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Innovative Skills Required by Electrical Electronics Technology Education Students For Effective Maintenance Of Digital Electronics Appliances In Public University In The Anambra State

[1]Oluka, Sussan (Ph.D) & [2*]Ideh, Nonso .F.

[1 & 2]Department of Technology and Vocational Education,
Enugu State University of Science and Technology, (ESUT) Enugu, Nigeria
***Email:realchukwunonso@gmail.com**

ABSTRACT

The study intends to determine the innovative skills required by electrical electronics technology education students for effective maintenance of digital electronics appliances in the public university in Anambra State. It was guided by three research questions and three null hypotheses. The study adopted a descriptive survey research design. The population for the study comprised 72 respondents made up of 12 Electrical/Electronics technology Lecturers from the one public university in Anambra, which includes; Nnamdi Azikiwe university Awka and 60 Electrical/Electronics Technologist in Anambra metropolis comprising of Awka, Umunze, Nkpor and Onitsha respectively. The instrument for data collection was 35 items structured questionnaire based on the three research questions that guided the study. The instrument was validated, and the reliability of the instrument was determined using Cronbach Alpha which yielded 0.75. Mean and standard deviation were used to analyze the data. Specifically, the study identified the embedded system skills, automated system skills and safety practice skills required by electrical electronics technology education students for effective maintenance of digital electronics appliances in public university in Anambra State. Based on the study, the advancement in electronics Technology appliances has drastically taken a new dimension and demands a corresponding change in the maintenance skills. Thus, in the recent time, the newly emerged digital electronics appliances like light emitting diode (LED) television and liquid crystal display (LCD) television had succeeded the existing digital electronics appliances like cathode ray tube (CRT) television, digital video display (DVD) home theatre sound system, cassette deck and turn table stereo sound system. However, the skills required in maintaining the newly emerged digital electronics had become obsolete as a result of the advancement in technology and have suffered a technical incapability. However, these could be linked to lack of proper training on the emerged innovative skills and this had resulted to the use of trial and error system in digital electronics appliances maintenance. The findings of the study revealed among others include; ability in interpreting computer programming language, ability in debugging mult-tasking code, ability in the use of automatic optical and x-ray inspection tool in detecting both open circuits soldering defects and solder bridges, ability in carrying out the system level test, proper components assemblage and ability in the use of an appropriate fuses power rating. Based on the findings, the following recommendations were made among others which include; that innovative skills for maintaining digital electronics appliances curriculum development should adopt a functional approach to meet contemporary needs of the nation; Government at all level should endeavor to provide the necessary tools/machines required for effective workshop practices and equipment for employment of university students through maintenance of digital electronics appliances on graduation in Anambra State.

Keyword: Innovative Skills, Electrical Electronics Technology, Education, Maintenance, Digital Electronics, Appliances

INTRODUCTION

The growth of any nation is hanged on innovation in technology which has led to advancement in technology, and had contributed immensely to all sectors of life. However, Innovation and technology are recognized as a source of economic growth, competitiveness and development in the developed

countries. Thus, being a source of economic growth, technology and skilled human capital is to dive into the valuable ideas and support that, which innovation had brought to the industries and educational institute, thereby making production, teaching and learning easier. However, Equity and Quality in Education (2012), stated that demands for skills shift towards more sophisticated tasks suggest that individuals with poor 21st century skills are more likely to find themselves at risk of unemployment and social exclusion. Therefore innovations is required in education to enable the students acquire the modern skills which allow them to become employable and fit in into the 21st century working environment.

Innovation according to Makarand & Osram, (2012) is an idea that has been transformed into a practical reality. One can describe innovation as a tool which enhances the sustainable development in education, by receiving the attention of educators, educationists and researchers across the globe. Hence, concepts/technologies has been introduce into the curriculum through the aid of innovation and this had resulted to the modification of what had existed before, leading to the development of ideals, practices and believes that are fundamentally new. Since the current era had encountered an emerged technologies and devices as result of innovation, electrical electronics technology education students are to acquire the necessary skills that matches the new trends in the technology.

Skills are proficiency that are acquired or developed through training (Houghton,2012). According to Oguejiofor and Ezeama, (2016) Skill is the ability to do something well arising from talent, training or practices. Acquisition of skills exposes the learner to the specific skills or relevant activities embodying the skill. For skills to be acquired and developed there must be opportunity for participation and practice of such skills under real life condition. Mgbeahurike (2000) listed among other the processes of skill acquisition to include; Observation –where the students watch the teacher perform the skill in real life to enable them form a concept; Imitation – here the students follow the example of what the teacher has done through demonstration and learning by doing; Manipulation- it involves operating and handling, for example the act of tighten and loosen of bolt and nuts, Performing- it involves carrying out the activities taught which the students are guided on what to do and Perfecting- This is highest form of skill acquisition process. The students probably becomes conversant with the demands and task of the operation after several practices, hence they become expert and saleable. When these skills are utilize to create values and improve processes, from inventing a machine to finding a faster process of making achievement in the work, these are referred to as innovative skills.

Innovative skills are the knowledge and abilities that is used to create and adapt to a change (Indeed Editorial Team, 2021). However, Innovative skills can be said to allow one to use the existing knowledge to discover original ideas that benefit him and his team. According to Wikipedia (2021), these skills are usually a combination of cognitive skills (e.g. the ability to think creatively and critically), behavioral skills (e.g. the ability to solve problems, to manage risk), functional skills (e.g. basic skills such as writing, reading and numeracy) and technical skills (e.g. research techniques, project management and IT engineering). However, these skills are not static; they are changing with the trends in the technological development. Thus, these skills demand an understanding through learning, for their effective utilization in the maintenance of electronics appliances.

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). However, electronics can be said to be a technology of using transistor and silicon chips especially in devices such as radios, television, and computers (Collins, 2018). Toppr, (2020) identified the different branches of electronics to includes; Digital electronics, Analogue electronics, Microelectronics, Circuit design, Integrated circuits, Power electronics, Optoelectronics, Semiconductor devices, Audio electronics, Telecommunications, Nano electronics and Bioelectronics. Digital Electronics is the sub-branch of electronics that deals with digital signals for processing and controlling various systems and sub-systems (ElectronicsCoach, 2022). The main and perhaps the most revolutionary advantage of digital electronics is the decrease in size and the improvement in technology (Electrical4u,2020). Electronic digital systems is operated in two discrete values i.e., 0 and 1, and it is said to be binary in nature which represents LOW and HIGH, OFF and ON, FALSE and TRUE, MINUS and PLUS, CLOSED and OPEN switch respectively(Beingintelligent, 2021; Alio &Onyebuenyi,2018).

However, this branch of electronics utilizes inorganic materials, such as Silicon (Si) and non-degradable materials like plastic and metals. Thus, inorganic materials are said to be the basis of digital electronic technology. In digital electronics, several components can be replaced by a single component, using prefabricated building blocks. Hence, the engineer simplifies the design process, thereby reduces the total design cycle, time and cost. In simplifying the design process, digital electronics has been designed in such a way that it has improve the performance of the appliance, decreases the device voltage stresses and increases its efficiency.

Thus, digital electronics deals with electronics products/appliances whose function is on the principles of logic gate and logic decision with the use of integrated circuits (ICs) as their main component (Theraja and sedha, 2009). However, its components/products include; 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 (Alio & Onyebuenyi,2018).

Hence, the structures and functions as well as the operation of the digital electronics 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 (Theraja and Sedha, 2009). 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 (Alio &Onyebuenyi,2018). These digital electronics appliances are manufactured and sold in different varieties for utilization In Anambra State.

In Anambra State in particular, these digital electronics appliances are widely used, its operation and function is based on electricity supply. These digital electronics appliances often develop fault when they are in use as a result of voltage fluctuations, thunder effects, temperature, dust and poor handling (Alio &Onyebuenyi, 2018). However, these appliances cannot function when this breakdown occurs, as a result of the damaged components, thereby not satisfactorily serving their purpose. These situations are common today and in turn demands innovative skills for their maintenances, repairs or replacement by electrical electronic technology education graduates of the university. However, the university student needs to acquire innovative skill for maintaining the digital electronics appliances and as well become self employed after graduation.

Self- employment is a state of one being a boss of himself without working for a specific employer who pays them a consistent salary (Oluka and Ideh, 2021). According them, it refers to a situation where an individual thinks, plans, creates, begins and takes control of business activities. Thus, for one to be self-employed, he needs to acquire skills. This is in line with Ogundele, (2010) who noted that skill acquisition helps people already on a job, intending to work in any of the varieties of occupations needed by the society. Skills can be acquired in various ways which public university is one of them.

However, public university being one of the Tertiary institutes in Anambra State offers different programmes which includes Electrical Electronics Technology Education programme EETE. Electrical/Electronics Technology Education EETE is one of the core areas of specialization in the technical education programme, which prepares learners for teaching and industrial engagements, through the provision of knowledge, skills and attitudes desirable in the world of work (Chukwuedo & Omofonmwan, 2013; Iliya, 2011). Electrical/electronics technology Education EETE is a subject area that involves the teaching of some abstract concepts such as application of electronic circuits, appliances and product atomic structure, flow of electrons, power generation, transmission and distribution, circuit design, electromagnetism, logic gates, circuit theory, amplifiers among others (Ogbunaya & Efuwape, 2018). It is said that electrical/electronics technology education undergraduate students become technologist, technical teachers after graduation. However, these technologists works frequently as members of engineering team in the areas of maintenance, installation, manufacturing, product development, and other applications of Electrical/electronics products and devices (Ohanu & Ogbuanya, 2018).

Maintenance is a service rendered which combine all technical, administrative and managerial actions during the lifecycle of an item, intended to retain it in, or restore it to a state in which it can perform

the required function (Jorge & Fernanda, 2015). Maintenance can be referred as an intended technical actions carried out to retain an item or restore it to a state in which it can perform its required function especially in the area of electrical installation. According to Bakare, Ojo and Akegbejo (2019) maintenance works are of different types which include; preventive, routine, emergency or corrective and predictive maintenance. Preventive maintenance according to Alabi & Nimmyel (2019) is a type of maintenance designed to preserve and restore equipment reliability by replacing worn components before they actually fail. One can say that it proceeds the routine maintenance made and implemented. Preventive maintenance proceeds the routine maintenance. Routine/Scheduled maintenance according to Aritonang and Sukardi (2019) is work based on known information, such as number of operations, hours run, mileage, etc., and can therefore be carried out at a predetermined time interval. Emergency or corrective maintenance according to Bakare, Ojo and Akegbejo (2019) is a maintenance operation which is carried out to correct malfunctioning component that has led equipment to break down. This dangerous situation can be prevented using some record keeping and reading of test to predict the initial fault so that it will not lead to breakdown of the installation. Predictive maintenance according to Aritonang and Sukardi (2019) is a maintenance that involves the use of computer softwares to predict equipment failure based on age, user demand and performance measures. In the university maintenance practices are generally done in the workshop

Workshop is a place where learners experiment, test, observe, manipulate, construct, dismantle, repair, design, create, imagine and study (Okorie in Ofombula and Ekereobong, 2012). According to Nwakanma and Izundu (2015) workshop serves as a training ground for students to acquire relevant skills in their field of their occupations. It is said to be a common practice class for the acquisition of practical skills in the prorgammes of the university. The electronics workshop practice had placed an emphasis on the design, construction and repairs of electrical/electronics circuits, devices or appliances.

In the university and electronics workshop in particular, more emphasis is placed on repairs or corrective maintenance of electrical/electronics appliances, apparently because the design and construction of digital electronics appliances may be higher or beyond the intellectual ability and internalization of the students. However, the corrective maintenance skills taught under the electronics technology workshop which were utilized in the maintenance of the likes of cathode ray tube (CRT) television, digital video display (DVD) home theatre cassette deck and turn table stereo sound system have been found to be obsolete in maintaining the newly emerged digital electronics appliances as a result of advancement in its technology.

The newly emerged digital electronics appliances include the likes of light emitting diode (LED) television and liquid crystal display (LCD) television which had succeeded the existing digital electronics appliances and thereby calls for improvement in the content of the course for effective maintenance of the newly emerged digital electronics appliances for self employment of the university graduates. However, the accelerating pace of innovation in technology has made a large number of job and skills obsolete and the technology of electronics appliances is not left behind, because it has improved immensely as a result of innovation. Hence, the innovative skills for digital electronics maintenance include but not limited to embedded system skills, automated system skills and Safety skills system skills.

Embedded system skill is a skill that involves the capacities in understanding the principle, design and operation of embedded systems (a combination of computer hardware and software implemented for maintenance purpose). Embedded system is a computer system with a dedicated function with a lager mechanical or electrical system (Michael, 2007). However, embedded system skill in electronics appliance maintenance involves the use of software which is embedded in computer hardware for easy faults analysis and identification in digital electronics appliance. Competency in embedded system would enhance manual dexterity and increase productivity in electronics appliances maintenance.

However, Mittal, (2014) noted that embedded system skills include; Competency in computer programming language, skills in understanding microprocessor internals (registers), a good understanding of digital and analog signal electronics and ability to understand memory regions and their uses. Thus, having the skills and theoretical knowledge on embedded system alone, is not enough to carry out an effective maintenance on digital electronics. However, for the students to be

grounded in the innovative skills they should also to master the use of automated tools and automated test equipment in repairs of digital electronics.

Automated system skill is a skill that involves the use of automated tools and automated test equipment as a medium of trouble shooting/fault finding and repairs based on computer-controlled system in digital electronics (Jose and Hubert, 2010). According to ELETimes (2022) Automatic Test Equipment ATE is computerized machinery that utilizes test instruments to complete and evaluate the results of functionality, quality, performance, and stress tests performed on electronic devices. According to Brett Daniel (2021) ATE controls, monitors, captures data using, and derives insights from a wide range of test instruments and signal source, including; Digital multi meters which is used in the voltage, current, and resistance measurements; LCR meters which is used in testing the inductance, capacitance, and resistance measurements, Digital storage oscilloscopes (DSOs) is used in displaying the signal voltages and analysis of amplitude, distortion, and other characteristics, Radio frequency (RF) or vector signal generators (VSGs) which is used in generating RF signal and Arbitrary waveform generators (AWGs) which is used in generating the user-defined electrical waveforms.

The devices tested by ATE include integrated circuits (ICs), printed circuit boards (PCBs), hard disk drives (HDDs), systems and modules in automobiles, and the various electronic systems and line-replaceable units (LRUs) that support aircraft, spacecraft, and satellites, a family of technologies known as avionics (Brett Daniel, 2021). However, the automated system skill required by electrical electronics technology education students for effective maintenance of digital electronics appliances include ability in the use of automatic optical and x-ray inspection tool in detecting both open circuits soldering defects and solder bridges, and ability in carrying out the system level test, In other to have a successful acquisition of innovative skills, one must apply safety practice skills in all he does.

Safety practice skills are those individualized skills that one is to apply in observing already laid down safety rules and regulations while working in the workshop. One can say that Safety practice skill is a skill that involves the conditions or efforts made towards being free from accident, casualty and hazardous state. These practices have been identified as an integral part of industrial activities which must be given a serious attention. It then mean for Electrical Electronics students to take precaution in preventing and minimizing an accident in the workshop which increases productivity output Safety practice skills will be the almost priority. Hence, the Safety practice skills required by electrical electronics technology education students for effective maintenance of digital electronics appliances include proper components assemblage and ability in the use of an appropriate fuses power rating.

However, if these innovative skills are practiced effectively in university, the students will be equipped with the relevant skills for self employment after graduation. It is against this background that the researcher sought to determine the innovative skills required for maintaining digital electronics by Electrical Electronics Technology Education graduates in Anambra State.

Statement of the Problem

The advancement in electronics Technology appliances has drastically taken a new dimension and demands a corresponding change in the maintenance skills of university Electrical/Electronics Technology education graduates. Thus, in the recent time, the emerged digital electronics appliances like light emitting diode (LED) television and liquid crystal display (LCD) television had succeeded the existing digital electronics appliances like cathode ray tube (CRT) television, digital video display (DVD) home theatre sound system, cassette deck and turn table stereo sound system. However, the skills required in maintaining the newly emerged digital electronics had become obsolete as a result of the advancement in technology and have suffered a technical incapability.

Thus, these could be as a result of lack of proper training on the emerged technologies in the digital electronics appliances and this had resulted to the use of trial and error system in digital electronics appliances maintenance. Therefore to avoid this menace, the university Electrical/Electronics Technology education graduates is to be equipped with these innovative skills for maintaining digital electronics for self employment after graduation thereby reducing the rate of unemployment in Anambra State. Consequently, the study therefore sought to determine the innovative skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances in Anambra State.

Purpose of the Study

The main purpose of the study was to determine the innovative skills required by Electrical Electronics Technology Education Students for effective maintenance of digital electronics appliances in Anambra State. Specifically, the study sought to determine the;

1. embedded system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State.
.2. automated system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State.
3. safety practice skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State.

Research Questions

The following research questions guided the study:

1. What are the embedded system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State?
2. What are the automated system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State?
3. What are the safety practice skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State?

Hypotheses

The following null hypotheses were tested at .05 level of significance:

1: There is no significant difference in the mean ratings of lecturers and technologist on the embedded system skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

2: There is no significant difference in the mean ratings of lecturers and technologist on the automated system skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

3: There is no significant difference in the mean ratings of lecturers and technologist on the safety practice skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

RESEARCH METHODS

The study employed a descriptive survey research design. A descriptive survey research design according to Idoko (2011) is concerned with the collection, analysis, interpretation of data the way they existed from relevant sources with appropriate tools, methods and then, using the result of the interpretation to describe the existing situations, events, characters, opinions, behaviors', belief and relationship that which generations are made over the entire population from ample of a sample population. The design was used because the researcher made use of questionnaire to collect data from Electrical/Electronics technology Lecturers Nnamdi Azikiwe university Awka, and Electrical/Electronics Technologist in Anambra State Metropolis consisting of Awka, Nkpor and Onitsha. These areas were chosen because of high level of development/industrialization in the area, availability of schools and number of TVE workshops located in the area.

The population for the study comprised of 72 respondents which made up of 12 Electrical/Electronics Technology Lecturers from Nnamdi Azikiwe University Awka and 60 Electrical/Electronics Technology in Anambra State Metropolis consisting of Awka, Nkpor, and Onitsha. The entire population was used for the study because the population size was manageable, therefore no sampling was made.

The study made use of a structured questionnaire developed by the researcher for the collection of data. The questionnaire titled Innovative Skills Required by Electrical Electronics Technology Education Students for Effective Maintenance of Digital Electronics Appliances (ISREETESEMDEA) was made up of two parts, 1 and 2.Part I, collected the respondents bio-data while part 2 constitutes 35 item statements produced after extensive literature review divided into section A, B & C according to the 3 research questions that guided the study. A four point rating and weighted values were applied to each item in section A - B respectively as; Strongly Agree (SA)-4; Agree (A)-3; Disagree (D)- 2 and Strongly Disagree(SD) – 1.

The instrument was subjected to face validation using three experts; two experts were from department of Technology and Vocational Education option of Electrical/Electronics Technology Education and one experts from the Department of Science and Computer (Measurement and Evaluation) Education, all from Enugu State University of Science and Technology. They read the copies of the instrument, checked the contents and clarity and suitability of the items in answering the research questions that guided the study, and also in texting the null hypotheses in the study. Their comments, corrections and suggestions contributed in the modification and production of the final drafting of the instrument use by the study.

The reliability of the instrument was determined using Cronbach Alpha. The reliability index arising from this method achieves a degree of internal consistency of the instrument, it yielded a reliability coefficient of 0.75, indicating that the instrument is reliable and suitable for data collection for the study. 77 copies of the questionnaire were administered by hand to the TVE (Electrical/Electronics Technology) Educators and her Youths/graduates by the researcher with the help of three research assistants and guided them on how to successfully administer the questionnaire to the respondents and help them properly fill and complete the questionnaire and collect them back. The researcher and his assistant administered the questionnaire to the respondents and collected them back by hand after completion. Out of 77 copies of the questionnaire that was administered 72 were filled and retrieved. Hence there was 96% return rate, and same number was used for data analyses of the study.

Mean and standard deviation were used to analyze the data collected from the items for answering the research questions based on the four-point rating scale. The decision rule was that any items with mean score 2.50 and above was regarded as agree while any item with mean score less than 2.50 was regarded as disagree. The standard deviation was used to determine the closeness or otherwise of the opinions of the respondents from the group data. The t-test of significant difference between two independent means were used to test the hypotheses at 0.05 probability level. In testing the hypotheses, the decision was that if the value of calculated 't' is equal or greater than the given table 't', at 0.05 level of significance, the null hypothesis was rejected otherwise do not reject.

Research Question 1: *What are the embedded system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State?*

Table 1: Mean Ratings and Standard Deviations of the Respondent on Embedded System Skills Required

S/N	embedded system skills required for effective maintenance of digital electronics appliances include;	EETE Lectures N=12		E/E Technologist N =60		Overall		Decision
		$\overline{X_1}$	SD_1	$\overline{X_2}$	SD_2	$\overline{X_G}$	SD_G	
1	Good understanding of direct memory access	2.97	0.93	3.31	0.68	3.12	0.85	Required
2	Ability in understanding the different kinds of memory	2.97	0.90	3.51	0.67	3.05	0.82	Required
3	Ability in debugging the mult-tasking code	3.03	0.74	3.23	0.59	3.11	0.69	Required
4	Competency in computer programming language	3.03	0.74	3.23	0.58	3.10	0.68	Required
5	Good understanding of boolean math	2.87	0.83	3.27	0.60	3.09	0.77	Required
6	Ability to understand memory regions and their use	3.03	0.83	3.23	0.58	3.11	0.74	Required
7	skills in understanding microprocessor internals (registers)	3.03	0.82	3.26	0.60	3.05	0.75	Required
8	Ability to debug breakpoints	2.89	0.75	3.27	0.60	3.03	0.72	Required
9	Ability to read and understand schematics	2.89	0.75	3.23	0.65	3.06	0.73	Required
10	understanding of digital and analog signal electronics	2.97	0.58	3.19	0.63	3.06	0.61	Required
11	competency in at least one assembly language	2.97	0.63	2.19	0.69	3.06	0.66	Required
12	skill in effective use of an oscilloscope	2.89	0.57	3.23	0.65	3.02	0.62	Required
13	Ability in using of microcontroller fundamentals	2.89	0.55	3.27	0.67	3.05	0.62	Required
14	skills in debounding of switches, resistive ladder, rotary encoders	2.89	0.55	3.19	0.57	3.02	0.57	Required
	Cluster Mean/ Standard Deviation	**2.93**	**0.72**	**3.03**	**0.62**	**3.05**	**0.70**	Required

Note: X =Mean; SD = Standard Deviation; N = Number of respondents;

The result of data analysis in **Table 1** shows that the mean ratings of the respondent's responses ranges from 3.02 to 3.12, indicating that all the items in the embedded system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State. The cluster mean of 3.05 further depicts that the itemized are the embedded system skills required for effective maintenance of digital electronics appliances. The low standard deviation of 0.70 indicates that the respondents have consensus opinion in their responses to the items.

Hypothesis 1

There is no significant difference in the mean ratings of lecturers and technologist on the embedded system skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

Table 2: t-test statistics on the mean ratings of lecturers and technologist on the embedded system skills (N=72)

Variables	N	t	df	Sig. (2tailed)	Mean Difference	Std. Error Difference	Decision
EETE LECTURERS	12	0.153	72	.085	4.80769	2.23331	NS
E/E TECHNOLOGIST	60						

The result of t-test analysis in Table 2 shows that the t-value at 0.05 level of significant and 72 degree of freedom for 14 items is 0.153 with a significant value of 0.085. Since the significant value of 0.0.85 is more than the 0.05 level of significant the null hypothesis is not significant. This implies that there is no significant difference between the mean ratings of lecturers and technologist on the embedded system skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

Research Question 2

What are the automated system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State?

Table 3: Mean Ratings and Standard Deviations of the Respondent on the Automated System Skills

S/N	Automated system skills required for effective maintenance of digital electronics appliances include;	EETE Lectures N=12		E/E Technologist N = 60		Overall		Decision
		$\overline{X_1}$	SD_1	$\overline{X_2}$	SD_2	$\overline{X_G}$	SD_G	
15	skill in the use of automatic optical and x-ray inspection	2.79	0.76	3.31	0.62	3.00	0.75	Required
16	Ability in identifying the misaligned component	2.79	0.77	3.19	0.80	2.95	0.79	Required
17	Ability in identifying the incorrect component value	2.95	0.79	3.15	0.85	3.03	0.81	Required
18	Ability in the use of boundary scan technique	2.92	0.84	3.12	0.82	3.00	0.83	Required
19	Ability in the use logic analyzer	2.95	0.86	3.19	0.75	3.05	0.82	Required
20	Ability in carrying out system level test	2.89	0.85	3.23	0.75	3.03	0.82	Required
21	Ability in carrying out memory testing	2.97	0.67	3.27	0.78	3.09	0.72	Required
22	Ability in carrying out flash programming	2.93	0.51	3.26	0.77	3.08	0.64	Required
23	Ability in carrying out CPU emulation	2.87	0.69	3.19	0.89	3.00	0.79	Required
24	Ability in carrying out FPGA programming	2.92	0.53	3.19	0.89	3.04	0.71	Required
25	Ability in the use of frequency counter	2.85	0.71	3.23	0.86	3.00	0.79	Required
26	Ability in the use of arbitrary waveform generator	2.79	0.77	3.19	0.75	2.95	0.78	Required
27	Ability in the use of RF Network analyzer	3.13	0.66	3.23	0.76	3.17	0.70	Required
	Cluster Mean/ Standard Deviation	**2.90**	**0.72**	**2.97**	**0.79**	**3.03**	**0.77**	Required

Note: X =Mean; SD = Standard Deviation; N = Number of respondents;

The result of data analysis presented in **Table 3** above indicated that the overall mean rating ranges from 2.95 to 3.17 indicating highly needed. This implies that the items are among the automated system skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State. The low standard deviation of 0.77 submits that the respondents' opinions did not differ remarkably concerning the items on the automated system skills required for effective maintenance of digital electronics appliances.

Hypothesis 2

There is no significant difference in the mean ratings of lecturers and technologist on the automated system skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

Table 4:

t-test statistics on the mean ratings of lecturers and technologist on the automated system skills (N=72)

Variables	N	t	df	Sig. (2tailed)	Mean Difference	Std. Error Difference	Decision
EETE LECTURERS	12	1.816	72	.074	3.97436	2.18892	NS
E/E TECHNOLOGIST	60						

The result of t-test statistic indicates that the t- value at .05 level of significance and 72 degree of freedom is 1.816 and the significant level is 0.074. Since the significant value of 0.074is more than the 0.05 level of significant the null hypothesis is not significant. The implication is that no significant differences exist in the mean ratings of lecturers and technologist on the automated system skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

Research Question 3

What are the Safety practice skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State?

Table 5: Mean Ratings and Standard Deviations of the Respondent on the Safety Practice Skills

S/N	Safety practice skills required for effective maintenance of digital electronics appliances include;	EETE Lectures N=12		E/E Technologist N =60		Overall		Decision
		$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	$\overline{X}_G$	SD_G	
28	Ability in the use of correct fuse appropriate power rating	3.05	0.60	3.04	0.82	3.05	0.69	Required
29	Ability in the appropriate use of circuit breakers	3.03	0.58	3.19	0.75	3.09	0.65	Required
30	Ability in detecting the wire code	3.02	0.58	3.19	0.74	3.09	0.66	Required
31	Ability in proper components assemblage	3.00	0.61	3.15	0.73	3.06	0.66	Required
32	Proper use of safety clothes and gloves	2.87	0.57	3.12	0.77	2.96	0.66	Required
33	Ability in enclosing of all electrical contacts and conductors	2.92	0.62	3.15	0.67	3.02	0.65	Required
34	Providing guards against hazardous condition	2.92	0.62	3.15	0.67	3.01	0.64	Required
35	Testing the tools and equipment before use	3.05	0.60	3.12	0.65	3.08	0.62	Required
	Cluster mean/SD	**2.98**	**0.62**	**3.14**	**0.73**	**3.04**	**0.65**	Required

Note: X =Mean; SD = Standard Deviation; N = Number of respondents

The analysis of data presented in **Table 5** above shows that the overall mean rating ranging from 2.96 to and 3.09 showing highly needed. This means that the items the respondents agree to the items as the Safety practice skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State. The overall cluster mean

of 3.04 further indicates that the items are the Safety practice skills required by Electrical Electronics Technology Education student for effective maintenance of digital electronics appliances of in Anambra State. The low standard deviation of 0.65 indicates that the respondents have similar opinion to the items.

Hypothesis 3

There is no significant difference in the mean ratings of lecturers and technologist on the safety practice skills required by Electrical Electronics Technology Education (EETE) student for effective maintenance of digital electronics appliances in the public university in Anambra State.

Table 6:

Summary of t-test analysis of mean ratings of lecturers and technologist on the Safety practice skills (N=72).

Variables	N	t	df	Sig. (2tailed)	Mean Difference	Std. Error Difference	Decision
EETE LECTURERS	40	1.075	72	.286	1.24359	1.15673	NS
E/ETECHNOLOGIST	30						

The result of t-test analysis in Table 6 shows that the t-value at 0.05 level of significant and 72 degree of freedom for the items is 1.075 with a significant value of 0.286. Since the significant value of 0.286 is more than the 0.05 level of significant the null hypothesis is not significant. This means that there is no significant difference regarding the items on the ratings of lecturers and technologist on the safety skills.

Major Findings

The following are the embedded system skills required by electrical electronics technology education student for effective maintenance of digital electronics appliances of in Anambra State which include; ability to debug mult-tasking code, competency in computer programming language, good understanding of boolean math, ability to understand memory regions and their use, skills in understanding microprocessor internals (registers), ability to debug breakpoints, ability to read and understand schematics, understanding of digital and analog signal electronics, competency in at least one assembly language, skill in effective use of an oscilloscope, ability in using the microcontroller fundamentals, skills in debounding of switches, resistive ladder, rotary encoders, ability in understanding the different kinds of memory and good understanding of direct memory access.

The following are the automated system skills required by electrical electronics technology education student for effective maintenance of digital electronics appliances of in Anambra State which include; ability in identifying the misaligned component, skill in the use of automatic optical and x-ray inspection, ability in identifying the incorrect component value, skills in the use of boundary scan technique, skills in the use logic analyzer, ability in carrying out system level test, ability in carrying out memory testing, ability in carrying out flash programming, ability in carrying out CPU emulation, ability in carrying out FPGA programming, skills in the use of frequency counter, skills in the use of arbitrary waveform generator and skills in the use of RF network analyzer.

The following are the safety practice skills required by electrical electronics technology education student for effective maintenance of digital electronics appliances of in Anambra State which include; ability in the use of correct fuse appropriate power rating, ability in the use of correct fuse appropriate power rating, ability in the appropriate use of circuit breakers, ability in detecting the wire code, ability in detecting the wire code, proper use of safety clothes and gloves, ability in enclosing of all electrical contacts and conductors, providing guards against hazardous condition and testing the tools and equipment before use.

DISCUSSION OF FINDINGS

Thus, the newly emerged digital electronics appliances in likes of light emitting diode (LED) television and liquid crystal display (LCD) television replaced the existing digital electronics appliances which include cathode ray tube (CRT) television and digital video display (DVD) home theatre sound system, gives room for Electrical Electronics Technology Education students to acquire the innovative skills required for effective maintenance of this new32newly digital electronics appliances in Anambra State. However, the skills required in maintaining the newly emerged digital

electronics had become obsolete as a result of the advancement in technology and have suffered a technical incapability. This is in line with Alio (2010) who noted that the accelerating pace of technology has made a large number of job and skill obsolete.

However, the study also revealed that the skills required by Electrical Electronics Technology Education students in debugging mult-tasking code, using the computer programming language, making proper use of boolean math, proper debugging of breakpoints, effective use of an oscilloscope, adequate in the use of microcontroller fundamentals were highly required in the embedded system skills required by electrical electronics technology education student for effective maintenance of digital electronics appliances of in Anambra State. This is commendable because no effective maintenance of digital electronics appliances is achievable without effective mastery in this area. This is in line with (Alio & Onyebuenyi, 2018) whom stated that these digital electronics appliances often develop fault when they are in use as a result of voltage fluctuations, thunder effects, temperature, dust and poor handling and demands emerging technological skills for their maintenances, repairs or replacement.

The study also revealed that ability in identifying the misaligned component, skill in the use of automatic optical and x-ray inspection, ability in identifying the incorrect component value, skills in the use of boundary scan technique, skills in the use logic analyzer, ability in carrying out system level test, ability in carrying out memory testing, ability in carrying out flash programming, ability in carrying out CPU emulation and ability in carrying out FPGA programming, skills in the use of frequency counter is highly required. This suggests that a sustainable automation is one of the major skills required for detecting faults in the digital electronics appliances. This is in line with Jose and Hubert, (2010) who asserted that acquisition of effective skill in the use of automatic optical and x-ray inspection machine as automatic tool is useful in detecting; insufficient solder, solder shorts, solder bridges and open circuits soldering defects and likes.

However, the study also revealed that the EETE students ability in the use of correct fuse appropriate power rating, ability in the use of correct fuse appropriate power rating, ability in the appropriate use of circuit breakers, ability in detecting the wire code, ability in detecting the wire code, proper use of safety clothes and gloves, ability in enclosing of all electrical contacts and conductors, providing guards against hazardous condition and testing the tools and equipment before use is required by EETE students in order to protect the life of human, equipment and materials, and without effective acquisition of safety practice skills occupational hazards (injuries and ill-health) will occur. This is in line with (Alio & Onyebuenyi, 2018) whom stated that the digital electronics maintenance workshop with good working environment and safety measures will always experience an improved productivity in work output.

CONCLUSION

Based on the findings of the study, the maintenances, detecting of fault, repairs, replacement and productivity in the newly emerged digital electronics appliances can be achievable through the introduction of these technological innovations in the form of the embedded system, automated system and safety skills required by EETE students in Anambra State. However, the study have provided information on embedded and automated system skills and the need for the skills which involves the use of a software embedded in computer hardware for maintaining and automated equipment for detecting of fault in the digital electronics appliances for self employment, work delivery and effective work productivity of the university students in Anambra State. This would also enable the lecturer to appreciate the advent of computer in teaching and its utilization in the maintenance works especially in digital electronics appliances.

Furthermore, Safety practice skills and its relevance for effective productivity especially in electrical/electronics works have been identified and are required in training the EETE students for optimum performance. On these bases, the study made it necessary to incorporate the identified skills into the curriculum programme of EETE for effective teaching and learning which would lead to self employment of EETE students after graduation in Anambra State.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made;

1. There should be an incorporation of the identified innovative skills for maintaining digital electronics appliances in EETE curriculum for effective teaching, learning and acquisition of saleable skills for almost productivity and a functional approach in meeting the contemporary needs of the nation.
2. The Government at all level should endeavor to provide the necessary facilities, tools and equipment required for effective workshop practices by EETE university students.
3. University lecturers should be trained and retrained on the adoption and utilization of the identified skills, tools and equipment required for effective teaching, learning and impartation of knowledge and the innovative skills on the students .

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