

DEVELOPMENT AND VALIDATION OF PSYCHOMOTOR COMPETENCY-BASED CONTENT FOR TRAINING OF APPRENTICES IN INFORMAL SECTOR DOMESTIC ELECTRICAL INSTALLATION WORKS IN NIGERIA

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ABSTRACT

Electrical Installation Works is a trade, majorly psychomotor-based, wherein training of artisans is achieved through apprenticeship in the informal sector. In Nigeria, this system of training has unstructured content. Thus this study was conducted to develop and validate contents for psychomotor competency-based training of apprentices in the informal sector domestic electrical installation works. Three research questions and a hypothesis tested at .05 level of significance, guided the study. Research and development design was adopted for the study. The area of the study was South East of Nigeria. The population of the study consisted of 61 technical college teachers of electrical installation works, 282 electrical installation works master craftsmen and 46 lecturers of electrical/electronic technology in the tertiary institutions in South East of Nigeria. The sample for this study consisted of 20 technical college teachers of electrical installation works, 94 electrical installation works master craftsmen and 15 lecturers in electrical technology that were sampled using stratified random sampling. The instrument used for data collection was Psychomotor Competency-based Training Programme for Domestic Electrical Installation Works Apprentice Questionnaire (PCTPDEIWAQ). The instrument was face and content validated by three experts. The internal consistency of the questionnaire items was determined using Cronbach alpha reliability method and reliability coefficient.88 was obtained. The mean statistic was used to answer the research questions while t-test was used to analyse the hypothesis. 38 contents found. To improve the psychomotor competency of apprentices in domestic electrical installation works, it was recommended, among others, that Licenced Electrical Contractors Association of Nigeria (LECAN) should map out strategies to ensure that the training of domestic electrical installation works apprentices (DEIWAs) must include, at least, all the content found.

Keywords: Psychomotor, Competency-based Training, Domestic Electrical Installation Works

The unemployment rate is alarming in recent times especially in developing nations such as Nigeria. Education (formal and informal) is being shaped by this rising challenge of unemployment. To this end, Technical and vocational education and training (TVET) increasingly being emphasized at various levels of education. (Odika & Tom, 2020). TVET refers to a cluster of skilled-based training. This kind of training is primarily to equip the trainee with skills, knowledge, and attitude to become self-reliant, enterprising, and ready to create an environment for self and societal empowerment. TVET produces artisans, technicians, and technologists among others. Generally, artisans constitute a great percentage of the workforce in the electrical industry (Agb0, 2019).

An artisan is a skilled craft worker who makes or creates things by hand. Artisans are also referred to as crafts workers. Thus, artisans are said to possess psychomotor competencies or skills. Psychomotor competency is a competency that borders on manual dexterity and motor skills. Artisans in most cases have little or no theoretical knowledge of their trades (Tsoho, 2013). There are many skill trades such as electrical/electronics, mechanic, building construction, fine arts among others that are prevalent in Nigeria. These trade areas give rise to various categories of artisans. Artisans are categorized based on their trade. For instance, there are electrical installation works artisans (usually called electricians), mechanical works artisans, building construction artisans among others.

Electrical installation work is a trade which involves electrical installation works and repairs. Electrical Installation Works is also one of the trades involved in electrical craft work (Tsoho, 2013). In clearer term, the Federal Republic of Nigeria in her National Policy on Education (2014) specified trades in electrical craft to include: electrical installation and maintenance work, radio, television and electrical works and appliance repairs. Specifically, Federal Republic of Nigeria (2001) listed components of Electrical Installation Works to include Domestic Installation, Industrial Installation,

Cable Jointing, Winding of Electrical Machines, Battery Charging and Basic Electricity. In the non-formal sector, electrical installation works artisans usually specialize in one area of these components of Electrical Installation Works. Thus, in this study, we focused on domestic installation.

Informal sector apprenticeship training in domestic electrical installation works in Nigeria

Training in domestic installation is meant to provide the trainee with the knowledge and skills for carrying out complete electrical installation in a building and its associated equipment (Federal Republic of Nigeria, 2001). Skills required for practice may include understanding of electrical drawings, knowledge of different types of domestic surface and conduit wiring, electrical devices' protection and installation, understanding sequence for inspecting and testing domestic installation, and understanding of various types of lamps for illumination and uses. These skills may be viewed as clusters in domestic installations.

In the informal sector, training of domestic electrical installation works apprentices (DEIWAs) is achieved through apprenticeship. Apprenticeship is a system whereby an experienced and skilled individual otherwise referred to as master trainer agrees to train an inexperienced individual known as an apprentice, in a prescribed occupation to acquire practical skills within a period (Ogbuanya et al, 2020). In this system, the trainee learns by observing the trainer. In Nigeria, this system of training is unorganized and has unstructured content. Tsoho (2013) observed that the present informal sector electrical craft apprenticeship does not have scheme for training apprentices. National Master Plan on Technical and Vocational Education Development noted that the informal apprenticeship lacks organization and its practice unsystematic (Federal Ministry of Education, 2000). Therefore, the content of their training is as deemed necessary by the trainer.

The training of DEIWAs and their practice in the informal sector has no regulation that guides it. Alio (2006) noted the non-existence of government policies and regulations in the operations of the artisans. This is traceable to lack of structured contents for the training of DEIWAs. This has resulted in producing DEIWAs that lack appropriate skills for the modern day practice of electrical installation works. Hence many DEIWAs trained in the informal sector apprenticeship find it difficult to secure employment in the industry or be self-reliant (Nwokike, 2014).

In a situation, such as found in Nigeria, where training of an apprentice is left to the discretion of the trainer, one cannot guarantee the quality of the training. This kind of training has dire implications. For instance, apprentices in such training systems will, to a great extent, imbibe innovations to the extent the master craftsman allows. This is the crux of the problem of this study. In other climes, such as Germany, England, USA, Japan, Russia, indigenous craft practice in the informal sector has a standard programme of training (Walther, 2007). Such training programmes clearly spell out the contents of training such that a prospective trainee knows what to expect from the onset of the training.

In a bid to change the situation, the Federal Government of Nigeria has made several attempts to train artisans in various trade areas and conduct accreditation of the informal sector craft practice. For instance, Uwameiye and Ede (2002) stated that the Federal Government of Nigeria directed that roadside apprenticeship centres should be accredited by National Board for Technical Education (NBTE). However, this plan failed (Uwameiye and Ede, 2002); partly due to lack of standard programme, with clear contents, that clarifies benchmark for such accreditation. Also, in February 2016, the senior special assistant to the Vice President of Nigeria on Job Creation and Youth Empowerment, Afolabi Imoukhude disclosed the plan of the Federal Government to train 370, 000 artisans to boost skills development and employment generation

(Ekwealor, 2016). These artisans were meant to be trained in various trade areas. This programme has long begun. However, the bugging question still remains “what are the contents and how were the contents selected for training those in domestic electrical installation works since there is no structured content in the informal apprenticeship system?”

Nigeria has many DEIWAs training centres, yet foreigners are continually hired to work in her power sector and also in various companies across the nation. The Minister of Power, Housing and Development in this regard, noted that investing in the training of artisans will not only boost the workforce but will also put an end to shipping foreign artisans into Nigeria to work (Ekwealor, 2016). It is disheartening to know that Nigeria, after 60 years of independence as a nation, still hires foreign DEIWAs to fix installations as common as street lights. This may be attributed to the fact that the indigenous DEIWAs lack requisite skills required to ameliorate the situation.

Lack of structured content and standards relevant to the industry/market needs has been noted as a major setback to apprenticeship training of artisans in the informal sector in Nigeria (UNESCO, 2015). Consequent upon this and the fact that the informal electrical installation work practice is a psychomotor based trade, it is imperative to develop and validate structured psychomotor competency-based content for training domestic electrical installation works apprentices in the informal sector.

Purpose of the Study

The purpose of the study was to develop and validate structured contents for psychomotor competency-based training of electrical installation works apprentices in the informal sector. Specifically, the study sought to:

1. Identify content clusters in domestic installation in the informal sector.

2. Determine the contents, based on the clusters, for psychomotor competency-based training of apprentices in domestic installation in the informal sector.
3. Validate the developed contents for psychomotor competency-based training of apprentices in domestic installation in the informal sector.
4. Determine the reliability of the developed contents for psychomotor competency-based training of apprentices in domestic installation in the informal sector.

Research Questions

1. What are the contents for psychomotor competency-based training of apprentices in domestic installation in the informal sector?
2. What is the reliability of the developed contents for psychomotor competency-based training of apprentices in domestic installation in the informal sector?
3. What is the difference in the psychomotor competency mean ratings of DEIWAs before and after training on the psychomotor competency-based contents in the informal sector?

Hypothesis

There was no significant difference in the psychomotor competency mean ratings of DEIWAs before and after training on the psychomotor competency-based contents.

Research Methodology

Research and development (R&D) research design was used for the study. According to Akuezilo and Agu (2003), R & D research design is a research method adopted when the aim of a research is to produce school materials like textbooks, equipment, teaching aids and curricula. The psychomotor competency-based training content developed and validated could be viewed, in part, as a curriculum since curriculum can be formal and

informal. The area of the study was the South East geo-political zone of Nigeria. The South East of Nigeria consists of five states (Enugu, Abia, Imo, Ebonyi, and Anambra).

Sample Selection

The population of the study consisted of 69 technical college teachers of electrical installation works, 282 electrical installations works master craftsmen and 46 lecturers of electrical technology in the tertiary institutions in the South East of Nigeria. Twenty three (23) technical college teachers of electrical installation works, 94 electrical installations works master craftsmen and 15 lecturers in electrical technology, drawn using proportionate stratified random sampling, constituted the sample for the study. According to Olatunji (2007), 15 – 30 percent of a small population is a good proportion of the population which can be sampled. Hence this principle guided the researcher in determining the sample size. Specifically, one-third (approximately 33 percent) of the population were sampled.

Instrument and Procedures

The procedure for the development and validation of psychomotor competency-based contents involved collection of data from the respondents using a questionnaire, development of the training contents based on the data collected, and trial-testing of the contents (validation). The development of the training contents for DEIWAs was based on the following R & D cycle by Gall, Gall and Borg (2007). They include:

1. Definition of goals which include need assessment.
2. Review of relevant literature pertinent to the product to be developed.
3. Statement of specific objectives and criteria for product development.
4. Development of prototype based on scientific evidence available or pertinent to research findings.

5. Field-test of prototype in the setting, where it will be used eventually.
6. Revision of the prototype to correct deficiencies found in the field testing state.
7. Conducting a main field test of the revised product

These steps were modified into eight phases for this study. They are:

Phase I: Need analysis (literature review on electrical installation work skill needs, visit to several sites where electrical installation were ongoing and EIW workshops wherein the researcher interacted and observed methods, procedures, techniques and application of tools for work and training purposes).

Phase II: Identification of the components of the psychomotor competency-based training contents

Phase III: Generation of items on each component of the psychomotor competency-based training contents and organizing them into a questionnaire

Phase IV: Administration and collection of the questionnaire (This stage involved collection of data from experts; master craftsmen, lecturers and teachers).

Phase V: Analysis of data collected using the questionnaire in phase IV

Phase VI: Development of the contents based on the result of data analysis

Phase VII: Face and content validation of the developed contents by experts

Phase VIII: Trial-testing (final validation) of the developed contents (In this stage, two groups; one experimental and the other control, were purposively selected were trained by master craftsmen)

The instrument used for data collection was the Questionnaire on Psychomotor Competency-based Contents for Training Domestic Electrical Installation Work Artisans (QPCCTDEIWA). The instrument was face and content validated by three

experts. A copy of QPCCTDEIWA was given to each of the experts to identify any ambiguity, ensure coherence of items and appropriateness for the study. In order to ascertain the reliability of the QPCCTDEIWA, 15 copies of QPCCTEIWA were administered to 15 respondents. The respondents were made up of 5 technical college teachers of electrical installation, 5 master craftsmen in EIW and 5 lecturers in electrical technology in Ogun and Lagos States. Data obtained were analyzed to determine the internal consistency of the instrument using Cronbach alpha formula. This yielded 0.88 alpha coefficients which indicated a high reliability index.

The QPCCTEIWA instrument was administered to the respondents by the researcher and five research assistants. A total of 132 copies of the questionnaire were distributed and 118 copies were retrieved from the respondents. This represented 89.4 percent return rate. The data collected using QPCCTEIWA were analyzed. Items of the questionnaire which was used for the development of the contents were selected or not selected using the real limits of number. Any item with a mean value of 3.5 and above was selected while items with mean value of less than 3.5 were not selected. The selected items were used for the development of a draft of the training contents. The draft of the training contents was face and content validated by three experts in electrical installation works. After the face and content validation of the training contents by the three experts, the researcher packaged the training contents for trial-testing which constituted the final validation of the contents.

In order to trial-test the training contents, a master craftsman and seven apprentices were purposively selected. The researchers drafted a rating tool based on the developed contents. The master craftsman used a rating tool to rate the psychomotor competency of the seven apprentices and recorded their scores. Afterwards, the apprentices were trained based on the contents for a period of three months by the master craftsman. The

master craftsman used the rating tool to rate the performance of the apprentices after training and also recorded their scores. The data collected from the apprentices before and after training were used to ascertain the validity of the developed training contents.

The research questions were answered using mean statistic. In selecting items for content development, the real limits of number were used for decision making. Five points Likert scale were used. Any item with mean value of 3.50 and above was regarded as agreed upon by the respondents. On the other hand, items with mean value less than 3.50 were regarded as not agreed upon by the respondents. The standard deviation was used to determine the closeness or otherwise of the opinions of the respondents from the group mean.

The hypothesis was tested at .05 level of significance using t-test for co-related data. SPSS version 20 was used for calculating the t-test value. If the p-value for the groups obtained after data analysis was less than or equal to .05 alpha value, it means that there was a significant difference while p-value greater than .05 implies no significant difference.

Research Results

The research results were presented in line with the research questions and hypothesis:

Psychomotor Competency-based Contents for Training of Apprentices in Domestic Installation

Table 1

Psychomotor Competency-based Training Contents for Domestic Installation Works Apprentices

Number of respondents (N) = 118

<i>Item No</i>	<i>Training Contents</i>	<i>X</i>	<i>SD</i>	<i>Remark</i>
1	How to keep a clean work environment	4.42	.54	Agreed
2	Personal and equipment safety	4.28	.50	Agreed
3	Safety regarding use and storage of tools	4.32	.52	Agreed
4	Workplace communication/interaction and safety	4.32	.52	Agreed
5	Domestic installation safety regulations	4.47	.55	Agreed
6	Identification, evaluation and control of hazards and risks	4.47	.55	Agreed
7	Domestic Safety gadgets	4.39	.68	Agreed
8	Electrical symbols/signs	4.83	.38	Agreed
9	Identification of electrical symbols in a drawing	4.81	.46	Agreed
10	Interpretation of electrical drawing	4.72	.50	Agreed
11	Identification/listing of accessories needed to implement a given drawing	4.68	.61	Agreed
12	Fittings and fixtures	4.59	.63	Agreed
13	Types of wiring systems	4.68	.61	Agreed
14	Location for the point of service entrance of electrical wires and main panels	4.73	.50	Agreed
15	Cable types, sizes and uses	4.75	.43	Agreed
16	Cable rating, maximum load and ambient temperature.	4.58	.84	Agreed
17	Material estimation	4.59	.63	Agreed

18	Selection of materials and accessories	4.57	.50	Agreed
19	Surface Wiring tools	4.47	.55	Agreed
20	Statutory regulations regarding surface wiring	4.47	.55	Agreed
21	Surface wiring of residential buildings	4.47	.55	Agreed
22	Types of conduits	4.63	.54	Agreed
23	Selection of materials and accessories	4.59	.54	Agreed
24	Conduit Wiring tools	4.59	.54	Agreed
25	Statutory regulations regarding conduit wiring	4.57	.63	Agreed
26	Conduit wiring of residential buildings	4.52	.81	Agreed
27	Statutory regulation guiding installation of final sub-circuits	4.11	.69	Agreed
28	Connection of one-way and two-way switch circuits	4.47	.65	Agreed
29	Installation of protective devices	4.52	.69	Agreed
30	Earth connection	4.74	.50	Agreed
31	Installation of socket outlets	4.42	.62	Agreed
32	Installation of meters	4.34	.74	Agreed
33	Installation of control panel	4.44	.85	Agreed
34	Installation of distribution boxes	4.51	.55	Agreed
35	Installation of lighting sub-circuits	4.61	.49	Agreed
36	Installation of ceiling fans	3.98	.91	Agreed
37	Inspection of installation	4.56	.84	Agreed
38	Testing of installations	4.50	.81	Agreed

Table 1 shows that all the items formulated for psychomotor competency based training contents for electrical installation works apprentices had their mean values ranging from 3.98 to 4.75. This implies that the mean value of each content was above the cutoff point of 3.50 indicating that all the 38 contents were required for psychomotor competency-based training of electrical installation works apprentices. Table 1 also revealed that the standard deviation (*SD*) of the items is within the range of .38 – .85. This indicates that the respondents were not far from one another in their responses.

Content Reliability for Psychomotor Competency-based Training of Apprentices in Domestic Installation

Table 2

Content Reliability for Psychomotor Competency-based Training of Apprentices in Domestic Installation

<i>No of respondents</i>	<i>No of Items</i>	<i>Cronbach's Alpha</i>
15	38	.88

From Table 2, Cronbach alpha reliability test was used to determine the internal consistency of QPCCTEIWA. The Cronbach's Alpha coefficient obtained from analysis of the data collected from 15 experts was .88. The alpha coefficient is above the minimum recommended value of .70 (Tavakol & Dennick, 2011). Therefore the developed contents is reliable.

Mean Ratings of DEIWAs before and after Training on the Psychomotor Competency-based Contents

Table 3

Apprentices' Performance Rating Scores before and after Training on Psychomotor Competency-based Training Contents for DEIWA

<i>Source of Variance</i>	<i>X</i>	<i>N</i>	<i>SD</i>	<i>SEM</i>
After training	87.69	7	2.06	.78
Before training	39.61	7	2.34	.89

The result shown in Table 3 reveals that the mean of the rating of the artisans before training is 39.61 while the mean of the rating after training on the psychomotor

competency-based contents for electrical installation apprentices is 87.69. This implies 48.08 (87.69 – 39.69) mean difference between the mean rating before and after training. Hence apprentices' performance improved after being trained on the developed psychomotor competency-based contents.

t-Test on Psychomotor Competency Mean Ratings of DEIWAs before and after Training

Table 4

The t-test on Psychomotor Competency Mean Ratings of DEIWAs before and after Training

<i>Source of Variance</i>	<i>X</i>	<i>SD</i>	<i>SEM</i>	<i>t</i>	<i>Df</i>	<i>Alpha level of sig.</i>	<i>P-value (two- tailed)</i>
Before and After Training pair	48.09	3.02	1.14	42.07	6	.05	.0001

The t-test analysis shown in Table 4 reveal a t-value of 42.07, 48.09 mean gain after training and *p*-value of .0001 at 6 degree of freedom and .05 level of significant. The *p*-value of .0001 is less than the .05 alpha level of significance. This implies that there is significant difference in the psychomotor competency mean ratings of EIWA before and after training using the psychomotor competency based programme. Hence the null hypothesis was rejected. In the same vein, the *t*-value of 42.07 is statistically significant.

Discussion

The study developed and validated structured contents for psychomotor competency-based training of electrical installation works apprentices in the informal sector. It identified 38 contents in which apprentices must be trained in order to acquire the minimum skills required for practice. Training content is an integral part of any training

programme. Hence this finding is in line with Walther (2007); in some climes, such as Germany, England, USA, Japan, Russia, indigenous craft practice in the informal sector has a standard programme of training. On the contrary, informal DEIWS apprenticeship in Nigeria, has over time been based on the trainer (Tsoho, 2013). It is our belief, based on this finding, that this study has added to extant literature on informal DEIWS apprenticeship and by implication revealed that informal DEIWS apprenticeship will become more robust as in other developed nations if trainers ensure that trainees are trained on this contents.

The findings of this study are in line with Nwokike (2014) who determined the skills needed for self-employment in electrical installation. Nwokike specifically found that, in domestic installations, skills such as identification of symbols in working drawing, cable selection, application of regulation among others, are required for self-employment. This study equally found these concepts among others, as part of the psychomotor competency-based contents on which the apprentices should be trained/retrained. The consideration of the findings of the study vis a vis skills needed for self-employment in electrical installation determined by Nwokike is that one is sure to be self-reliant upon completion of training in the concepts that formed the developed content.

Additionally, the findings of the study on training contents are in line with Val (2016) and Alvior (2015) who are of the view that curriculum content refers to the subject matter or what is to be taught to the learners. They further posited that contents of a programme must not be selected haphazardly. The contents that emerged as a result of this were carefully selected based on data and so conforms to this assertion. Hence there is no doubt regarding reliability as the trial testing of the content showed positive result.

Limitation to the Study

The researchers could not train more than seven apprentices due to lack of sufficient facility. The researchers believe that training more apprentices on the developed training contents would give more credence to the validity of the contents. However, this does not invalidate the findings of this study as the average number of apprentices per master craftsman in the informal sector domestic electrical installation in Nigeria is five.

Conclusions

The study identified 38 psychomotor competency-based training contents for apprentices in domestic installation in the informal sector. It was established that these contents are valid and reliable. It was also confirmed that apprentices trained on the structured contents identified performed better than those trained conventionally. Based on these, it is expected that trainees in domestic installation in the informal sector trained on these contents in a progressive manner will acquire minimum psychomotor competencies required for self-reliance and employment.

Recommendations

The following recommendations were made based on the findings of this study:

1. The Licensed Electrical Contractors Association of Nigeria should map out strategies to enforce the progressive and systematic training/training of DEIWA son these contents.
2. Seminar and workshops should be organised for DEIWAs to explicate the need and benefits of training apprentices on organised content such as this rather than the usual haphazard training done as it pleases the trainer.

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