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Research paper

Causes of Students' Poor Electronic Circuit Analysis Skill in the Polytechnics in Rivers State

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Abstract: Circuit analysis is a crucial aspect of electronics engineering that involves the study and analysis of various electrical quantities in different electronic components. This process enables engineers to determine the unknown elements of a circuit, such as voltage, current, resistance, impedance, power, among others, across its components. However, a recent study has shown that students in polytechnics in Rivers State are struggling with electronics circuit analysis. To investigate the causes of this problem, a descriptive survey design was adopted for the study. The population for the study comprised of 200 final year students and 40 lecturers from the 3 government polytechnics offering circuit analysis/related courses in Rivers State. A sample size of 80 students and 19 lecturers was obtained using a simple random sampling technique, which gave a total of 99 participants. The researchers developed an instrument to measure the knowledge of electrical/electronic technology among students in polytechnics in Rivers State. The instrument was validated by three experts from Ignatius Ajuru University of Education. The questionnaire items had a 4-point rating scale format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). A test re-test method was used to test the reliability of the instrument, and a coefficient of 0.75 was obtained. The study utilized a 7-item questionnaire for both lecturers and students as instruments for data collection. The results revealed that the major causes of poor electronics circuit analysis among students were inadequate knowledge of circuit theory, lack of practical experience, poor understanding of mathematical concepts, and inadequate laboratory facilities. The study found that poor knowledge of schematic diagram technique and fundamental theorems and laws technique were the main causes of students' poor electronic circuit analysis skills in the polytechnics in Rivers State. The data collected were analyzed descriptively using mean and standard deviation to answer the research questions. On the other hand, lecturers attributed the problem to inadequate teaching materials, lack of qualified instructors, inadequate funding for research, and poor curriculum design. The study recommended that polytechnics in Rivers State should provide more practical training opportunities for students, improve laboratory facilities, and employ qualified instructors who are knowledgeable in circuit analysis. Based on the findings, the study recommends that polytechnic governing councils and management in Rivers State should ensure that candidates for electrical/electronic technology programs are well-grounded in mathematical calculations before admission is offered to them. This will help to improve the knowledge and skills of students in electronic circuit analysis.

Keywords: Causes, poor, electronic, circuit, analysis, Polytechnics, Rivers State

INTRODUCTION

Prior to the arrival of the British, there were two major types of education in Nigeria: Islamic education, which taught children the Quran and the Arabic alphabet, and indigenous education, which taught children the practical skills needed to function successfully in traditional society. These two-education programmes provided the pupils with knowledge that was appropriate for the intended society (Ifeoma et al., 2013). However, at the arrival of the British, western education was introduced into Nigeria by the British missionaries in the 1840s. Different church denominations like the Anglicans, Methodists, Baptists etc. began and operated several primary and secondary schools in the mid-1800s.

The colonial government gave the churches financial aid, but in the early twentieth century the government began building primary and secondary schools. By the time of the amalgamation of the northern and southern regions of Nigeria into one colony in 1914 by the British government, there were 91 missionary and 59 government primary schools (IQAS, 2016). A total of 11 secondary schools virtually operated by the missionaries were in existence. Nigeria education has made considerable progress over the years, which has resulted in a healthy literacy rate. Today, this progress has culminated in the establishment of several tertiary institutions like the universities, polytechnics and colleges of Education (Chinyere and Chidinma, 2016). The first tertiary institution in Nigeria was a polytechnic popularly known as Yaba College of Technology (Yaba Tech) in 1934. The name Yaba Tech which most people still call today was adopted in 1963. The institution was given its present name Federal Polytechnic Yaba in the year 1976; but the name Yaba Tech remains more popular. In the year 1948 when the first university in Nigeria (University of Ibadan) was established, the first set of students were transferred from Yaba Tech to the University. Indeed, Yaba Tech was not just the first polytechnic in Nigeria, but one of the best polytechnics (Sood, 2008).

In Nigeria, a polytechnic is a tertiary institution that was established to focus on applied technology. It is designed to blend theory and practice in order to solve real-life problems for the benefit of the society. It can be defined as an institution that focuses on the demonstration of applied knowledge through practical skills that solve societal problems (Mercer and Ponticell, 2012). Fundamentally, polytechnics are regarded as technological institutions that produce technological manpower for technological development of a nation. The aim of establishing polytechnics in Nigeria was to train technologists, technicians and management skills in courses leading to the award of certificates in National Diploma (ND) and Higher National Diploma (HND), which are relevant to the needs and development of the Nigerian socio-economic life. Polytechnic training emphasizes on personal development in the areas of critical thinking, analytical skill and practical abilities. This type of training is vital to the technological development and advancement of any country (Ebele, 2014). Practical trainings carried out in the polytechnics have applications in the industry. Polytechnic training provides students with practical experiences, skills and knowledge that fit into the industry. This is because they are equipped with hands on skills that are needed to solve societal problems, hence making their graduates highly marketable. They are also equipped with skills necessary for self-employment, thus contributing to the economic growth and development of the country (Innocent, 2013). There are several fields of study that students in the polytechnics are trained for. One of such fields is electrical/electronic engineering or technology.

Electrical/electronic engineering or technology is a field of study that implements and applies the principles and behaviour of electrons to develop devices, machines and equipment. It deals with the design, application, installation, manufacturing, operation and or maintenance of electrical/electronic systems. Electronic technology is a branch of electrical/electronic engineering or technology that specializes on the application, theory, applied design, implementation of the properties of electrons flowing through a circuit (Robinson, 2018). It has to do with the use of some components like transistor, capacitor, resistor and diode to develop what is referred to as electronic circuit. An electronic circuit is the interconnection of electronic components such as resistors, transistors, capacitors, inductors and diodes by conductive wires or traces through which electric current can flow. The combination of components and wires allows various simple and complex operations to be carried out such as: flow of signals, movement of data and analysis of quantities. One key area in electronic technology where students' skills are fundamentally required in building electronic systems for the development of any society is in circuit analysis (Robinson, 2017).

The idea of circuit analysis is derived from electrical engineering or technological ideas. The primary principle behind it is that you should know whether the components you choose can withstand the voltages and currents they will be exposed to before you design a circuit. These entail various mathematical operations that are typically employed to make the circuit simpler. Finding the voltages and currents in each component of an electronic circuit is another name for the process of conducting a circuit analysis (Robinson, 2018). It is the mathematical analysis of any electrical circuit, to put it briefly. Hence, the computations of unknowable circuit components like voltage or current.

This can imply that the purpose of circuit analysis is to solve problems in electric circuits using an established set of equations, emanating from some confirmed theories and laws. Two popular methods for circuit analyses are the node voltage method and mesh current method. Our modern world relies so much on advancing technologies built around electronic technology. Circuit analysis is one of the key aspects of understanding how these technologies work. Again, its process encompasses studying various electrical quantities in the different components of the circuit. Circuit analysis is a skill; however performing well in it requires the acquisition of some techniques which are expected to be applied when solving problems in it (Amadike and Agwi, 2016). Skill is the ability to use one's knowledge effectively and readily in execution or performance.

They are character attributes that bring out an

individual's dexterity in a specific field of study (Bhasin, 2019). Skills assist a student in developing his professional personality, which reflects in his capacity to perform work with maximum responsibility and excellence. Skills are like the frosting on the cake in that they are necessary, but there is a need to apply specific strategies that will improve circuit analysis skills (Aderoba and Okala, 2000).

Thus, according to the researchers, two techniques that can aid students in developing their dexterity in circuit analysis are the schematic diagram technique (also known as circuit drawing/diagram) and the technique of fundamental theorems and laws of circuits (also known as the mathematical analysis of circuits).

For students to perform very well in circuit analysis, they must be armed with the technique of drawing schematic diagram of circuits. A schematic diagram is a fundamental two-dimensional circuit representation showing the functionality and interconnection of different electronic components. It is important for a PCB designer to get familiarized with the schematic symbols that represent the components on a schematic diagram. Knowing what the circuit looks like on paper will make it a lot easier for students to calculate and record certain values at certain points around the circuit. The best way to do this is to draw a circuit diagram by indicating every component inside. Once the schematic diagram of the circuit has been achieved, there would be need to simplify all the resistors down into one resistor. It means, any resistor whether in series or parallel, should be placed into the value of a single resistor in series with the rest of the circuit. Most times, they have to be properly drawn before building the physical circuit itself. Sloan, (2010) opined that the main goal of schematic diagram technique is not only for students to acquire information on several circuit components, but also to develop their capacity of deciding which of the known components is more appropriate for a given circuit analysis skill. Similarly, there is need for students to also be armed with the technique of fundamental theorems and laws of the circuits. The fundamental here simply means, ideal circuits of varying resistances, currents and voltages. This technique is invariably the mathematical analysis of the electronic circuit. It is the process of studying and analyzing electrical quantities through calculations. By this analysis, we can find the unknown elements of a circuit such as voltage, current, resistance, impedance, power, among others, across its component. When doing circuit analysis, we need to understand the electrical quantities, relationships, theorems, and some essential laws. This implies that there are a few theorems and laws to keep in mind, ranging from the simple Ohm's law to the complex differential equation. Similarly, Robinson (2017) opined that a good knowledge of this technique, is the most extremely efficient and elegant ways to streamline circuit analysis. Besides, it will develop and broaden the horizon of the students critical thinking, as well as create vision for them to promote skills and business potentialities. Unfortunately, students of polytechnics in Rivers State are experiencing poor electronic circuit analysis skill. This was seen in their inability to interpret and resolve problems of circuit properties and quantities in employment test of companies, after graduation. Reports from some Human Resources (HR) departments of some companies located in Rivers State, expressed their disappointment over the huge failure rate of polytechnic graduates on employment test of companies. The tests results show that the failure rate was centered more on topics in circuit analysis. Finding the causes of this failure is the essence of this paper.

Statement of the problem

Our modern world relies so much on advancing technologies built around electronic technology. But circuit analysis is one of the key secrets in electronic technology that is behind this technological advancement (Mercer and Ponticell, 2012). Circuit analysis is studied at the tertiary education level like the polytechnics, but it was reported that most graduates of the polytechnics in Rivers State are yet to be armed with the skill. This implies that, students of polytechnics in Rivers State have poor electronic circuit analysis skill. This was seen in their inability to interpret and resolve problems of circuit properties and quantities in employment test of companies, after graduation. This huge failure has affected the employment rate of polytechnics graduates, and if not properly checked, can cause a decline in the enrollment of candidates in the electrical/electronic programmes of polytechnics. Now the question is: what are the causes of students' poor electronic circuit analysis skill in the polytechnics in Rivers State. The answer to this question is the essence of this paper.

Purpose of the study

The main purpose of the study is to investigate the causes of students' poor electronic circuit analysis skill in the polytechnics in Rivers State. Specifically, the study sought to:

1. determine the level to which poor schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State.
2. determine the level to which poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State.

Research questions

The following research questions were postulated to guide the study:

1. to what level does poor schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State?
2. to what level does poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State?

METHODOLOGY

The study employed descriptive survey research design. The population for the study comprised of 200 final year students and 40 lecturers from the 3 government polytechnics offering circuit analysis/related courses in Rivers State, which are; Ken Sarowiwa Polytechnic Bori, Federal Polytechnic of Oil and Gas Bonny and Elechi-Amadi Polytechnic, Port Harcourt. The population comprised of 80 students and 18 lecturers for Ken Sarowiwa Polytechnic Bori, 60 students and 11 lecturers for Federal Polytechnic of Oil and Gas Bonny, and 60 students and 11 lecturers for Elechi-Amadi Polytechnic, Port Harcourt. These made a total population of 240 persons. A simple random sampling technique was used to obtain a sample size of 99 persons which comprised of 80 students and 19 lecturers. A 7-item questionnaire each for lecturers and students was used as instrument for the study. The instrument was developed by the researchers and was validated by 3 experts in electrical/electronic technology lecturers of Ignatius Ajuru University of Education. Each questionnaire item was followed by a single response category based on a 4-point rating scale format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Strongly Agree (SA) has a rating scale of (4), Agree (3), Disagree (2) and Strongly Disagree (1). A test re-test method was adapted to test the reliability of the instrument and a coefficient of 0.75 was obtained. The data collected were analyzed descriptively using mean and standard deviation to answer the research questions, with a standard mean value of 2.00 as the bench mark for decision making. The mean value was accepted when it was 2.00 and above, but reject when it was below.

RESULTS

Research Question 1: To what level does poor schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State?

Table 1 above shows the mean responses of lecturers and students on the level to which poor schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. From the items in table 1, apart from items 6 and 7 which are Strongly Agree (SA), all the rest items for lecturers indicated a mean response of Agree (A). The average mean response of the lecturers from the items was found to be 3.01 with a standard deviation of 0.93; which indicated a response of Strongly Agree (SA). Similarly, with respect to the mean response of students from the above table; apart from item 2 which is Strongly Agree (SA), all the rest items indicated a mean response of Agree (A). The average mean response of the students was found to be 2.76 with a standard deviation of 0.93; which also indicated a response of Agree (A). The standard deviation for lecturers and students were respectively seen as 0.93 and 0.93, which showed homogeneity of the respondents. The whole indication is that the responses of both lecturers and students revealed at least a Agree (A) on the level to which poor schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State.

Research Question 2: To what level does poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State?

Table 2 above shows the mean responses of lecturers and students on the level to which poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. Considering lecturers response from table 2; item 3 indicated a Disagree (A), items 2 and 7 indicated a Strongly Agree (SA), while the rest items indicated a mean response of Agree (A). The average mean response of the lecturers from the items was found to be 3.18 with a standard deviation of 0.89; which indicated a Strongly Agree (SA). With respect to the mean response of students from the above table; apart from item 2 which indicated a Strongly Agree (SA), the rest items indicated a mean response of Agree (A). The average mean response of the students was found to be 2.81 with a standard deviation of 1.09; which also revealed a response of Agree (A). The standard deviation for lecturers and students were respectively seen as 0.89 and 1.09, which showed homogeneity of the respondents. The whole indication is that, the responses of both lecturers and students indicated at least a Agree (A) on the level to which poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State.

DISCUSSION

From the finding in Research Question 1, lecturers and students responses revealed a Strongly Agree (SA) and Agree (A) respectively on the level to which poor

Table 1: Mean and Standard Deviation on which poor schematic drawing technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State.

		Lecturers			Students		
S/N	**Items**	$\bar{X}$	**SD**	**DEC.**	$\bar{X}$	**SD**	**DEC.**
1	Students with poor knowledge of components functions, cannot use schematic diagram technique to analyze circuits.	2.96	1.03	A	2.80	1.07	A
2	Students with poor knowledge of interconnection of components, cannot use schematic diagram technique to analyze circuits.	2.75	0.90	A	3.04	0.89	SA
3	Students with poor knowledge of circuit symbols, cannot use schematic diagram technique to analyze circuits.	2.81	1.06	A	2.70	1.06	A
4	Students with poor knowledge of circuit polarity, cannot use schematic diagram technique to analyze circuits.	2.95	1.02	A	2.75	0.45	A
5	Students with poor knowledge of current direction, cannot use schematic diagram technique to analyze circuits.	2.67	1.12	A	2.98	1.04	A
6	Students with poor knowledge of potential difference, cannot use schematic diagram technique to analyze circuits.	3.89	0.32	SA	2.40	1.08	A
7	Students with poor knowledge of supply voltage, cannot use schematic diagram technique to analyze circuits.	3.01	1.07	SA	2.68	0.95	A
	Average Scores	3.01	0.93	SA	2.76	0.93	A

Table 2: Mean and Standard Deviation on which poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State.

		Lecturers			Students		
S/N	**Items**	$\bar{X}$	**SD**	**DEC.**	$\bar{X}$	**SD**	**DEC.**
1	Students with poor knowledge in Ohn's law, cannot use mathematical analysis technique to analyze circuits.	2.95	0.95	A	2.91	0.98	A
2	Students with poor knowledge in Kirchoff's current law, cannot use mathematical analysis technique to analyze circuits.	3.11	0.89	SA	3.11	0.92	SA
3	Students with poor knowledge in Kirchoff's voltage law, cannot use mathematical analysis technique to analyze circuits.	1.90	0.90	D	2.83	1.12	A
4	Students with poor knowledge in Thevenin's law, cannot use mathematical analysis technique to analyze circuits.	2.86	1.08	A	2.94	1.09	A
5	Students with poor knowledge in Norton's law, cannot use mathematical analysis technique to analyze circuits.	2.96	0.10	A	2.37	1.30	A
6	Students with poor knowledge in simple algebra, cannot use mathematical analysis technique to analyze circuits.	2.15	1.34	A	2.81	1.08	A
7	Students with poor knowledge in simple arithmetic, cannot use mathematical analysis technique to analyze circuits.	3.15	0.98	SA	2.73	1.13	A
	Average Scores	3.18	0.89	SA	2.81	1.09	A

schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. This means that, both lecturers and students are of the opinion that, there is a high level to which poor schematic diagram technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. In other words, the finding revealed that there is poor schematic diagram technique knowledge in the polytechnics; and this poor state is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. This finding is in agreement with Sloan (2010) opinion that the main goal of schematic diagram technique is not only for students to acquire information on several circuit components, but also to develop their capacity of deciding which of the known components is more appropriate for a given circuit analysis skill.

Similarly, from the finding in Research Question 2, lecturers and students responses revealed a Strongly Agree (SA) and a Agree (A) respectively on the level to which poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. This means that, both lecturers and students are of the opinion that, there is a high level to which poor fundamental theorems and laws technique is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. In other words, the finding revealed that there is a poor fundamental theorem and laws technique knowledge in the polytechnics; and this poor state is a cause to students' poor electronic circuit analysis skill in the polytechnics in Rivers State. This finding is in agreement with Robinson (2017) opinion that a good knowledge of fundamental theorems and laws technique, is the most extremely efficient and elegant ways to streamline circuit analysis. Besides, it will develop and broaden the horizon of the students critical thinking, as well as create vision for them to promote skills and business potentialities.

Conclusion

The Study sought to investigate the causes of students' poor electronic circuit analysis skill in the polytechnics in Rivers State. It has been observed that, there is students' poor electronic circuit analysis skill in the polytechnics in Rivers State. This poor state has affected the employment rate of polytechnics graduates, and might affect fresh candidates' enrollment in the polytechnics. However, it has been revealed from the study that poor knowledge of schematic diagram and fundamental theorems and laws techniques are the causes of students' poor electronic circuit analysis skill in the polytechnics in Rivers State. This implies that, an eradication of these poor knowledge will definitely enhance students' electronic circuit analysis skill in the polytechnics in Rivers State.

Recommendations

Based on the findings, the following recommendations were made:

1. Lecturers and the administration should ensure that, students learnings on circuit analysis are properly re-enforced by giving better attention and adding pre-requisite topics on schematic diagrams that will enhance learning
2. Subsequently, polytechnic governing councils and management in Rivers State should ensure that candidates for electrical/electronic technology programme are well grounded in mathematical calculations before admission is offered to them.
3. The curriculum planners of electronic technology programme, should constantly collaborate with employers of labour to develop course content on circuit analysis.

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