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ASSESSMENT OF THE IMPLEMENTATION OF DIGITAL ELECTRONICS COURSE AT HIGHER NATIONAL DIPLOMA LEVEL IN NIGERIAN POLYTECHNICS

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Abstract

This paper evaluates the implementation of Digital electronics course in the Nigerian federal polytechnics. The respondents consisted of 177 Students of Electrical and Electronics Programme of the two Federal Polytechnics in Benue State; the instrument used for data collection is a structured questionnaire tittle Digital Electronics Assessment Questionnaire (DEAQ). The DEAQ was validated (both face and content) by experts and a reliability coefficient of 0.81 was obtained using the Cronbach's Alpha method. Mean and standard deviation were used as methods of data analysis. The study reveals that the implementation of Digital Electronics course in the Nigerian polytechnics is half way, as most of the effective teaching strategies explored in so many researches are yet to be adopted by the lecturers; lack of equipped laboratories, less effective teaching strategies, lack of good orientation to Digital Electronics lecturers, poor background of digital electronics from National Diploma level are some of the identified setbacks faced by the implementation of digital electronics course in Nigerian Polytechnics.

Keywords: Digital Electronics\, Assessment, Polytechnics, Higher National Diploma

1.0 Introduction

Polytechnic Education in Nigeria is one out of the three arms of Tertiary Education in Nigeria [1]. The relevance of Polytechnic Education cannot be over emphasized and can serve as a panacea to economic problems of unemployment and youths' restiveness [2]. It is the responsibility of the Polytechnics is to discharges alongside with Universities of Technology in Nigeria to offer courses (programmes) in various fields of Technology and Applied 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 year programme in the polytechnic [1]. In each phase (that is, The National Diploma or Higher National Diploma) the students are expected to undergo a one year (internship) industrial training on completion of the Programme registered for. Specifically, Polytechnic Education in Nigeria is meant to provide technical learning that could assist the Nigerian society in meeting her industrial aspirations. Since the objective of Polytechnic Education is geared towards development of skilled manpower to man the industries in Nigeria, it is crucial that, graduates of polytechnics should be equipped with requisite skills that will guarantee employment and its sustainability [3]. One distinctive mark of polytechnic education is the strong emphasis it has on practical based learning, with work-attachment as part of the practical area of the curriculum [4].

1.1 Background of the study

Digital electronics course is a core course requirement in the polytechnic curriculum of the electrical and electronic engineering (EEE) program, it is because o+++++++f the increased number of digital electronics devices that refer the recent age as the digital age [5]. At present, all offices, industries, educational institutions, business organizations etc., are being digitalized. Therefore, most of the engineering disciplines incorporate digital electronics course as a compulsory course in its curriculum. This course has many direct practical applications. Without the knowledge of this course, it is not possible for an engineer to design and develop any electronics circuits or systems or any electronic controllers that are controlled or operated by digital signals, and it is one of the most desired outcome of engineering education, especially in

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the 21st century. Therefore, digital electronics' course is a core course requirement in the polytechnic curriculum of the electrical and electronic engineering (EEE) programme. It is designed to teach the students number systems, Boolean algebra, basic logic gates and their construction and working principles. Besides, combinational and sequential circuit design, various types of logic families, analogue-to-digital and digital-to-analogue conversion processes, and computing various digital electronic circuit parameters are taught in this course [6].

The technology of electronics can be broadly grouped into analogue and digital electronics. The changeover to digital technology was a welcome relief from a variety of electrical noise generated at home [7]. Unfortunately, the tragedy is that polytechnics in Nigeria are gradually losing its allure [2]. Stakeholders in the education sector are aware that the neglect of technical and vocational education is socially and economically injurious, because it is robbing the nation of the contributions the polytechnic graduates would make on National development [8]. Similarly, Nigeria is today wearing the toga of a poor state because of our non-chalet attitude to Technical and Vocational Education and Training often given by polytechnic education [9]. Thus, the polytechnic provides students with life skills to become productive entrepreneurs as it engenders creative and innovative ideas, enlarge the economic pie, and increase personal economic freedom and independence. The bedrock to technical emancipation for Nigeria is centered on polytechnic education. The implementation of TVET curriculum in Nigerian tertiary institution has been faced with various challenges which are synonymous with some of the problems of education in Nigeria such as poor funding, obsolete facilities and poor provision of instructional materials for effective implementation of TVET curriculum. The advancement in electronics appliances has drastically taken new dimension that required change in the maintenance and repair skills of technical college, polytechnics, and universities [10]. In recent times, the use of digital electronic products such as mobile phones have increased, but there seems to be relatively inadequate qualified and competent technicians to repair these products when they are in bad conditions [11]. That is to say, there is need for digital electronic course to be assessed. The recent age is the digital age. Without the knowledge of digital electronics course, it is not possible for an engineer to design and develop any electronics circuits or systems or any electronic controllers that are controlled or operated by digital signals, and it is one of the most desired outcome of engineering education, especially in the 21st century [5].

Digital electronics are electronics devices or appliances borne as a result technological advancement to substitute analog types. 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 [12]. Digital electronics components/products such as pocket personal Computer (PC), personal digital assistant (PDA),

MP3 player, digital cameras, digital camcorders, mobile phones 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. 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 [12] Digital electronics 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. Digital electronic circuits are usually made from large assemblies of logic gates, simple electronic representations of Boolean logic functions [13]. 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.

Electronics according to is a branch of science which deals with the motion, emission and behavior of current as free electronics especially in vacuum, gas or photo tubes and special conductors or semiconductors [14]. 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. The changeover to digital technology was a welcome relief from a variety of electrical noise generated at home [7]. 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 [12].

The implementation of TVET curriculum in Nigerian tertiary institution has been faced with various challenges which are synonymous with some of the problems of education in Nigeria such as poor funding, obsolete facilities and poor provision of instructional materials for effective implementation of TVET curriculum. Curriculum Implementation entails putting into practice the officially prescribed courses of study, syllabuses and subjects. The process involves helping the learner acquire knowledge or experience. It is important to note that curriculum implementation cannot take place without the learner [15]. However, the learner is therefore, the central figure in the curriculum implementation process. Implementation takes place as the learner acquires the planned or intended experiences, knowledge, skills, ideas and attitudes that are aimed at enabling the same learner function effectively in a society.

1.2 Factors that Influence TVET

Curriculum Implementation in Nigerian University Various factors influence TVET curriculum implementation. Some of which include;

i TVET Lecturers/Teachers

Therefore, digital electronics' course is a core course requirement in the polytechnic curriculum of the electrical and electronic engineering (EEE) programme. It is designed to teach the students number systems, Boolean algebra, basic logic gates and their construction and working principles. Besides, combinational and sequential circuit design, various types of logic families, analogue-to-digital and digital-to-analogue conversion processes, and computing various digital electronic circuit parameters are taught in this course [6]. Skills offered in Technology Education curriculum are in many cases of low quality and lack the ingredients of new and emerging technologies, which cannot fit in well with the competitive global market and are not suited for actual socio-economic conditions and production needs [16]. A viable curriculum framework for new and emerging technologies, careers and professions needs to be developed so as to inculcate knowledge, skills, values and attitudes [17]. Another challenge confronting Technology Education curriculum is the rapid technological growth that is hard to keep up with, which results in irrelevance of the curricula taught in TVET programs [18]. An analysis of TVET curriculum points to a mismatch between demand for skills and supply for skills. This is not surprising, as the conventional Technology Education curriculum development established weak link between industries and training institutions [19]. Curriculum is a major material for carrying out training in the field of Electrical Electronics Technology Education in various institutions; hence, the curriculum must be updated or reviewed in order to integrate new and emerging knowledge and skills to match development in science and technology [20]. The curriculum taught in Technology Education institutions should be reviewed in order to integrate new technological innovations so as to meet the demands of the labour market [21]. The entire curriculum design and instructional delivery pattern are targeted at enabling the students to have on-the-job work experience.

It is noted that the development of polytechnic education is fundamental, if Nigeria must succeed in her quest for economic diversification. The essence of polytechnic education in Nigeria is therefore, to train students in technical areas where they can graduate and be self–employed, and also create employment opportunities for others. Polytechnic Education can be a means to an end out of the present economic hardship that is characterized by graduate unemployment. It is in fact, a tool for securing employment and emancipation of recipients from poverty, especially, through the provision of necessary knowledge and skills. The relevance of polytechnic education cannot be over emphasized, and can serve as a panacea to economic problems of unemployment and youths' restiveness [2].

ii Lecturers' competencies and Effective Teaching and Learning Strategies in Technology Education

Competency is usually associated with highly professional performance and there is a direct link in the field of education between a teacher's professional competency and students' performance [22]. He further observed that there are two distinct meanings of competency in education. From a theoretical point of view, competency is understood as a cognitive structure that facilitates specified behaviors. From an operational point of view, competency seems to cover a broad range of higher order skills and behaviors that represent the ability to deal with complex unpredictable situations. This operational definition includes knowledge, skills, attitude, metacognition and strategic thinking, and presupposed conscious and intentional decision making.

iii Competencies to match new requirements

The new approach to education increases the need to professionalize the act of teaching. The reform of the education system introduces several demands that will affect the role of technical teachers and the nature and significance of the competencies required to teach [23]. Some of these elements are: increased autonomy to schools, an approach to learning that places student at the heart of the learning process, a competency based approach to programme design, a range of options of varying duration, and the policy of adapting schools to the needs of all students whether children or adults. He further observed that, the new conception of learning that gives students primary responsibility in the learning process requires technical teacher trainers to use new pedagogical approaches and ways of dealing with student-teachers. These teacher-trainers must adopt their teaching methods to the rate of progress of each student. They must focus on students in order to redefine their relationship to knowledge and facilitate its acquisition. Competency-based programme of study, and the map of options, requires teachers to perform some tasks differently and to develop new competencies.

Teamwork with colleagues who come into contact with the students in the programme or teach other subjects will become especially important in developing, integrating and evaluating competencies over periods ranging from few days to the length of an entire programme. Teacher-trainers do not work with inert materials but with living subjects and social cases [24]. Student-teachers today are no longer docile-beings subjected to the trainers' authority. They resist the trainers influence, and always want to do something else, or do it differently or at another time. The teachers' knowledge no longer in the eyes of students of whatever age gives him or her an unconditional right to exercise intellectual authority and attain their attention, trust and obedience [25].

Furthermore, since the role of the teacher and the context of teaching, have changed, new resources (knowledge, skills, and attitudes) are required to practice the profession. Certification in a given trade is no longer the sole qualification needed in order to be considered competent to teach. To qualify, teachers must acquire the more complex competencies that underlie the new professionalism of the teaching profession.

1.3 Statement of the problem

The education provided by the polytechnic is directly focused on the students' future career. Thus, Nigerian polytechnics give emphasis to the attachment of requisite skills acquisition in every facet of course delivery. The target here is to develop students' self-belief and critical faculties which are essential for eventful involvement in societal growth and development [26]. Analogous researches have shown the pattern and position of digital electronics course at higher national diploma of Nigerian polytechnics, some issues might not be unassociated to the lack of good background knowledge of digital electronics of some students because they don't take it at national diploma level.

1.4 Objectives of the research

The main purpose of this study is to assess the implementation of digital electronics course at higher national diploma level in Nigeria. Specifically, the study will:

i. Ascertain the availability of instructional materials for teaching digital electronics at higher national diploma of Nigerian polytechnics.
ii. Determine the teaching strategies employed by the lecturers of digital electronics at higher national diploma of Nigerian polytechnics.
iii. Identify the challenges faced by the students in learning digital electronics at higher national diploma of Nigerian polytechnics.

1.5 Research questions

The following questions are formulated to guide the study:

i. What are the available instructional materials for teaching digital electronics at higher national diploma of Nigerian polytechnics?
ii. What are the teaching strategies employed by the lecturers of digital electronics at higher national diploma of Nigerian polytechnics?
iii. What are the challenges facing students in learning digital electronics at higher national diploma of Nigerian polytechnics.

2.0 Materials and methods

The study adopted descriptive survey research design because it targets small group of people and the result will be later generalized to the entire population. The data for the study is obtained using a questionnaire administrated to the students of electrical and electronics engineering in federal polytechnics situated in Benue state of northwestern sub-region of Nigeria (area of the study). The population of the study comprised of 117 students of electrical and electronics programme at higher national diploma level in federal polytechnics in Benue state. Total population sample is used as the sampling technique.

A questionnaire developed by the researcher was used to collect data, the questionnaire is divided into four sections: section one recorded the demographic information of the respondents; section two collected data on the level of availability of instructional materials for teaching digital electronics; section three are items on the level of lecturers' orientation on digital electronics; section four are items on teaching strategies used by the lecturers in teaching digital electronics course. The questionnaire was validated (both content and face) by two experts of electrical/ electronic engineering; the five responses on the questionnaire are: Strongly Agreed (SA), Agreed (A), Undecided (U), Disagreed (D) and Strongly disagreed (SA). Any item with a mean of 2.5 will be accepted and any item with mean response below 2.5 will be considered as rejected.

3.0 Results and Discussion

The results are presented in the tables below according to the research questions stated before.

Table 1: mean responses of students of electrical/electronic engineering programme at higher national diploma on the available instructional materials for teaching digital electronics.

S/No	Items	Mean	SD	Decision
1	There is adequate instructional materials for the implementation of DE course in our school	3.4	0.81	Accepted
2	DE laboratory apparatus are installed appropriate with good maintenance	4.1	0.09	Accepted
3	Real objects are readily available for teaching and learning	2.98	1.0	Accepted
4	Audiovisual materials are available for instructions	3.11	0.62	Accepted
5	There are well experienced laboratory attendants in DE laboratories	2.76	0.66	Accepted
6	Complex electrical circuits	2.62	0.99	Accepted
7	Training simulators (sensors and actuators)	2.21	0.41	Rejected

Research question one was posed to find out the level of availability of instructional materials used in teaching digital electronics course at higher national diploma of Nigerian polytechnics. It is shown that there is adequate instructional materials for the implementation of digital electronics course, thought, the respondents are of the view that there is no good training simulators (sensors and actuators), for this, table 1 shows that items number 1-6 have means above 2.5 and therefore they are considered to be accepted. Item number 7 on the other hand has a mean below 2.5 and therefore it is considered rejected.

Table 2: Mean responses of students of electrical/electronic engineering programme at higher national diploma on the teaching strategies employed by the lecturers of digital electronics at higher national diploma of Nigerian polytechnics.

S/No	Items	Mean	SD	Decision
1	Our lecturers use project based method in teaching us DE course	2.33	0.34	Rejected
2	Blended learning	1.99	0.24	Rejected
3	Lecture method	4.3	0.11	Accepted
4	Presentation method	3.92	0.14	Accepted
5	Fieldtrips	2.16	0.95	Rejected
6	Computer simulation strategy	1.92	0.74	Rejected

Table 2: Presented the results for question 2 where items are posed to assess the teaching strategies in the implementation of digital electronics course at higher national diploma of Nigerian polytechnics. Items number 10 and 11 have means above 2.5 and thereby considered accepted while items 8, 9,12 and 13 have means below 2.5 and they are considered rejected. The result shows that the lecturers of digital electronics course use lecture and presentation methods in teaching their students despite the effectiveness of other teaching methods in teaching practical related courses.

Table 3: Mean responses of students of Electrical / Electronic Engineering Programme at higher national diploma on the challenges faced by the students in learning digital electronics at higher national diploma of Nigerian polytechnics.

S/No	Items	Mean	SD	Decision
1	Lack of adequate instructional aids	2.42	0.34	Rejected
2	There is no good and well equipped laboratory	2.08	0.74	Rejected
3	DE lecturers don't have much orientation on the course	3.41	0.91	Accepted
4	Lack of good DE background from our national diploma level	3.36	0.44	Accepted
5	There is no enough textbook on DE in our school library	2.13	0.32	Rejected
6	There is no good maintenance strategies of laboratory apparatus	2.30	0.16	Rejected
7	We don't have good access to our DE laboratory	2.38	0.50	Rejected

Question 3 of the research that sought to find the challenges faced by digital electronics students in learning the course at higher national diploma was presented in table 3 above. Items number 14, 15, 18, 19 and 20 are rejected because their means are below 2.5 while items number 16 and 17 are accepted because their means are above 2.5. The table shows that the major challenges facing the students of digital electronics at higher national diploma level is about poor background and lecturers' orientation about the course.

4.0 Conclusion

Digital electronics course is believed to be practical oriented course which form the bases of electronics studies in engineering that qualifies this century to be called a digital age. Like other engineering courses, digital electronics is facing many challenges ranging from poor adaptation of instructional strategies to the uproot challenges that hinder its proper implementation at the higher national diploma level Nigerian polytechnics. This study therefore, Is conducted to highlight the basic challenges so that good and sound recommendations will be given to Nigerian educational policy makers on ways to improve on the recent situations in digital electronics course.

5.0 Recommendation

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

i. More complex instructional materials should be installed/provided to the polytechnics that have digital electronics as a course of study at higher national diploma so that proper and efficient learning outcomes will be realized.

ii. Lecturers of digital electronics course should consider adopting current and effective teaching methods rather than using the conventional lecture and presentation methods.

iii. National board for technical education (NBTE) should do well to develop curriculum for teaching digital electronics course at national diploma level as this will help in strengthening the students' background in digital electronics.

iv. Seminars, workshops and capacity building programs should be frequently organized to the lecturers of digital electronics course as it will help in giving them more orientation on the course.

v. Merit should be the major criteria for admitting students in to the higher national diploma too study electrical and electronics engineering so that digital electronics will be taken by due students.

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