level of significance which is higher than 0.05 level of significance set for this research. Hence, the null hypothesis two is not rejected. This means, there is no significant difference in the mean achievement scores of urban and rural students when taught radio receiver using constructed devices and those taught same topic using conventional method in technical colleges in Rivers State. It implies that location was not found significant with respect to achievement.

III. DISCUSSION OF FINDINGS

The study revealed in Research Question 1 that students taught with constructed devices (experimental group) had a higher mean achievement score in electronics works compared to those taught with lecture method (control group). This is further confirmed in Hypothesis 1 by high achievement which indicated that method of teaching was a significant factor in the achievement of students in electronics works. This means that the students who were taught using constructed devices performed better. The reason for the better performance by constructed devices may be that the students were able to link the new concepts to relevant instructional resources that were constructed. Thus, the result of the study revealed that the adoption of relevant concepts of constructed devices enhances meaningful academic achievement of electronics subjects. This study is supported by Kaplan and White (2003) view that the use of constructed devices for the teaching of electronics subjects will help students to easily grasp basic rules and principles in electronics.

The study findings also revealed that in Research Question 2, urban and rural students taught with constructed devices achieved better than their counterparts taught with lecture method in electronics works. However, testing for significance, the results in Hypothesis 2 reveals that the difference in mean achievement of urban and rural student is not significant, which revealed that both

urban and rural students achieved well despite their location. This result is in agreement with Umunadi (2009) who stated that school location among other factors is not a necessary prediction in electronics works achievement. This result is at variance with the findings of Jahun (2001) which revealed that urban students achieved significantly higher than their rural counterparts in mathematics. However, this study showed that achievement in electronics works does not depend on location rather it depends on the method of teaching.

IV. CONCLUSION

The study was carried out keenly and the results provided the empirical evidence that constructed devices method of teaching enhanced students' academic achievement more than the conventional method in electronics works. This implies that for an effective teaching that will bring about a better academic achievement of students in electronics works, constructed devices should be used in the absence of the required instructional resources. This finding is irrespective of where the technical colleges are located; rather it is depended on the method of teaching.

V. RECOMMENDATIONS

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

1. Since the use constructed devices method of teaching has been found to be effective in a better academic achievement of students in electronics works; teachers in electronics works should be encouraged seriously in the construction of electronic devices.
2. Proper and regular seminars on electronic devices construction should be carried out for teachers in electronics works in order to create more awareness on the subject of construction.
3. Technical colleges' administrators and their sponsors should ensure that teachers are supported with whatever they need in carrying out electronics devices construction.

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