Development and Implementation of Apprenticeship Training Programme on Electrical/Electronic Technology Education for Sustainable Workforce in Nigeria

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Abstract

*T*he study determined the needed techniques on the development and Implementation of apprenticeship training programme on electrical/ electronic technology for sustainable workforce. The study answered four research questions and one hypothesis. Descriptive survey was adopted to carry out the research at Awka Educational Zone of Anambra State. The population of study was 35 respondents, comprising of 16 Electrical/ Electronic Technology Education Lecturers and 19 Electrical/Electronic Engineering Technology Lecturers from the Zone. There was no sampling due to smallness of the population, an intact population was used. A 22 – item questionnaire titled, 'Development and Implementation of apprenticeship training programme on electrical/ electronic technology education for sustainable workforce (DIATPSW) was used for data collection; which was validated by three experts and also try tested outside the area of study. The reliability of the instrument was 0.83 established using Cronbach Alpha. The questionnaire items were generated from the review of the related literature. Out of 35 questionnaires administered,34 of them were returned. Mean and standard deviation were used to answer the eight research questions while the null hypothesis was tested 0.05 level of significance using Z-test. Mean of 3.50 or above was considered required. Result of study revealed 29 needed techniques,4-items based on introduction to the programme; 7- items were based on contents area; and 6-items on teaching methods; others,5-items on evaluation / assessment strategies. Consequently, it was recommended that standard apprenticeship training programme should be drawn, implemented and organised at Local Government Area or at State level. The findings of the study should be integrated into local informal apprenticeship system and more researches on the development and integration of apprenticeship programme should be encouraged.*

Keywords: *Sustainable workforce, Electrical/Electronic Technology, Apprenticeship training*

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Background to the Study

Technology is a means, processes, ideas based on scientific principles in addition to tools and machine for making and doing things, thereby solving the problems of mankind. (Teacher's Education in Sub-Sahara Africa (TESSA, 2011) stated that technology is a process of practically applying knowledge and using the resources of matter, energy and natural phenomena to solve human problems and making life easier. Technology entails knowledge of materials, tools, safety skills, project or product-oriented hands-on activities in addition to information and communication technology (Law-Obi,2014).

Electrical/electronic technology education is one of the programmes offered in tertiary institution in Nigeria. The programme has been designed to provide competences in a wide range of occupations aimed at inculcating in individual the knowledge, attitude and skills in electrical electronics field. The field embraces electrical electronics equipment, machines and materials; house hold gadgets and appliances, telecommunication devices, maintenance and repairs, servicing through testing of component parts and assembling. In addition to electrical installation, transmission, distribution and utilization of electricity in manufacturing industries. Workforce in electronics technology are artisans, craftsmen, technicians, technologists, engineers, who are prepared through formal and informal system of education; others are technical/ technology educators and engineering lecturers. The Technical/Technology Educators prepare teachers for Secondary/ Technical Colleges, Colleges of Education and Universities. While the engineering technology lecturers prepare technician and technologists through Polytechnique coupled with the engineering lecturers in university. They are the stakeholders in the field. The practical knowledge and skills are not mainly acquired through formal teaching and learning of the course in institution but also through apprenticeship training.

Apprenticeship is a household word in Nigeria. It is a contracted training given to learners(apprentice) by a master craftsman in a job specific skill for an occupation within a specified period of time. Traditional apprenticeship can take place between a father and son; informal apprenticeship is evolved through agreement between master craftsman and apprentices, enshrine in framework of law, regulations, training fees with other supporting items (ILO,2012). In addition, (ILO,2012) emphasised that formal apprentices entail a structured education/training, integrating alternating learning in the workplace with learning in educational institution, it is that type of training through which a learner acquires skill for trade in an enterprise, learning and working side by side with an experienced craftsman. This type of apprenticeship training programme is not officially practiced in Nigeria, the programme is important; and the development of any programme or course of study takes into consideration – programme description, contents, significance and the number of years of completion (law-Obi, 2024).

Apprenticeship entails individualised interactive learning approaches that allow apprentice to acquire knowledge through informal teaching with close observation, feedback and coaching, which are effective for building deep expertise and skill mastery (Christensen etal,2021) and complemented by classroom instruction with its policy framework well-articulated to

achieve the desired objectives, apprenticeship training programme is part of TVET (Technical Vocational Education and Training) curriculum; and the content delivery is based on practically modular competency model and certification-based; affirming the research of findings conducted (Law-Obi & Dara, 2020; Egbo, Aneke & Nwankwo, 2018). In addition. team teaching, team work learning strategies; and stimulus and response were rated high, indicating methods of teaching required in formal apprenticeship setting (Law-Obi & Ogbuanya, 2017). In agreement with Kumar (2020), Lamidi & Efuwape, who opined that appropriate teaching models, collaborative learning and project works / team work are means of acquiring saleable skills in electronics technology. This formal apprenticeship mostly exists in companies and quite different from informal apprenticeship (open apprenticeship) which mostly exist in our communities. This informal apprenticeship is needed to be formalised and structured through the development and implementation so that products will be sellable. A lot of setback exists in informal apprenticeship.

Informal apprentices in Nigeria have no policy framework for carrying out training and impartation of skills in different areas (Oseni, 2012). The master craftsman formulates the contents, delivers to the apprentice / learner, who observes, imitate and construct the knowledge through trial and error (Sonnenberg, 2012), while Merrien etal (2007) reiterate that apprenticeship training for skill acquisition should be based on essential skills (soft skills), technical skills and job skills, for today's knowledge based highly competitive economy, technical skills are no longer enough to get and keep a job. Employers expect employees to have knowledge of soft skills such as oral, written communication, critical thinking and collaboration and making use of digital technology and continuous learning (Merrien,2007, Law-Obi, 2024). Apprentice acquire not only technical skills but also soft skill such as communication, problem solving and teamwork, including digital and computational skills (Vaughan 2017). Therefore, curricula are being reviewed to capture workplace essential skills (Oseni,2012, Okadi etal, 2020). There is limited facility used in training, Fafunwa (2004) in Ogbunnaya (2018) observed that master's craftsman teaches and solely formulate the teaching contents; and learning it without standard regulation guiding it. Equally, informal apprenticeship does not record any relationship between its contents of training with industrial standard to abridge skill gap. Many researchers conducted and recorded that establishing collaboration between apprenticeship and industries enhances development of quality specific vocational skill leading to long term employability (Ryan,2001). The value of apprenticeship training is enhanced through certification, for it promotes the values and enhances higher wages and provide security (Gunderson & Krashinsky, 2009, Abugo chigbo, 2014). In the same vein OECD (2018) lamented that local content workers are dropped, importing skilled manpower due to formal institution offer theoretical content that does not align with the trend and production processes needed in the labour market and industries in all technical vocational skills.

Therefore, formal teaching alone on electrical electronics technology, may not turn out quality workforce, who will be acceptable in many standard companies; and mastering of practical knowledge and skills in electrical/ electronic technology in the class room setting is really doubtful for few credit hours a week for practical and few hours for instruction can never be

enough for mastering effective learning of technical skills in electrical electronics. Apprenticeship in electrical / electronic technology is TVET programme and its key goal is to improve productivity of the workforce, which will be reflected in the curriculum of the training programme. This is an indication that the mode of lesson delivery, evaluation / assessment are the core criteria in the policy statement of the training programme, visa vee the actual mode of the programme implementation. The assessment / evaluation is based on competency mode of assessment, qualification standard obtainable in industries (Boahim & Boahim, 2018). In addition to industrial practical modular content assessment, that requires hands on experience. The continuous assessment / evaluation to ensure proper skill acquisition may be in the form of self-assessment and remediation as the individual observes the master craftsman (Travels & McQiggie, 2013). In addition to formative and summative evaluation as applicable to all teaching, since the stake holders relevant in this formalised apprenticeship are the engineers/ technology educators from higher institutions, craftsmen with experts from industries. Therefore, the formalised apprenticeship needed to be developed will possess some of the characteristics of formal and informal (blended type) Formative evaluation takes care of prior learning and also recognize current competencies, which is continuous processes in the system (Mukhtar & Ahmad, 2000). To complete formalise apprenticeship electronic assessment is applicable in line with simulation mode of delivery; enrolling for out school for further training in skill up apprenticeship is not out of place for all levels (secondary & post-secondary) of the field (Oseni,2012); acquiring skills in electrical electronics technology is essential for developing a sustainable workforce capable of meeting the demands of modern industries and addressing energy challenges. Osuiyi and Owenvbiugie (2015) have weighed the benefits of open (informal) apprenticeship training programme and suggested replacing SIWES with apprenticeship system; for example, the German apprenticeship system, based on study and work in skill acquisition yielded positive labour market outcome. Leman (2014) reiterated that the effectiveness of apprenticeship varies based on structure and therefore, policy maker and educator should consider integrating with formal education thereby achieving strong industry partnerships to maximise benefits. Based on this back drop the research set to develop and implement a structured content to be used in apprenticeship training in electrical electronics technology, which will be integrated with informal apprenticeship to achieve a robust and functional apprenticeship as needed which will strengthen collaboration and linkages between the formal and informal education.

Purpose of the Study
The main purpose of this study was to investigate the required criteria in the development and implementation of apprenticeship training programme on Electrical / Electronic Technology education for sustainable workforce in Nigeria.
Specifically, the study sought to determine for sustainable workforce:
1. The required introductory considerations in the development of apprenticeship training programme on Electrical / Electronic Technology education.
2. The programme content areas required in the development and implementation of apprenticeship training programme on Electrical / Electronic Technology education.
3. Teaching methods required in the development and implementation of

apprenticeship training programme on Electrical / Electronic Technology education.
4   The evaluation / assessment strategies required in the development and implementation of apprenticeship training programme on Electrical / Electronic Technology education.

Research Questions:
1. What are the required introductory considerations in the development of apprenticeship training programme on Electrical / Electronic Technology education?
2. What are the programme content areas required in the development and implementation of apprenticeship training programme on Electrical / Electronic Technology education?
3. What are the teaching methods required in the development and implementation of apprenticeship training programme on Electrical / Electronic Technology education?
4   What are the evaluation / assessment strategies required in the development and implementation of apprenticeship training programme on Electrical / Electronic Technology education?

Hypothesis
The null hypothesis was tested at 0.05 level of significance
1. There is no significance difference on the mean rating of Engineering Lecturers from Polytechnics and Technical Educators on the programme content areas

Method
The study determined the required techniques on the development and Implementation of apprenticeship training programme on electrical/ electronic technology education for sustainable workforce. The study answered 6 research questions and one hypothesis. Descriptive survey was adopted to carry out the research at Awka Educational Zone of Anambra State. The population of study was 43 respondents, comprising of 24 Electrical/ Electronic Technology Education Lecturers and 19 Electrical/Electronic Engineering Technology Lecturer from the Zone. There was no sampling due to smallness of the population, an intact population was used. A 22 – item questionnaire titled, 'Development and Implementation of apprenticeship training programme on electrical/ electronic technology for sustainable workforce (DIATPSW) was used for data collection; which was validated by three experts and also try tested outside the area of study. The reliability of the instrument was 0.83 established using Cronbach Alpha. The questionnaire items were generated from the review of the related literature; which consisted of seven sections, A to G. Section A, solicited for information on correspondence personal data. Section B, assesses the introductory considerations for the development; Section C was based on the training programme content area, Section D dwelled on the teaching methods for the training programme while Section E was based on evaluation/ assessment strategies for the training programme. The instrument made use of 5 points Likert scale = Highly Required (HR), Barely Required (BR), Not Required (NR) and Highly Not Required (HNR). The response categories values were assigned 5,4,3,2, and 1 respectively. The instrument was validated by three experts from Technical Education, Engineering Technology and Curriculum experts

outside the area of the study; mean and standard deviation were used to answer the research questions while Z- test was used to answer the hypothesis and any item with a mean of 3.50 or above was considered required. The hypothesis was tested at 0.05 level of significance. Out of 43 questionnaires administered,40 of them were returned.

Table 1: Respondents' mean ratings on the introductory considerations in the development and Implementation of apprenticeship training programme

S/N	Items	X	SD	Remark
1.	Programme Description	4.68	0.75	R
2.	Objective of the programme	3.99	0.83	R
3.	Significance of the programme	4.39	0.77	R
4.	Number of years to complete the training	4.47	0.88	R

The data presented in table 1, revealed that 4 items had mean range from 3.99 to 4.68 above the minimum cut off point off point of 3.50. these items are the required introductory consideration for the development of the apprenticeship training programme.

Table 2: Respondents' mean ratings on the content areas in the development and implementation of apprenticeship training programme

S/N	Items	X	SD	Remark
1.	Technical competencies	4.77	0.83	R
2.	Computational and digital skills	4.45	0.76	R
3.	Professional Ethics	4.39	078	R
4.	Practical skills	4.43	0.88	R
5.	Soft skills	4.44	0.77	R
6.	Sustainable environment and safety	4.45	0.76	R
7.	Innovation/ creativity and entrepreneurship	4.36	0.65	R

The data presented in table 1, revealed that 7 items had mean range from 4.36 to 4.77 above the minimum cut off point off point of 3.50. these items are the needed course contents of the employability skills as a course of study to be integrated for achievement of a sustainable workforce.

Table 3: Respondent mean rating on method of teaching in the development and implementation of apprenticeship training programme

S/N	Items	X	SD	Remark
1.	Individualised teaching with demonstration	4.23	0.78	R
2.	Using stimulus and response	3.81	0.75	R
3.	Informal teaching with observation	4.65	0.69	R
4.	Teaching based on previous knowledge	4.36	0.68	R
5.	Team teaching method and teamwork Learning strategies / Project	4.55	0.66	R
6.	Hands on and practical method	3.75	0.83	R

Table 4: Respondent mean rating on evaluation / assessment strategies in the development and implementation of apprenticeship training programme

S/N	Items	X	SD	Remark
1.	Self-assessment	4.35	0.73	R
2.	Competency based assessment	4. 62	0.65	R
3.	Practical Evaluation / Project work	4. 54	0.64	R
4.	Formative and Summative Evaluation	4.32	0.76	R
5.	Electronic Evaluation	4.05	0.83	R

Table 5: Z-test of the Difference Between the Mean Response of Technical Educators in Colleges and Engineering Technology Lecturers from Polytechnics on the content areas in the development and implementation of apprenticeship training programme

S/ N	Technical Staff	Mean	Standard Deviation	N	Df	Standard Error	Level	Z-cal	Z-crit
1.	Technical Educators	4 .35	0.891	16	128	0.70	0.05	0.514	196
2.	Engineering Technology	4.38	0.895	18					

The z-test analysis summarised in table 5 revealed that there is no significant difference between the mean rating of technical educators and engineering technology lecturers on the contents area for the development and implementation of apprenticeship training programm**e** sustainable workforce. It tested at 0.05 z-level and degree of freedom, 128.The calculated z-value is 0.511 less than the critical z-value, 196.This has led to decision that the null hypothesis should be

Discussion
It was found out from the first research questions that 4 items in table 1 were the required introductory consideration for the development of the apprenticeship training programme. The finding affirmed that the development of any programme or course of study takes into consideration – programme description, contents, significance and the number of years of completion (law-Obi, 2024).

The research findings in table 2 indicated that all the items are the contents areas required for the development of apprenticeship programme in electrical / electronic technology, apprenticeship go beyond traditional education by encompassing hands-on learning and practical experience. Apprentice acquire not only technical skills but also soft skill such as communication, problem solving and teamwork, including digital and computational skills (Vaughan 2017). In the same vein formal apprenticeship is a TVET programme that captures soft or essential skills make use of digital technology and continue learning as demanded by that individualised interactive learning approaches allow apprentice to acquire knowledge through informal teaching with close observation, feedback and coaching, which are effective for building deep expertise and skill mastery (Christensen,2021) the employer of labour in agreement (Merrian, 2007; Law-Obi, 2024). In addition, innovation, creativity, knowledge of professional ethics and code of conduct are the content areas, which are employability skills mostly demanded by employer of labour in industries mostly in line with the findings (Law - Obi,2024).

The research findings in table 3, affirmed Likewise, apprenticeship training programme is part of TVET curriculum; and the content delivery is based on practically modular competency model and certification-based competency affirming the findings conducted (Law-Obi & Dara, 2020; Egbo, Aneke & Nwankwo, 2018). Team teaching, team work learning strategies; and stimulus and response were rated high, indicating methods of teaching required in formal apprenticeship setting in confirmation (Law-Obi & Ogbuanya, 2017). In agreement with Kumar (2020), Lamidi & Efuwape, who opined that appropriate teaching models, collaborative learning and project works / team work are means of acquiring saleable skills in electronics technology.

The findings in table 4, displayed that all items are the required evaluation techniques, Boahim & Boahim (2018) affirmed that competency mode of assessment is a sure means of obtaining qualification standard in industries that require hands on experience. In addition to industrial practical modular content assessment that requires hands on experience. Travels & McQigge (2013) stated that continuous assessment / evaluation ensure proper skill acquisition through self-assessment and remediation as the individual observes the master craftsman. In agreement with Mukhtar & Ahmad (2000), who affirmed that formative evaluation takes care of prior learning and also recognize current competencies. In addition to summative evaluation as applicable to all teaching coupled with electronic evaluation, which is in line with electronic simulation accepted as a teaching method.

There is no significant difference established indicated that technology educators and engineering lecturers understand the required contents in the development and implementation of training programme on electrical/ electronic technology education for sustainable workforce in Nigeria.

Conclusion
The programme description, content areas, method of teaching and evaluation criteria identified as research findings in the development and implementation of formalised

apprenticeship training programme will go in long way in helping the Nigerian government in the policy formation coupled with intimating the stakeholders from higher institutions, entrepreneurs. experts from industries and master crafts men, the necessary steps in formalizing the existing local informal apprenticeship system in electrical / electronics technology education, so that our products will be relevant in labour market.

Recommendation

Based on the findings of the researcher among others, recommends that:

i.   The Federal Government should formalise the modern techniques that create opportunities based on the policy framework and standard curriculum.
ii. The stakeholders in electrical / electronic technology should liaise with the Government,
iii. Stake holders in Industries and entrepreneurs to develop apprenticeship training programme and model the implementation system to suite Nigerian needs. All the findings of the study should be articulated and utilised in the development and the implementation of apprenticeship training programme in electrical/ electronic technology.
iv. Standard apprenticeship training programme should be drawn, implemented and organised at Local Government Area or at State level.
v.   The findings of the study should be integrated into local informal apprenticeship system and more researches on the development and integration of apprenticeship programme should be encouraged.

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