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The Influence of Nanoelectronics in the Teaching and Learning of Electronics Works In Technical Colleges in Rivers State

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ABSTRACT
Nanoelectronics has significant promise for expanding the abilities of electronics components while reducing their sizes, weight and power requirements. It is said to be the next future of electronics. Hence, this study is on the influence of nanoelectronics in the teaching and learning of Electronics Works in technical colleges in Rivers State. The study adopted a survey research design. The population comprised of 40 teachers and 140 students of Electronics Works in the four Government Technical Colleges in Rivers State of Nigeria. The entire population of 180 respondents was used as the sample size for the study. Two research questions in line with the objective of the study were formulated, while two hypotheses were tested at 0.05 level of significance. A 10 item questionnaire was constructed to collect data for the study. The instrument was validated by three experts in Industrial Technology Education and Measurement and Evaluation. Cronbach's Alpha reliability coefficient was used to ascertain the stability of the instrument which was obtained as 0.87. The mean and z-test statistical analysis were used for the research questions and hypotheses respectively. The findings of the study revealed that nanoelectronics influences the teaching and learning of Electronics Works in technical colleges in Rivers State. Based on the findings, it was recommended among others that the concept and use of nanoelectronics in technical colleges should be employed in the teaching and learning of Electronics Works in technical colleges in Rivers State.
KEYWORDS: Influence, Nanoelectronics, Teaching, Learning, Electronics components, Electronics works, Technical, Colleges.

I. INTRODUCTION

The word electronics was derived from the term electron, which was as a result of studying the behavior of electrons under different conditions of applied electric field. Electron is one of the smallest particles of an atom. Electronics is the branch of engineering or technology that deals with the study of flow and control of electrons and its behavior (Lojek, 2007). This control of electrons is accomplished by some components that resist, carry, select, steer, switch, store, manipulate, and exploit the electron. The electrons flow in one direction only. The device which controls the flow of electrons is called electronic components or devices. These components are the main building blocks of electronic circuits. The key to an electronic circuit is not just the components it contains, but the way they are arranged in circuits. The circuit allows each component of the circuit to interact, and be connected. Analog electronic appliances tend to have far simpler circuits than digital ones. A basic transistor radio might have a few dozen different components and a circuit board probably no bigger than the cover of a paperback book. But in something like a computer which uses digital technology, circuits are much more dense and complex and include hundreds, thousands, or even millions of separate pathways. Generally speaking, the more complex the circuit, the more intricate the operations it can perform.

The flow of electrons through a conductor gives us electric current. This electric current can be produced with the help of batteries and generators (energy source). The heart of electronics is centered on the control of electric current through a process that can yield a useful result; by powering an external source (output device) like lamp, sound, heat etc.

Electronic circuits have the capability to store (memory), analyze and retrieve information. These capabilities of electronic circuits require knowledge of basic electronic components and courses. This is in order to familiarize with commonly used active and passive electronic components like resistors, capacitors, inductors, transformers, diodes, transistors and electronic hardware like switches, relays, connectors and cables. Students are taught basic building blocks of electronic circuits using sensors, 555 timers, op-amp and other commonly used circuits in making projects (Bose, 1996). They also learn soldering and use of test equipments in fault finding. Electronics have various branches which any individual can specialize on. These branches are; solid state electronics, telecommunication, analogue electronics, digital electronics, embedded systems, power electronics, signal processing, robotics, microelectronics, optoelectronics, integrated circuit and nanoelectronics.

Nanoelectronics is based on the application of nanotechnology in the field of electronics and electronic components. Nanotechnology is the science, engineering, and technology that is concerned with the building of extremely small things like materials and devices on the scale of atoms and molecules (nanoscale), which is about 1 to 100 nanometers. In a nutshell, nanotechnology is the study and application of extremely small things that can be used in the sciences and engineering. It is difficult to imagine how small the working of nanotechnology is. One nanometer is a billionth of a meter, or 10^{-9} of a meter. Comparatively, a sheet of newspaper is about 100,000 nanometers thick, or the diameter of a human hair is on an average of 80,000 nanometres (Pandey, Rawtani and Agrawal, 2015). Nanotechnology involves the ability to see and to control individual atoms and molecules which can only be seen by a nanoscaled microscope. The essence is to enhance properties like much smaller in size but possessing higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger sized counterparts (Brahic and Shanahan, 2005). Nanotechnology has the potential to increase the efficiency of energy consumption, help clean the environment, solve major health problems and massively increase manufacturing production at significantly reduced costs. Products of nanotechnology will be smaller, cheaper, lighter yet more functional and require less energy and fewer raw materials to manufacture. It is this evolving field of study called nanotechnology that gave rise to nanoelectronics. Hence, nanoelectronics refer to the use of nanotechnology in electronic components (Pandey, Rawtani and Agrawal, 2015). Nanoelectronics can be defined as the application of the science and principle of nanotechnology to build extremely small electronics components that can be used in the field of electronics. The term covers the building of diverse sets of electronics components and materials, with the mind set of miniaturizing electronic systems. According to Jensen, Weldon, Garcia and Zettl (2007), this concept and study of miniaturization of electronics components or devices using nanoelectronics is so fascinating that the interest of both teachers and learners are easily developed generally in the field of electronics at schools. This fascinating concept has attracted concentrated research attention on inter-atomic interactions and quantum mechanical properties in electronics.

Although the term Nanoelectronics may generally refer to all the electronic components, however special attention is given to transistors. Transistors have a size lesser than 100 nanometres. Their small size attracted scientist attention of knowing its quantum mechanical properties and inter-atomic design. As a result, though the transistors appear in the nanometre range, they are designed through nanotechnology. Their design is also very much different from the traditional transistors and they usually fall in the category of one-dimensional nanotubes/nanowires, hybrid molecular electronics, or advanced molecular electronics (Pasa, 2010). Pasa opined further that in nanoelectronics, the transistors are packed as arrays on to a single chip. Thus they remain in a uniform manner and symmetrical in nature. Thus they are known to have a more speedy movement of electrons in the material. The dielectric constant of the device also increases and the electron or hole characteristics also become symmetrical in nature. Nanoelectronics is said to be the next future of electronics. It holds significant promise for expanding the abilities of electronics devices while reducing their size, weight and power requirements. Display screens can be improved by cutting power requirements while lowering the weight and density of displays. Scientists are also working on a kind of nanoscale memory chip capable of holding one terabyte of data per square inch or more.

Nanoelectronics includes a broad group of technology and materials with unique qualities so minute that atomic-scale interactions and quantum mechanical qualities play a considerable role in their functionality. At the nanoscale, different forces have more influence than those that dominate at the macro-scale. For instance, quantum tunneling and atomistic disorder are essential concerns for those working with nanoelectronics. Scientists are making frantic efforts in more extreme approaches to advancing technology, including approaches related to nanoscale. According to Walder, (2007) the conventional computers with a big processor will soon be replaced with nanocomputers with nanoprocessors that will have higher performance and speed than the conventional computers. This will bring about extreme processor speed in the development of electronics

systems. This kind of nanoelectronics concept might create curiosity to both the trainer and the trainee in the study of electronic technology (Waldner, 2007). Researchers are performing various experiments on by using nanolithographic methods to design better nanoprocessors. Experiments are also taking place by replacing the CMOS components in conventional processors with nanowires. The FET's in the computers are replaced by carbon nanotubes. Other devices using nanoelectronics technology also includes solar cells that are highly efficient and cheaper than the conventional ones. If such efficient solar energy can be created, it would be a revolution to the global energy needs. The ongoing shrinking of electronics is indeed essential to further boost processor speed and lower manufacturing cost per bit; however, as the proportions of vital electronics get closer to atomic size, quantum tunneling and other effects become increasingly challenging, there is the believe that nanoelectronics appear very promising. Indeed, nanoelectronics holds the promise of making computer processors more powerful than are possible with conventional semiconductor fabrication techniques. However, many institutions of learning in most developing nations like Nigeria are yet to be awakened by this innovative technology. One of such institutions is the Technical College.

Technical College is an education institution that prepares students for a career in a specific field. Students are taught skills that are relevant to their vocational area only. Onoh (2020) posited that technical colleges are designed to prepare individuals to acquire practical skills, basic scientific knowledge and attitude required by craftsmen and technicians at sub-professional levels. Technical colleges give full vocational training to students for entry into specific engineering trade 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 involves 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. According to 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, devices which are used in electronics systems, control the flow of electrons which emanates from atom.

Electronic devices and circuits is one of the branch subjects offered in electronics works. Electronic devices and circuits involve the design and interconnection of electronic components, such as resistors, transistors, capacitors, inductors and diodes, connected by conductive wires or traces through which electrons can flow. The combination of components and wires allows various simple and complex operations to be performed: signals can be amplified, computations can be performed and data can be moved from one place to another (Roy and Rashid, (2012). Electronics works can appear complex and difficult for students to learn if not properly taught. A proper teaching and learning of the fundamentals of devices and circuits in technical college enhances the performances of students in electronics works. Proper teaching and learning encompasses the curiosity and motivation of both teachers and learners.

Learning is the act or process of acquiring new, modifying or reinforcing existing knowledge, skills, values and preferences (Okonkwo, 2018). It is also the relatively enduring permanent change in behaviour of the learners which occurs as a result of practice, training or experience. For learning to be effective there must be effective teaching. Teaching according to Njoku and Ogundu (2018) is an intentional activity in form of inter-personal influence aimed at changing the behaviour of another person in the desired direction. Teaching and learning is a process that includes many variables. These variables interact as learners work toward their goals and incorporate new knowledge, behaviours, and skills that add to their range of learning experiences. According to Okonkwo (2018), teaching and learning is combined processes where an educator assesses learning needs, establishes specific learning objectives, develops teaching and learning strategies, implements plan of work and evaluates the outcomes of the instruction. According to Akinfolarin, Ajayi and Oloruntegbe (2012), poor teaching and learning outcome can be measured from students' performance in examinations. Hence, a good teaching and learning outcome will bring about a good performance in examination.

However, it has been observed that there has been poor teaching and learning outcome in electronics works in the technical colleges. This is due to poor curiosity and motivation of teachers and students on teaching and learning respectively, which in turn has brought about poor performances of students in various examinations. Federal Ministry of Education (FME, 2010) reported that there was a decline in students' performance in electronics works due to poor teaching and learning outcome. This is a worrisome situation. According to Akinfolarin, Ajayi and Oloruntegbe (2012), poor teaching and learning outcome is as a result of poor teachers and learners' curiosity and motivation to a subject matter. However, Pandey, Rawtani and Agrawal (2015) opined that in subjects like electronic works, the intermittent introduction of efficient innovative concept like nanoelectronics in the teaching and learning will bring about better curiosity and motivation of teachers and students. This is the premise of this study. The study intends to find out the influence of nanoelectronics in the teaching and learning of electronics works in technical colleges in Rivers State. Influence in this context refers to positive curiosity and motivation to teaching and learning. Pandey, Rawtani and Agrawal (2015) opined further that the introduction of innovative concept like nanoelectronics intermittently in

a teaching and learning process might arouse teachers and students' curiosity and motivation in electronics works, even when topics are complex. This idea will help future technicians how to apply innovative concepts to teaching and learning in electronics. In essence, having students apply innovative concept in electronics devices, assures meaningful learning.

Statement of Problem

Teaching and learning is an interaction between teachers and students. It is multi-faceted phenomena in which teachers try to transmit knowledge and contents to students according to their age, capabilities, skills and living conditions. Teaching and learning process is a transformation process of knowledge from teachers to students. In all, a good teaching and learning outcome that will reflect a good examination performance is expected. However, it has been observed that there has been poor teaching and learning outcome in electronics works in the technical colleges of Rivers State. This is due to poor curiosity and motivation of teachers and students on teaching and learning respectively, which in turn has brought about poor performances of students in various examinations, particularly the National Business and Technical Education Board (NABTEB) examination. Federal Ministry of Education (FME, 2010) reported that there was a decline in students' performance in electronics works due to poor curiosity and motivation of teachers and students on the teaching and learning of electronics works. As a result, FME stressed that teaching and learning outcome in electronics works in technical colleges has been dwindling in recent time, and the situation calls for immediate attention in the institutions. The situation calls for urgent attention in order to avoid a fast depletion of students' enrolment in electronics craft trade in technical colleges, especially in Rivers State. According to Pandey, Rawtani and Agrawal (2015), in subjects like electronic works, the intermittent introduction of efficient innovative concept like nanoelectronics in the teaching and learning process is a key factor to better curiosity and motivation of teachers and students. This is the premise of this study. The study intends to find out the influence of nanoelectronics in the teaching and learning of electronics works in technical colleges in Rivers State. The researchers believed that the introduction of innovative concept like nanoelectronics intermittently in a teaching and learning process arouses teachers and students' curiosity and motivation to electronics works.

Purpose of the Study

The main purpose of the study was to determine the influence of nanoelectronics in the teaching and learning of electronics works in technical colleges in Rivers State. Specifically the study sought to;

1. ascertain the influence of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.
2. ascertain the influence of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

Research Questions

The following research questions guided the study:

1. To what extent does the concept of miniaturization of electronic devices influence the teaching and learning of Electronics Works in technical colleges in Rivers State?
2. To what extent does the concept of extreme processor speed of electronic devices influence the teaching and learning of Electronics Works 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 between the mean responses of teachers and students on the influence of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.
2. There is no significant difference between the mean responses of teachers and students on the influence of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

II. METHODOLOGY

The design adopted for the study was the descriptive survey. The study was carried out in the Technical Colleges of Rivers State, located in Nigeria. The population comprised of 40 teachers and 140 students of Electronics Works in the four Government Technical Colleges (GTC) of Rivers State. The entire population of 180 respondents was used for the study. Hence, no sampling was carried out since the population size was manageable.

A 10-item questionnaire each for teachers and students was used as instrument for the study, which was developed by the researchers. The instrument was face and content validated by three experts; one from the

department of Measurement and Evaluation, while two are from the department of Industrial Technology Education, all of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. The comments from the validations guided the modification of the final instrument. Each questionnaire item was followed by a single response category based on a 3-point rating scale format of High Extent (HE), Moderate Extent (ME) and Low Extent (LE). High Extent has a rating of (3.51-5.0), Moderate Extent (2.51-3.5) and Low Extent (1.0-2.5). Cronbach's Alpha method was adapted to test the reliability of the instrument and a coefficient of 0.87 was obtained indicating that the instrument was reliable for the study. The mean and z-test statistical analysis were used for the research questions and hypotheses respectively. The null hypothesis is rejected if the z-calculated exceeds the z-table; otherwise, the null hypothesis is not rejected.

Presentation of Results

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

Research Question 1: To what extent does the concept of miniaturization of electronic devices influence the teaching and learning of Electronics Works in technical colleges in Rivers State?

Table 1: Teachers and students responses on the influence of miniaturization of electronic devices

S/N	Items	Teachers N=40			Students N=140		
		Mean (X)	**Std. Dev. (SD)**	**Dec.**	**Mean (X)**	**Std. Dev. (SD)**	**Dec.**
1	Concept of extreme small sizes of electronic devices will create curiosity to teaching and learning in electronic works.	4.70	1.14	HE	4.77	1.12	HE
2	Concept of extreme small weight of electronic devices will create curiosity to teaching and learning in electronic works.	4.78	1.12	HE	4.00	1.16	HE
3	Concept of extreme small power sources of electronic devices will create curiosity to teaching and learning in electronic works.	4.05	1.18	HE	4.07	1.12	HE
4	Concept of extreme small display screens of electronic devices will create curiosity to teaching and learning in electronic works.	4.06	1.22	HE	4.06	1.41	HE
5	Concept of extreme small density of electronic devices will create curiosity to teaching and learning in electronic works.	3.71	1.25	HE	3.56	1.25	HE
Average Mean and Standard Deviation respectively		**∑X 4.12**	**∑SD 1.20**	**HE**	**∑X 4.08**	**∑SD 1.23**	**HE**

Source: Field Survey

The result in Table 1 showed that all the items in teachers' responses indicate a High Extent (HE). This reveals their opinion that the concept of miniaturization of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State. Similarly, all the items in the students' responses indicate a High Extent (HE); revealing that the concept of miniaturization of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State.

The average mean response of students and teachers for the statement items were found to be respectively 4.08 and 4.12. These indicate High Extent (HE), revealing that both teachers and students are of the opinion that the concept of miniaturization of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State. The average standard deviation of students and teachers were respectively seen as 1.23 and 1.20. These low standard deviations indicate that the respondents were very close in their opinions.

Research Question 2: To what extent does the concept of extreme processor speed of electronic devices influence the teaching and learning of Electronics Works in technical colleges in Rivers State?

Table 2: Teachers and students responses on the extreme processor speed of electronic devices

S/N	Items	Teachers N=40			Students N=140		
		Mean (X)	**Std. Dev. (SD)**	**Dec.**	**Mean (X)**	**Std. Dev. (SD)**	**Dec.**
6.	Concept of nanoscale time of electron speed on PCB of electronic devices will create curiosity to teaching and learning in electronic works.	4.28	1.02	HE	3.50	0.92	HE
7.	Concept of terabyte memory of electronic chips will create curiosity to teaching and learning in electronic works.	4.10	1.10	HE	3.60	1.13	HE
8.	Concept of nanoscale time of electronic devices display screen will create curiosity to teaching and learning in electronic works.	3.95	1.15	HE	4.50	1.18	HE
9.	Concept of nanoscale time of data speed in electronic devices will create curiosity to teaching and learning in electronic works.	4.78	1.00	HE	3.50	0.92	HE
10.	Concept of lower manufacturing cost per bit of electronic devices will create curiosity to teaching and learning in electronic works.	4.28	1.02	HE	4.60	1.23	HE
Average Mean and Standard Deviation respectively		**∑X 4.28**	**∑SD 1.04**	**HE**	**∑X 3.94**	**∑SD 1.11**	**HE**

Source: Field Survey

The result in Table 2 showed that all the items in teachers' responses indicate a High Extent (HE). This reveals their opinion that the concept of extreme processor speed of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State. Similarly, all the items in the students' responses indicate a High Extent (HE); revealing that the concept of extreme processor speed of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State.

The average mean response of students and teachers for the statement items were found to be respectively 3.94 and 4.28. These indicate High Extent (HE), revealing that both teachers and students are of the opinion that the concept of extreme processor speed of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State. The average standard deviation of students and teachers were respectively seen as 1.11 and 1.04. These low standard deviations indicate that the respondents were very close in their opinions.

Hypothesis 1: There is no significant difference between the mean responses of teachers and students on the influence of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

Table 3: Z – test analysis on the influence of the concept of miniaturization of electronic devices

RESPONDENTS	$\bar{X}$	SD	N	Z-CAL	Z-CRIT	d.f	P
TEACHERS	4.12	1.20	40	0.09	1.96	178	0.05
STUDENTS	4.08	1.23	140				

The results in Table 3 show that the calculated z-value (0.09) is less than the critical value (1.96) at 0.05 level of significance and 178 degree of freedom. Hence, the null hypothesis was not rejected which implies that there is no significant difference between the mean responses of teachers and students on the influence of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

Hypothesis 2: There is no significant difference between the mean responses of teachers and students on the influence of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

Table 4: Z – test analysis on the influence of the concept of extreme processor speed of electronic devices

RESPONDENTS	$\bar{X}$	SD	N	Z-CAL	Z-CRIT	d.f	P
TEACHERS	4.28	1.04	40	1.67	1.96	178	0.05
STUDENTS	3.94	1.11	140				

The results in Table 4 show that the calculated z-value (1.67) is less than the critical value (1.96) at the 0.05 level of significance and at 178 degree of freedom. The null hypothesis was therefore not rejected. This implies that there is no significant difference between the mean responses of teachers and students on the influence of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

Major Findings

Based on the results of the analysis of data, the following major findings were made in the study:

1. The concept of miniaturization of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State.
2. The concept of extreme processor speed of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State.
3. There is no significant difference between the mean responses of teachers and students on the influence of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.
4. There is no significant difference between the mean responses of teachers and students on the influence of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State.

III. DISCUSSION OF FINDINGS

The first finding of this study revealed that the mean responses of teachers and students were on a High Extent concerning the influence of the concept of miniaturization of electronic devices on the teaching and learning of Electronics Works in technical colleges in Rivers State. This implies that, the intermittent introduction of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges will arouse teachers and students' curiosity and motivation to teaching and learning of electronics works. The finding is in support with the opinion of Jensen, Weldon, Garcia and Zettl (2007), who stated that the concept and study of miniaturization of electronics components or devices using nanoelectronics is so fascinating that the interest of both teachers and learners are easily developed generally in the field of electronics at schools. The finding also indicated that there is no significant difference between the mean responses of teachers and students on the influence of the concept of miniaturization of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State. This means both teachers and students in reality have the same view that, nanoelectronics influences teaching and learning of electronics works in technical colleges in Rivers State.

The second finding revealed that the mean responses of teachers and students were on a High Extent concerning the influence of the concept of extreme processor speed of electronic devices on the teaching and learning of Electronics Works in technical colleges in Rivers State. This implies that, the intermittent introduction of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges will arouse teachers and students' curiosity and motivation to teaching and learning of electronics works. The finding is in support with the opinion of Waldner (2007), who stated that the concept of nanoprocessors that have higher performance and speed than the conventional computers will create curiosity to both the trainer and the trainee in the study of electronic technology. The finding also indicated that there is no significant difference between the mean responses of teachers and students on the influence of the concept of extreme processor speed of electronic devices in the teaching and learning of Electronics Works in technical colleges in Rivers State. This means both teachers and students in reality have the same view that, nanoelectronics influences teaching and learning of electronics works in technical colleges in Rivers State.

IV. CONCLUSIONS

The study determined the influence of nanoelectronics in the teaching and learning of electronics works in technical colleges in Rivers State. From the data analysis and findings, it was discovered that the concept of miniaturization of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State. In addition, the concept of extreme processor speed of electronic devices influences the teaching and learning of Electronics Works in technical colleges in Rivers State. All these culminate to the fact that nanoelectronics influences teaching and learning of electronics works in technical colleges in Rivers State. Nanoelectronics appear very promising in expanding the abilities of electronics devices and hence, becoming the next future of electronics.

V. RECOMMENDATIONS

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

1. The concept and use of nanoelectronics in Technical Colleges should be employed in the teaching and learning of Electronics Works in technical colleges in Rivers State.
2. Adequate provision of nanoelectronics facilities should be made available in every electronics Works workshop in Technical Colleges.
3. The basic scheme of Nanoelectronics should be included in the curriculum of Electronic Works in the technical colleges.

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