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Restructuring of Digital Electronics Curriculum for Electrical Engineering Programme in Nigerian Polytechnics

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ABSTRACT
This study is to determine the Development of Digital Electronic Course for Electrical Engineering Programme at National Diploma Level in North Central, Nigeria. Specifically, the study addressed four research questions and four hypotheses which in both cases based on objective, content, method of assessment and evaluation all for Developing Digital Electronic Course for EET Programme at National Diploma Level. The population of the study is made up of 87 lecturers and 38 workshop instructors making a total of 125. Total population sampling technique is used from the institution within the area of the study. A validated structured questionnaire instrument containing a four-point Likert scale of assessment is used for data collection. The data collected is analysed using Cronbach Alpha formula to determine reliability coefficient of the instrument. The reliability coefficient value obtained is 0.81. The findings of the study among others revealed in table 1. Indicated that items 1-9, 11, and 12 have the mean ratings above 2.50 as a result they are considered relevant to be included in the objectives of DE course. Item 10 which is on Examining Electronic Appliances for compliance with EET regulations has the lowest mean of 2.37 which is below 2.50. The table 2, indicated that items 13 to 48 have the mean ratings of 2.50 and above which are considered important to be included in the content area of DE course, with the exception of items 27 and 35 which are on Flip Flops and Seven Segment Display with mean ratings of 2.33 and 2.41 respectively. The table 3. Indicated that items 49 - 56 have mean ratings above 2.50, as a result they are considered relevant to be included in the teaching strategies to be used in DE Course. Item 51 which is computer simulation strategy has the highest mean rating of 3.55 and item 49 which is demonstration teaching strategy has the lowest mean of 3.00 but still above 2.50 and considered relevant to be included among the teaching strategies to be used in teaching DE course. The table 4, indicated that items 57-61 and 63 have the mean ratings above 2.50, as the results are accepted to be included in the assessment strategies that can be used to determine the attainment of the objectives: Item 62 which is on rubrics and item 64 which is on portfolios have mean ratings of 2.29 and 2.43 respectively.

I. INTRODUCTION

Polytechnic is an educational institute that teaches applied art and sciences. The Nigeria educational system provide the establishment of polytechnic to accommodate students who had chosen to study applied art and sciences including engineering courses. The relevance of polytechnics education cannot be under estimated as it can serve and as panacea to economic problem. Such as unemployment, youth restiveness, lack of required local content for the local industries, export of technical aid to boost our foreign reserve to mention just a few. (Oduma, 2018) highlighted that it is the responsibility of the polytechnics alongside the university of technology to offer courses (programmes) in various field of technology as well as applied art and sciences leading to the award of National Diploma (ND) certificate for the first two years of study and a higher national diploma (HND) certificate for the second phase of the four years programme in the polytechnics. In both cases of national diploma and higher national diploma, students are to go through one year (internship) industrial training on completion of the programme of study registered for.

The polytechnic in Nigeria are establish of founded mainly to provide technical learning that

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could assist the Nigerian society in meeting her industrial aspirations since one of the objectives of polytechnic education is geared towards the development of skilled manpower to man industries in Nigeria. It is crucial that graduate from polytechnic should be equipped with requisite skills that will guarantee employment and its sustainability. One of the peculiarity of the polytechnic is the emphasis it has on practical based learning.

As an Electronics industry moves from the simple technology of the conventional transistorized electronic appliances to present stage of digital electronics technology, the maintenance requirements has moved from the old traditional method to modern method enhanced with modern equipment for accuracy (Silas, 2015). Alio (2010) noted that the accelerating pace of technology has made a large number of job and skill obsolete. As most of the electronics appliances like Cathode Ray Tube (CRT) television, turn table Stereo sound system and the likes become obsolete; the skills in maintaining them are also becoming obsolete. Consequently, due to emerging and changing technologies, electronic appliances have gone digital and there is no way these appliances can be maintained with obsolete skills possessed by the current technicians (Oyenbuyi, 2018). Silas (2015) observed that most of the electronic technician in North Central, Nigeria who were trained through the apprenticeship system, with the conventional, analogue appliances encounter problems when attempting to repair electronics appliances different from those used during their training. This creates a situation aptly described as skill obsolescence which according to Beaudry& Sand (2016) occurs when skills become less valuable or depreciates due to changes in workers themselves or due to changes in production technology and technological improvements.

Electronics Graduates from Polytechnics have quickly switch over to non-skilled jobs like trading or perpetual search for white-collar jobs. Rufai (2012) confirmed that Nigeria have unemployment problems but the real problem its inadequate technical skills among the Polytechnic Graduates. This has clearly made it necessary to identify the content areas of Digital Electronics (DE) course and determine the anticipated learning outcomes, find out the relevant teaching strategies for teaching DE course and determine the assessment strategies to be used in ascertaining the attainment of the learning outcomes. Thus, important of developing DE course in the present Electrical Technology Education Curriculum in Nigerian polytechnics at ND level need not to be underscore. This could go a long way in bridging the gap between the curriculum and modern technological advancements in Electronics.

1.2 Statement of the Problem

The innovation in electronics appliances has drastically taken new dimension that demands corresponding change in the maintenance skills of Nigerian Polytechnic graduates (Onyebuenyi, 2018). In recent times, the use of Digital Electronic products have increased but there seems to be relatively inadequate qualified and competent technicians to repair these products when they are in bad conditions (Chukwuedo, 2014). Chukwuedo further stated that the relative inadequacy of technicians in maintenance and repairs of digital electronics products may be traced to inadequate inclusion of such skills in the curriculum of the school system as early as necessary. As a result, measures to keep educating and training in tune with the knowledge and skills needed in the world of work, school courses as curricula must be reviewed, enriched and updated regularly in line with changes that are taking place in Electronics Industries (Alome, Ogumah&Uduafemhe, 2018). Polytechnic Education in Nigeria is controlled by National Board for Technical Education (NBTE) but over the years, the National Board for Technical Education (NBTE) is yet to review the existing curriculum to meet up with the current trends. In fact, the last time National Board for Technical Education (NBTE) reviewed Nigerian Polytechnic Curriculum was (2001). Although, United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2015) stated that another challenge confronting NBTE curriculum is the rapid technological growth that is hard to keep up with, which results in irrelevance of the curricula taught in NBTE programmes which an analysis of the NBTE curriculum points to a mismatch between demand for skills and supply for skills. Hence, this study proposes to fill in this existing literature gap by restructuring Electronics Course for Electrical Engineering Programme at the National Diploma level in north central, Nigeria Besides, concern by Polytechnics lecturers and Workshop Instructors have been lamented; for instance, Tayo (2017) reveals that EEE students on the completion of their ND course, most of them enrolls for their HND in which they find it difficult to cope adequately in most of the HND fundamental courses of their specialization in both theory and practical, this could be due to the absent of fundamental courses like the Digital Electronics (DE) in the ND curriculum.

Polytechnic Education in Nigeria is controlled by National Board for Technical Education (NBTE) but over the years, the National Board for Technical Education (NBTE) is yet to review the existing curriculum to meet up with the current trends. In fact, the last time National Board for Technical Education (NBTE) reviewed Nigerian Polytechnic Curriculum was (2001). Although, United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2015) stated that another challenge confronting NBTE curriculum is the rapid technological growth that is hard to keep up with, which results in irrelevance of the curricula taught in NBTE Programmes which an analysis of the NBTE curriculum points to a mismatch between demand for skills and supply for skills. This leaving the students of Electrical Electronics Engineering to be obsolete whose knowledge acquired cannot meet the need and yearnings of the current industrial revolution. Development in an electronics world has leads to the needs for integrating DE course at ND level not only at HND level (Oduma, 2018).

This among others have made students at HND and Degree levels not to meet up in their courses. Consequently, effort in the literature is on the specific learning outcomes, assessment methods, teaching methods, learning objectives and evaluation of DE course at ND level. To the best of the researcher's knowledge, no published study conducted on development of Digital Electronics Course for Electrical Engineering Programme at National Diploma (ND) level. Hence, this study proposes to fill in this existing literature gap by developing digital electronics course for Electrical Engineering Programme at the National Diploma level in north central, Nigeria

1.3 Purpose of the Study

The main purpose of this study is to develop digital electronics course for Electrical Electronics Engineering Programme at National Diploma level in North central, Nigeria. Specifically, the study will determine:

i. The objectives of Digital Electronics course for Electrical Electronics Engineering students at the National Diploma level
ii. The content area of Digital Electronic course for Electrical Electronics Engineering students at the National Diploma level
iii. The appropriate methods for teaching Electrical Electronics Engineering students DE course at the National Diploma level
iv. The assessment methods to be used in Digital Electronics course at the National Diploma level

1.4 Research Questions

The following research questions will be formulated to guide the study.

i. What are the objectives of Digital Electronic course for Electrical Electronics Engineering at National Diploma level?
ii. What are the content areas of Digital Electronic course for Electrical Electronics Engineering at National Diploma level?
iii. What are the appropriate teaching methods to be used in teaching Digital Electronic course for Electrical Electronics Engineering students at the National Diploma level?
iv. What assessment methods are to be used in Digital Electronics course at the National Diploma level?

II. THEORETICAL FRAMEWORK

The current study used Tyler's model to Develop Digital Electronics Course for Electrical Electronics Engineering at National Diploma level. Tyler (1950) model presented a linear relationship between the four steps and that they are sequential. This gives the impression that specifying aims and objectives precedes a curriculum design while evaluation comes at the end. According to Tyler (1950) this linear representation of curriculum design was accepted and practices by scholars for providing the comprehensiveness of the planning activities and led to refinements such as system analysis taxonomies of learning. Tyler's model suggested that educational objectives should describe pupil's behavior and not the teachers. Specifically, objectives should specify how pupils are to behave at the end of a particular teaching unit, and content of that behavior.

Tyler's model however was criticized by scholars for portraying curriculum development process as involving rigidly sequential steps hence it failed to make distinction between content and learning experiences which were regarded as educational experiences, and also failed to show the necessary interdependencies of the four problem areas emerging from the four fundamental questions. This study adopted a competency-based model of curriculum development which involves identification of all tasks to be learnt and determining what one needs to know for mastery of each knowledge or skill. This model conceives the fact that each stage is interrelated to the other. In this context, the final stage evaluation, affects the initial stage, which are the objectives rather than terminate the Programme. Tyler's model theory relates to this study because the model captured all the four specific objectives of the study, see (Fig. 1) below;Tyler's four fundamental questions

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represent the four-step sequence of curriculum planning:

III. CONCEPT AND EMERGENCE OF DIGITAL ELECTRONICS

Digital electronics are electronics devices or appliances borne as a result technological advancement to substitute analog types (Therajaet al., 2009). Digital electronics deals with electronics products or appliances which function on the principles of logic gate and logic decision with the use of integrated circuits (ICs) as their main component (Therajaet al., 2009). Theraja&Sedha also noted that, Digital electronics components/products such as pocket personal Computer (PC), personal digital assistant (PDA), MP3 player, digital cameras, digital camcorders, Electronic Appliances compact disc (CD), home theatre-sound system, laptop computers, digital versatile disc (DVD) digital dictionaries and digital translators, liquid crystal (LCD) television and the likes make use of integrated circuits (ICs) extensively (Ogbuanya, 2009). Their structures and functions as well as the operation of their circuits are apparently similar because of the presence of integrated circuits in which both the active and passive components are fabricated on a tiny chip of silicon (Therajaet al., 2009).

Digital electronics or digital (electronic) circuits are electronics that handle digital signals (discrete bands of analog levels) rather than by continuous ranges as used in analog electronics. All levels within a band of values represent the same information state. This discretization produces relatively small changes to the analog signal levels due to manufacturing tolerance, signal attenuation or noise do not leave the discrete envelope, and as a result are ignored by signal state sensing circuitry. In most cases, the number of these states is two, and they are represented by two voltage bands: one near a reference value (typically termed as "ground" or zero volts), and the other a value near the supply voltage. These correspond to the false and true values of the Boolean domain respectively. Digital techniques are useful because it is easier to get an electronic device to switch into one of a number of known states than to accurately reproduce a continuous range of 29 values. Digital electronic circuits are usually made from large assemblies of logic gates, simple electronic representations of Boolean logic functions (Null et al., 2006). The knowledge of digital electronics and its fundamentals would give polytechnics students clear view and understanding of electronics principle of operation and corresponding technological skills required for maintaining digital electronics appliances in North Central, Nigeria (Oduma, 2018).

Electronics is a branch of science which deals with the motion, emission and behaviour of current as free electronics especially in vacuum, gas or photo tubes and special conductors or semiconductors (Ogbuanya, 2009). Electronics on the other hand involves electronic components, devices, systems or equipment, and these devices operate on a relative low voltage. The technology of electronics can be broadly grouped into analogue and digital electronics. On the other hand, digital electronics deals with electronics products or appliances which function on the principles of logic gate and logic decision with the use of integrated circuits (ICs) as their main component (Theraja&Sedha, 2009). Digital signals in contrast to analogue are designed to take on a discrete set of values. The values of digital circuits are meaningful for the digital cases and they employ logic circuits and decisions (Frey, 2000). All operations that can be performed on the analogue signal such as amplification, filtering, limiting and others, can also be duplicated in digital domain, even better (Singmin, 2001).

However, digital circuits operations are based on a number of discrete voltage levels. They are the most common physical representation of Boolean algebra and are the basis of all digital computers such as laptops. Most digital circuits use two voltage levels of zero (0) and (1) which represents LOW and HIGH, OFF and ON, FALSE and TRUE, MINUS and PLUS, CLOSED and OPEN switch respectively. Often “Low” will be near zero volts and “High” will be at a higher level depending on the supply voltage in use (Therajaet al., 2009; Emant, 2013). This represents the fact that every digital electronic appliance takes such states of logic decisions during operation and therefore works with two or more functions at a time, as it is found in laptop computers where more than one window can be operated simultaneously or using the laptop as a caller and browser device at the same time. These states and functions in any digital system are guided by some building blocks at the same time.

The inception of digital electronics started with the electronic circuit or gate which was invented in 1835 by Joseph Henry. In the next century, a vacuum tube was invented. After the invention of various devices, different gadgets were introduced later on. The most useful inventions were that of microprocessors and integrated circuits which helped in the development of the present digital electronics. Oyenbuyi (2018) observed that the latest developments which are taking place in

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the sector of digital electronics have a great influence on kids and teenagers. And thus the present generation has earned the title of 'digital generation'. It's a common sight to notice children all around the world with digital phones, interactive TVs, palm pilots, laptops and many other such devices. This is exactly why young people are considered the main target group of companies which manufacture digital electronics.

Predictions for the Emergence of New Technologies over the coming years (Bryan, 2012). Steven (2016) the consultancy noted, technologies making their mark would include wearable electronics including tattoos, accessories and shoes. In addition, consumers would reap the benefits of new applications and services for wearable, especially those working in harmony with location-aware technologies, bio sensing, personal preferences and social data.Bryan (2016) recently highlighted its top 10 technology trends expected to lend a strategic advantage to companies in 2016. Strategic technology trend is one with potential to significantly impact an organization and with a high expectation of disrupting an industry. For companies to take full advantage of strategic technology trends, major investments may be required, and adopting late can lead to significant business risks (Bryan, 2016).

IV. MATERIALS AND METHODS

The design adopted for this study were both Research and Development (R&D) and Descriptive Survey Design and the area of the study covered Nigeria Polytechnics in North Central States, these states in the North Central consists of Niger, Kwara, Kogi, Nassarawa, Benue, Plateau States and FCT-Abuja in Nigeria. The population used were lecturers and Workshop Instructors of Electrical Engineering Programme. Total Population sampling (TPS) was used since the population was small. One hundred and fifty-five (125) respondents were used for the study which comprised of eighty seven (87) lecturers and thirty eight (38) Workshop Instructors. A semi-structured questionnaire containing 64 items which was validated by three (3) experts to ensure effectiveness of the items that were used to collect data from the respondents. The data collected for the study was analyzed using mean and standard deviation for the research questions 1 - 4.

V. RESULTS AND DISCUSSION

This chapter presented the result and discussion of findings. The result was presented in the order in which the research questions are presented.

Research question one

What are the objectives of DE course?

The data collected from the respondents on the relevance of the objectives of DE course are analyzed using mean and standard deviation and is presented in table 1.

The number of respondents are one hundred and twenty-five (125). The data presented in table 1 indicated that items 1-9, 11, and 12 have the mean ratings above 2.50 as a result they are considered relevant to be included in the objectives of DE course. Item 10 which is on Examining Electronic Appliances for compliance with EET regulations has the lowest mean of 2.37 which is below 2.50 hence, this item is considered not relevant to be included among the objectives of DE course.

Table 1: Mean responses of Lecturers and workshop instructors of Electrical and Electronics Engineering Programme on the objectives of DE course.

S/N	Items	$\bar{X}$	SD	Remarks
1.	Develop in students, competencies in handling emerging technologies in Digital Electronics	2.78	1.01	HR
2.	Expose students to vital issues in modern Electronics	2.58	0.92	HR
3.	Gives students confidence and good judgment in solving problems of modern electronics appliances	3.08	0.97	HR
4.	Understand and explain various digital electronics terms and fundamental functions	2.91	0.92	HR
5.	Select proper components for an application	3.28	0.83	HR
6.	Make soldering of electronics components and test the digital appliances for proper operation.	3.20	0.77	HR
7.	Troubleshoot, repair/replace a faulty digital electronics	3.08	0.92	HR

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8.	Update embedded system software and test equipment	3.38	0.76	HR
9.	Examine electronic appliances	3.23	0.77	HR
10.	Examining Electronic Appliances for compliance with EET regulations	2.37	0.97	NR
11.	Diagnose fault and malfunctions in digital electronics appliances	3.12	0.90	HR
12.	Equip, retrofit and upgrade digital electronics appliances	3.04	0.86	HR
	GRAND MEAN	**3.00**	**0.88**	**HR**

$\overline{X}$ = mean response, SD= standard deviation, N= no. of respondent 125

Research question two

What are the Content Areas of DE Course?

The data collected from the respondents on the level of importance of the content areas of DE course are analyzed using mean and standard deviation and is presented in table 2.

The number of respondents are one hundred and twenty-five (125). The data presented in table 2 indicated that items 13 to 48 have the mean ratings of 2.50 and above which are considered important to be included in the content area of DE course, with the exception of items 27 and 35 which are on Flip Flops and Seven Segment Display with mean ratings of 2.33 and 2.41 respectively, and they are considered not important to be included in the content area of DE course.

Table 2: Mean responses of Lecturers and Workshops instructors of Electrical Engineering on the content area of DE course.

S/N	Items	$\overline{X}$	SD	Remark
	Basic Digital Electronics			
13.	Digital electronics appliances	3.08	0.83	VI
14.	Emerging technologies and their application in DE	3.29	0.80	VI
15.	Digital Electronics appliances fault analysis and diagnosis	3.08	0.92	VI
	Number Systems and Boolean Algebra			
16.	Basics of Analog and Digital	3.12	0.85	VI
17.	Number systems: Binary,	3.04	0.85	VI
18.	Octal and Hexadecimal,	3.20	0.83	VI
19.	Number system conversions, 1's and 2's complement	2.91	0.92	VI
20.	Fixed point representation,	3.08	0.83	VI
21.	Floating point representation	2.95	0.85	VI
22.	De Morgan's Theorem, Truth table.	2.95	0.85	VI
23.	K-Map	3.16	0.86	VI
	Logic Circuits			
24.	Introduction to Logic gates: Negative logic and positive logic, AND, OR, NOT, NOR, NAND, XOR and XNOR gates.	3.08	0.92	VI
25.	Arithmetic Circuits: Half adder, Full adder, half subtractor and Full subtractor.	3.12	0.90	VI
26.	Data Processing Circuits: Encoders, Decoders, Multiplexers, De-Multiplexers, Code converters and Comparators.	3.08	0.83	VI
	Latches and Flip Flops			
27.	Flip Flops	2.33	1.12	NI
	Number Systems and Boolean Algebra			
28.	Basics of Analog and Digital	3.16	0.91	VI
29.	Number systems: Binary, Boolean Algebra - Basic laws,	3.20	0.83	VI

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30.	De Morgan's Theorem, Truth table.	3.12	0.85	VI
31.	Octal and Hexadecimal,	3.29	0.80	VI
32.	Number system conversions,	3.12	0.90	VI
	Introduction to Display Devices			
33.	Working Principle of LED	3.16	0.86	VI
34.	Working Principle of LCD	3.12	0.85	VI
35.	Seven Segment Display	2.41	1.06	NI
36.	Common Anode Configuration	3.04	0.90	VI
37.	Common Cathode Configuration	3.08	0.88	VI
	Integrated Circuits and Memories			
38.	Integrated Circuit (IC)	3.00	0.83	VI
39.	Applications of Microprocessors	3.12	0.85	VI
40.	Micro-controllers	2.33	0.85	VI
	TOOLS/EQUIPMENT/MATERIALS NEEDED			
41.	Hot Glue Gun	3.08	0.77	VI
42.	Multimeter	3.08	0.88	VI
43.	Precision Screwdriver Set	3.12	0.79	VI
44.	Tweezers	3.04	0.85	VI
45.	Soldering Station	3.04	0.80	VI
46.	Dremel Rotary Tool	3.00	0.78	VI
47.	Cabinet Organizer	3.20	0.77	VI
48.	Self-adjusting wire stripper/cutter	2.91	0.88	VI
	GRAND MEAN	**3.04**	**0.86**	**VI**

$\overline{X}$ = mean response, SD= standard deviation, N= no. of respondent 125

Research question three
What are the relevant teaching strategies to be used in DE Course?

The data collected from respondents on the relevance of the teaching strategies to be used in DE course are analyzed using mean and standard deviation and is presented in table 3.

The number of respondents are one hundred and fifty-five (125). The data presented in table 3 indicated that items 49 - 56 have mean ratings above 2.50, as a result they are considered relevant to be included in the teaching strategies to be used in DE course. Item 51 which is computer simulation strategy has the highest mean rating of 3.55 and item 49 which is demonstration teaching strategy has the lowest mean of 3.00 but still above 2.50 and considered relevant to be included among the teaching strategies to be used in teaching DE course.

Table 3: Mean responses of lectures and Workshops instructors of Electrical Engineering on the relevant teaching strategies to be used in teaching DE course.

S/NO.	Items	$\overline{X}$	SD	Remarks
1.	Demonstration teaching strategy	3.00	0.84	HR
2.	Lecture/presentation strategy	3.20	0.83	HR
3.	Computer simulation strategy	3.55	0.90	HR
4.	Cooperative Learning strategy	3.04	0.85	HR
5.	Project based method	3.12	0.79	HR
6.	Competency based approach	3.12	0.95	HR
7.	Flexible grouping method	3.08	0.92	HR
8.	Experiential method	3.04	0.85	HR
	GRAND MEAN	**3.14**	**0.87**	**HR**

$\overline{X}$ = mean response, SD= standard deviation, N= no. of respondent 125**Research question four**

What assessment strategies can be used to determine the attainment of the objectives?
The data collected from the respondents on the assessment strategies to be used in DE course are analyzed using mean and standard deviation and was presented in table 4.

The number of respondents are one hundred and twenty-five (125). The data presented in table 4 indicated that items 57-61 and 63 have the mean ratings above 2.50, as the results are accepted to be included in the assessment strategies that can be used to determine the attainment of the objectives: Item 62 which is on rubrics and item 64 which is on portfolios have mean ratings of 2.29 and 2.43 respectively. These mean ratings are below 2.50 as such they are not accepted to be included among the teaching strategies to be used in the assessment strategies that can be used to determine the attainment of the objectives.

Table 4: Mean responses of Lecturers and Workshop instructors on the assessment strategies that can be used to determine the attainment of the objectives:

S/NO.	Items	$\overline{X}$	SD	Remarks
9.	Authentic Assessment	3.16	0.81	SA
10.	Holistic Assessment	3.28	0.83	SA
11.	Performance Testing	3.48	0.92	SA
12.	Achievement Testing	3.24	0.85	SA
13.	Rating Scaling	3.04	0.80	SA
14.	Rubric	2.29	0.99	DA
15.	Checklist	3.12	0.90	SA
16.	Portfolios	2.43	1.02	DA
	GRAND MEAN	**3.01**	**0.89**	**SA**

$\overline{X}$ = mean response, SD= standard deviation, N= no. of respondent 125

VI. RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations are made:

i. The NBTE should strive to introduce DE Course into the Nigerian Polytechnic curriculum at ND level for Students to have requisite Knowledge of the course to provide them with solid foundation before getting to the HND
ii. Government should provide the needed support in terms of resources that will enable NBTE incorporate DE Course into the curriculum of Electrical Engineering programme at ND level
iii. The NBTE should as matter of importance ensure the review of Nigerian Polytechnics curriculum at stipulated period of every five years.
iv. The NBTE in the course of its introduction of DE course carry along the major stakeholders particularly, the EEE lecturers of Nigerian Polytechnics who would be responsible for teaching DE course.
v. The NBTE should also focus more on practical skills acquisition throughout the duration of the course so as to equip the students with adequate DE skills needed for them to be employable in government and private establishments as well being fully prepared for self-employment.

REFERENCES

[1]. Alio, A.N. &Uzor, O.O (2010). Enhancing management competencies of electronics craftsmen in the economy of Enugu State Nigeria. International Technology Journal (INTERJ0) 1(1).
[2]. Alome, S. A., Ogumah B. A. O. &Uduafemhe (2018) M. E. Competency needs of electronic technicians for effective maintenance and repairs of digital. Atbu

journal of science, technology and education

[3]. Bhuyan, M. H., Khan, S. S. A. & Rahman, M. Z. (2018). Teaching digital electronics course for electrical engineering students in cognitive domain. International Journal of Learning and Teaching. 10(1), 001–002

[4]. Brian B. (2016) Current Predictions for the Emergence of New Technologieshttps://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2016

[5]. Bryan B. (2012) Current Predictions for the Emergence of New Technologies pnghttps://blogs.gartner.com/smarterwithgartner/files/2012/10/SWG_

[6]. Bryan B. (2012) Current Predictions for the Emergence of New Technologies pnghttps://blogs.gartner.com/smarterwithgartner/files/2012/10/SWG_

[7]. Chukwuedo .S. (2014). Maintenance practices in Electronic Appliances for training prospective electronic technologists JORIND 12 (1) June, 2014.

[8]. Eta, E. (2017).The role of Polytechnic education in Nigeria's quest for economic diversification under Buhari. A Key Note Matriculation Lecture at the First Matriculation and Inauguration Ceremony of Sure Foundation Polytechnic on 27thJanuary, 2017

[9]. Oduma, C. (2018). Polytechnic Education: A Gate Way for Youths' Empowerment, Entrepreneurship and Sustainable Economic Development in Nigeria. A lecture delivered at the First Eminent Scholars Lecture Series in Edo State Polytechnic.

[10]. Ogbuanya, T.C. &Fakorede, S.O.A. (2009). Technical skill improvement needs of metal work technology teachers for entrepreneurship in response to MDG for quality assurance. Nigerian Vocational Association Journal 13(1), 70-79.

[11]. Rufai, R. (2012). Skill Gap and Unemployment in Nigeria. Lagos: Business Day Press.

[12]. Silas, E. I. (2016) Competency Needs of Electronics Craftsmen For Maintenance of Electronic Appliances in Akwaibom State, Nigeria. International Journal of Educational Benchmark, eISS: 2489-0170 pISS: 2489-4162, University of Uyo, Nigeria.

[13]. Singmin, A. (2001). Beginning digital electronics through projects. U.S.A: Newness.

[14]. Steven S. (2016) Emergence of New Technologies: Huge Trends for 2016.

[15]. Tayo, O. (2014). The odds against polytechnic education. Retrieved from www.pmnewsnigeria.com. on 23/11/2019 Technology Research Journal, 1(1), 45-53.

[16]. Theraja, B.L, &Sedha, R.S. (2009). Principals of electronic devices and circuits: analog and digital in S.I. units. New delhi: S. schand& company Ltd. U.S.A

[17]. Tyler, R. W. (1950). Basic principles of curriculum and instruction: Syllabus for Education 360. [Ninth impression, 1957] Chicago, IL: Syllabus Division, the University of Chicago Press.

[18]. UNESCO. (2015). World TVET Database Nigeria. Paper presented at the International Conference for TVET, Bonn.