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Skills retraining programmes for electronic laboratory technologists in universities in developing countries like Nigeria

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Abstract. The dynamic nature of the world had resulted in state of the art electronics gadgets. This has led to calls for periodic analysis of the skills retraining programmes of electronic laboratory technologists in Universities. The study adopted the survey research design. The target population for the study was 68electronic laboratory technologists. A 60task items structured questionnaire was used for data collection. The instrument was validated by three experts and a reliability coefficient of 0.72 obtained. Data were collected and analyzed using statistical package for social sciences (SPSS, version, 24). Mean, standard deviation, Cronbach's Alpha, and principal component analysis were the statistical tools used for data analysis. Findings in the study revealed that 5 major skills retraining programmes are often deployed by electronic laboratory technologists and therefore requires module development. The study therefore recommend that a committee of experts should be inaugurated urgently to design a comprehensive module for electronic laboratory technologists that will include these five major skills retraining programmes and should be reviewed periodically.

Keywords. Electronic Laboratory, Electronic Technologists, skills retraining programmes

Introduction

In the electronics laboratories of Universities, highly trained personnel who are required to man the various units and to act as instructors giving pedagogical instructions to the students during practical are engaged. These trained personnel are referred to as electronic laboratory technologists and they are experts in the manipulation of electronics apparatus, instruments and equipment in the performance of required electronic experiments, demonstrations and repairs and maintenance of electronic gadgets in the classrooms. In most institutions of learning, there are electronic laboratories such as electrostatic laboratories where experiments on those areas of electronics which deals on static electricity are practically carried out (Federal Government of Nigeria, 2014). The use of capacitors and capacitive resistance of components are studied and experimented on in such electrostatic laboratories. In other universities, there are also special laboratories for instruments and measuring devices. In these laboratories, the principles of working of those instruments are studied and characteristics of such instruments are determined that would help the students in identifying such instruments (Okunade, 2013). These instruments are voltmeters, ammeters, avometer and cathode ray oscilloscopes (CRO),

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Meter Bridge, potentiometer, multi-meters and mega meter and calibration of meters. Electronic laboratory technologists are therefore required to possess composite skills on areas of electronics engineering and should be able to also impact such knowledge and skills to students assigned to them for practical's in the laboratories. Not only manipulative skills are required, cognitive skills are also required by electronic laboratory technologists to detect and troubleshoot the equipment to detect faulty functional parts by taking data and analysis of the values of the components (Okeme, & Aneke, 2016).

Hence, electronic laboratory technologists require skills that need to be up-graded and also to be evolving with modern information and communication technology skills. Skills are required behaviours exhibited in the process of performing a task. They are the activity required for the purpose of performance of a task. Kratawohl as cited in Toby (2000) defined skills and abilities as organized mode of operations and generalized techniques for dealing with materials and problems. The materials and problems in this case are the knowledge that the laboratory technologists have to internalize or the behaviour they have to exhibit. And as such, specific skills retraining programmes are required through laboratory processes which require specialized and technical information and manipulations in dealing with the problems and materials required(Robert, 2012). Analyses of these specific skills retraining programmes by electronic technologists require some mental processes in organizing the materials so as to achieve a particular purpose. In this case, the materials in the laboratories are consumables or apparatus or applications arrayed or connected or in the case of MATLAB run on a computer to achieve a learning objective.

However, the dynamic nature of the world had resulted in state of the art electronics gadgets. According to Chukwuedo and Osaigbovo (2017), the world of electronic technology is exponentially increasing in its technological dimensions. This has led to consistent production of electronic gadgets that arithmetically and geometrically replace the progression of the existing ones. Modern electronic technologies are used in detection of faults, automobile, automotive engineering, maritime technology autotronics and other aspects of life.Hence, the emergence of the state of the art technology in electronics calls for periodicanalysis of the skills retraining programmes of technologists in the various field of electronic technology. According to Wilburn and Wilburn (2010) electronics technology is a fast emerging technology and if analyses of technologists'skills retraining programmes arenot carried out periodically, skills previously learnt may quickly obsolete and the individuals become un-skilled as regards modern technology. Considering the state of the art electronics gadgets in modern laboratories, it becomes imperative to analyze the skills retraining programmes of technologists in the electronic laboratories of Universitiesin Edo and Delta States of Nigeria. The study also analyzed the task required and performed by electronics laboratory technologists in Universities.The significance of this study is that it may guarantee the production of university graduates and electronics teachers with relevant skills and competencies for industries, universities and the nation at large.

Statement of the Problem

Electrical and Electronics technological had over the years been acquired with obsolete skills and trained with very old analog and near obsolete equipment and devices. Many employers are not satisfied with the level of skills possessed by engineers and technologists graduated from universities. In most developing countries universities only earned their reputation only on theories and not on practical skills training and innovations

To be able to bridge the gap between practical and theory, there is the need to undertake studies to find the most required skills and equipments required for training laboratory technologists so

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as to equip them with the necessary skills for teaching the students, universities in developing countries are being urged to bridge the gap between the developing economics in digital electronics and information and communication technology (ICT) and other industrial applications.

Research Objectives

1. Identify the contents of the skills retraining performance for electronics laboratory technologist
2. Identify the necessary facilities and equipments needed for the skills retaining obtaining laboratory technologists in the universities.
3. Identify the task analysis for skills retraining programme for electrical technologists on the job of performing experiments in the laboratories

Methods

The study was carried out usingthe survey research design. The population of the study consisted of 76 electronics laboratory technologists who are presently serving in four (4) public universities in Edo and Delta states, namely; University of Benin, Benin City, Ambrose Alli University, Ekpoma, Delta State University, Abraka, and Federal University of Petroleum Resources (FUPRE), Effurun. The other privately owned Universities in Edo and Delta states do not have accredited courses in Electronics Engineering and Industrial Technology Education with Electrical/Electronic option. Therefore they do not have electronics laboratories. Since the population was of a manageable size, there was no sampling.

The instrument for data collection was a self-structured questionnaire. Each item in the instrument was assigned a five-point Likert scale response of Always Utilized (AU), Often Utilized (OU), Undecided (U), Rarely Utilized (RU), Never Utilized (NU) respectively with corresponding numerical values of 5, 4, 3, 2, and 1 were adopted in the instrument design.The draft copies of the research instrument were subjected to face validation by three experts. The internal consistency of the instrument was determined using the Cronbach alpha reliability technique. The overall reliability coefficient for the research instrument obtained was 0.72.

Seventy six (76) copies of the questionnaire were administered to the respondents with the help of four (4) research assistants who had been previously briefed by the researcher. At the end of two weeks, the research assistants went round for the collection of the copies of the questionnaire from the respondents. Sixty-eight (68) copies of the questionnaire were collected which represents 89.5 percent return rate.Data collected from the respondents were analyzed using Mean Item Score (MIS),standard deviation, and factor analysis. Statistical Packages for Social Sciences (SPSS) version 24.0 was employed to analyze the data collected from the respondents.

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Results

The 60 identified skills retraining programmes of electronic laboratory technologists were subjected to principal component analysis (PCA). Prior to performing the PCA, the suitability of data for factor analysis was assessed using both the KMO test and Bartlett's test of sphericity.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.531
Bartlett's Test of Sphericity	Approx. Chi-Square	3014.656
	Df	136
	Sig.	.000

Source: Researcher's computations with SPSS

Table 1 presents the results of the KMO with the data returning a value of sampling adequacy of 0.531. This is considered sufficient to conduct a factor analysis as any value above 0.5 (the cut-off point) is considered acceptable (Wilburn & Wilburn, 2010). The p-value of Bartlett's test of sphericity (represented by "Sig"), indicates a measure of the multivariate normality of the set of distributions. According to Gall, Gall and Borg (2007), a significant value (< 0.05) indicates that the data does not produce an identity matrix and are thus acceptable for factor analysis. This set of data returned a significance value of 0.000, indicating that the data was acceptable for factor analysis. Also, the latent root or Kaiser's criterion of retaining the skills retraining programmes factors with eigen values greater than 1.0 was employed. Hence, five competency factors with eigen values exceeding 1 were retained, resulting in 69.473 percent of the variance.

Table 2: Summary Statistics of Clustered Mean, Standard Deviation, and Factor Loading of Electronic Laboratory Technologists' Responses

S/N	Skills retraining programmesfor electronics laboratory technologists	α	Mean	SD	Factors 1	2	3	4	5
1	Identify the steps that must be followed to perform the experiment; identify the tools, equipment and apparatus and distributes to students	.71	3.04	.53	.82				
2	Recognize the dangers associated with the performance of the task and take precautionary measures; ensure safety of staff, students and materials	.69	3.37	.88		.69			
3	Draw circuit diagrams and interpret. Set-up apparatus and connect circuit, set-up network operating systems and install MATLAB application systems	.75	3.51	.71			.71		
4	Describe the theory of why a properly performed task works and instructs students. Run the experiment and	.67	3.29	.64				.53	

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	perform MATLAB experiment using computer					
5	Take readings and evaluate a properly performed task and calculate percentage error. Write the report of the experiment using the proper technical report writing format	.86	3.09	.59		.47

Source: Researcher's computations with SPSS

Table 2 show the clustered responses of the electronic laboratory technologists on the skills retraining programmes most frequently used in the laboratory. The results of mean and Cronbach's Alpha in Table 2 showed that these five major skills retraining programmes are needed and frequently used by the electronic laboratory technologists in Universities in Edo and Delta States. The cluster of the factor loading equally confirms the importance of five factor solution. These five clusters of skills retraining programmes factors together have a total cumulative percentage of 69.473 percent of the total importance which highlights their significance from the sixty skills retraining programmes of electronic laboratory technologists.

Conclusion

Electrical and Electronics technology are a major disciplines in universities that enable graduates to perform the various tasks and technical jobs associated with actualizing the use of electrical energy and electronics in performing tasks in industries, homes and in information and communication technology. In modern world, information and communication technology is a sine-qua non-practical and experiment in electronics laboratory are necessary courses of study towards acquiring skills in technology and engineering, five major skills retraining programmes are often performed by electronic laboratory technologists in Universities in Edo and Delta States. However, we live in a dynamic world where technology development is continually evolving and so, curriculum developments should also evolve to reflect the change. Thus, the teaching of laboratory skills retraining programmes associated with modern electronics in Universities should be an urgent necessity in Universities so as to produce the required, competent and skilled manpower that will carry out the maintenance of the devices at their down time.

Recommendation

Based on the result of the study, the following recommendations are made and advocated.

1. It is recommended that a committee of experts should be inaugurated urgently to design comprehensive module for electronic laboratory technologists.
2. Such modules should be periodically reviewed to reflect the dynamics of the chopping world of electronics.
3. Universities should be equipped with appropriate equipment and facilities for executing different skill retraining programmes for major areas of technology and digital electronics.

The study therefore showed that the periodic task analyses of electronic laboratory technologists are necessities in Universities' curriculum. The study therefore advocated contents or topics that are necessary via skills retraining programmes analysis, for module development. The study therefore recommends that committee of experts should be inaugurated urgently to design a comprehensive module for electronic laboratory technologists and such

module should be reviewed periodically. Additionally, Universities should be equipped with the appropriate facilities for executing different skills retraining programmes of electronic laboratory technologists.

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APPENDIX

Dear Respondent,

QUESTIONNAIRE ON THE SKILLS RETRAINING PROGRAMME FOR ELECTRONIC LABORATORY TECHNOLOGISTS IN UNIVERSITIES IN EDO AND DELTA STATES

I am carrying out a research study on the topic: "skills retraining programme for electronic laboratory technologists in universities in Edo and Delta States". Kindly assist me by indicating your opinion where necessary. This study is strictly for academic purpose and you are hereby assured that all information supplied will be treated in a strictly confidential manner.

Thank you.

Yours faithfully,
Osaigbovo Louis Odaro

Instruction: Please tick **(√)** appropriately in the sections that follow. Please indicate the extent of your agreement to the following items in the table below which relates to the skills retraining programmes for electronic laboratory technologists:
KEY: Aways Utilized (AU) Often Utilized (OU) (Undecided) U Rarely Utility (RU) Never Utilized (NU)

S/N	Skills retraining programmes often carried out by electronic laboratory technologists	5	4	3	2	1
1	Trains and directs the work of students					
2	Ensure the laboratory is well-stocked and resourced with sufficient supplies					
3	Review technical documents to plan work					
4	Establishes and maintains electronics laboratory procedures					
5	Perform day-to-day administrative skills retraining programmes such as maintaining information files and processing paperwork					
6	Establish long-range objectives and specify the strategies and actions to achieve them					
7	Providing guidance and direction to subordinates, including setting performance standards and monitoring performance					
8	Provide guidance and expert advice to management or other groups on technical, systems, or process-related topics					
9	Assemble electronic systems or prototypes, using hand tools or measuring instruments					
10	Plan method or sequence of operations for developing or testing experimental electronic equipment					
11	Write specifications to clarify design details or functional criteria of experimental electronics units					
12	Perform supervisory duties, such as recommending work assignments, approving leaves, or completing performance evaluations					
13	Trains and guides students to assure proper operation and maintenance of equipment and laboratory; distributes parts to students for use in laboratory exercises					
14	Carry out risk assessments					
15	Disinfect and clean the electronic equipment and working area					

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16	Ensure health, safety, and security procedures are followed					
17	Identify and resolve equipment malfunctions					
18	Handle complaints, settle disputes, and resolve grievances and conflicts, or otherwise negotiating with others					
19	Collaborate with other personnel to identify, define, or solve developmental problems					
20	Servicing, repairing, adjusting, and testing machines, devices and equipment that operate primarily on the basis of electronic principles					
21	Use relevant information and individual judgment to determine whether processes comply with laws, regulations or standards					
22	Getting members of a group to work together to accomplish skills retraining programmes					
23	Inspect electronic project work for quality control and assurance					
24	Inspect equipment, structures, or materials to identify the cause of errors or other problems or defects					
25	Installs, administers and monitors network operating system in computers in the laboratory					
26	Read blueprints, wiring diagrams, schematic drawings, or instructions for assembling electronics units					
27	Confer with other personnel to resolve design or operational problems					
28	Assemble electronic equipment or components					
29	Maintain working knowledge of state-of-the-art tools or software by reading or attending conferences, workshops, or other training					
30	Create physical electronic models or prototypes					
31	Fabricate parts, such as coils, terminal boards, or chassis, using bench lathes, drills, or other machine tools					
32	Provide documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used					
33	Develop, design, or create new applications, ideas, relationships, systems, or products, including artistic contributions					
34	Plan, schedule, or monitor work of project support personnel					
35	Prepare electronic project cost or work-time estimates					
36	Installs application systems like MATLAB in the computers in the laboratory					
37	Troubleshoots, repairs, calibrates and designs circuits and fabricates electronic test equipment					
38	Loads and configures software utilities or applications used to facilitate the operation of computer					
39	Conduct and support scientific investigations and experiments					
40	Plan, set-up and undertake controlled experiments and trials					
41	Apply knowledge of electronic theory and components					
42	Resolve operational performance problems					
43	Test performance of electronic or integrated systems or equipment					
44	Adjust or replace defective or improperly functioning circuitry or electronics components using hand tools or soldering iron					

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45	Use either control mechanisms or direct physical activity to operate electronics equipment or processes					
46	Identify the educational needs of others, developing formal educational or training programs or classes, and teaching or instructing others					
47	Identify the developmental needs of others and coaching, mentoring, or otherwise helping others to improve their knowledge or skills					
48	Write procedures for the commissioning of electronic installations					
49	Provide technical support and present results to senior staff					
50	Writing reports, reviews and summaries					
51	Test procedures and practices to ensure the veracity of resulting information					
52	Maintain detailed and accurate records of research findings					
53	Enter test results into a database and ensure that all information is both current and accurate					
54	Test electronics units, using standard test equipment, and analyze results to evaluate performance and determine need for adjustment					
55	Maintain system logs or manuals to document testing or operation of equipment					
56	Analyze information and evaluate results to choose the best solution and solve problems					
57	Modify electronic prototypes, parts, assemblies, or systems to correct functional deviations					
58	Provide technical assistance in resolving electronic problems encountered before, during, or after construction					
59	Interpret test information to resolve design-related problems					
60	Evaluate properly performed task analysis and calculate percentage error in the skills retraining programmes performed					