Development and Validation of an Instrument for Assessing Practical Skills in Domestic Installation Processes in Technical Colleges of Yobe State, Nigeria

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Abstract: *In order to improve the assessment of students' practical performance, this study developed and validated an instrument for assessing practical skills in domestic installation processes at the Technical College Level in Yobe State, Nigeria. The study answered three research questions employing instrumentation research design with a target population of 108 comprising of Electrical Installation and Maintenance Works Trade (EIM) teachers and National Technical Certificate (NTC) III students of 2016/2017 academic session. The study was conducted in Yobe State, Nigeria located atlongitude $11^0 30^{'}E$ and latitude $12^0 00^{'}N$ of the Greenwich Meridian. The study had a total population 234, comprising 41 EIM teachers and 202 NTC III students. A stratified proportionate-random sampling technique was used to determine eight technical colleges used and a purposive sampling technique was used to select 12 EIM teachers while a simple random sampling was used to select 60 students that were used in the study.Two instruments were used for data collection in two different stages. An Appropriate Task Operation in Domestic Installation Processes Questionnaire (ATODIPQ) was developed and validated by three practicing teachers in domestic installation from technical college Yola, Adamawa State. The ATODIPQ was then administered on 18 technical teachers of EIM in three technical colleges in Yobe State using a five point rating scale to determine the level of appropriateness of each operational task to be performed by NTC III domestic installation students. The second instrument tagged Domestic Installation Processes Instrument(DIPI) comprising of domestic installation practical skills based on National Business and Technical Examinations Board (NABTEB, 2007) curriculum and related literature was developed and validated by experts. The draft DIPI was subjected to content validation by three electrical installation lecturers from ModibboAdama University of Technology, Yola, and Adamawa State. Final copies of the instrument were then administered on 23 domestic installation teachers and 60 NTCIII students in fiveaccredited NBTE Government Science and Technical Colleges of Yobe State. Data collected from the tryoutwas analyzed using inter-rater reliabilitymethod. Findings of the study showed that four clusters and 32 practical skills operations were found appropriate for the DIPQ. The instrument was found to possess an overall reliability coefficient of 0.77. Based on these findings, it was recommended among others that, state ministry of education should impose the use of the assessment instrument in the Technical Colleges of Yobestate, Nigeria*

Keywords: *Development, Assessment, Domestic Installation, Technical Colleges*

I. INTRODUCTION

Assessment in any educational programme ascertains the outcome of learner's achievement in terms of knowledge, skills, attitudes, ability and intelligence acquired in the course of the study (Bukar, 2006). Assessment without valid and reliable criteria could be subjective and bound to injustice or lack of acceptance.

Performance assessment may be either in the form of process assessment, product assessment or some combination of both (Okeke, 2004). Process assessment requires attentive and consistent teacher observation and rating of students' performance; while product or outcome assessment involves the teacher objectively judging the quality of the finished product. This implies that performance test involves assessing how students are working as well as the completed task or product. Both process and product assessment are accomplished by the teacher through the development of some type of observational techniques such as checklists, rating scale and recording sheet to be used for rating the students' performances (Okeke, 2004).

In Nigerian educational system, technical colleges offer technical and vocational education programmes for the purpose of producing middle level skilled manpower required for the nation's economic and technological development (Federal Republic of Nigeria [FRN], 2013).Technical trades according to Igwe and Bakare, (2012) are

concerned with the ability to handle objects in a skillful manner. Osuala cited in Moses, (2013) viewed technical skill development as the ability to do or perform an activity that is related to some meaningful work or job. Turvey (2010), defined technical skills as a function of knowledge translated into practical activity which means that technical skills indeed involve mental as well as physical activities as stipulated in the psychomotor characteristics of electrical installation and maintenance works trade curriculum (NBTE, 2007).According to Thompson in Moses, (2013) the conventional Electrical Installation and Maintenance Works comprise of the following main units: Domestic Installation, Industrial Installation, Overhead Installation (transmission and distribution system), Underground Cable Installation, Cable Jointing and Brazing, Battery Charging and Electrical Machines.The trade group components leading to the National Technical Certificate (NTC)are now classified into five broad modules namely, domestic installation (CEI 12), industrial installation (CEI 13), cable jointing (CEI 14), battery charging (CEI 15) and winding of electric machines (CEI 16) NABTEB (2007).

Domestic Installation therefore becomes one of the engineering trade module offered at Technical College level in Nigeria, whose aim is to produce competent craftsmen with sound theoretical knowledge and practical skills that would be able to diagnose faults and carryout repairs/ maintenance on all types of electrical installations (NBTE, 2007). Uwaifu (2009) reported that technical college Electrical Installation and Maintenance Works graduates show strong relationship between occupational task performance in basic skills such as in electrical domestic installation and safety. Yet further researches showed that the performance of graduates in higher skill areas in domestic installation is low (Uwaifu, 2009). Aliyu (2009) also noted that Electrical Installation and Maintenance works graduates perform below expectations in their various work places.

Poor assessment method was responsible for low standard of performance by students in terms of practical skills acquisition in Domestic Installation (Moses, 2005). The psychomotor aspect of Domestic Installation is meant to achieve adequate development in skills which can make the recipient of such skills employable. Despite all efforts by the government to provide qualitative education in technical colleges, there have been persistent reports of high failure rate among graduates of technical colleges in Yobe state, National Business and Technical Examination Board NABTEB (2007), pointed out that one cause of the high failure rate of students is due to assessment methods employed by the teachers.

Students' process skills cannot be ascertained with the present NABTEB assessment strategy due to its product assessment mode, hence the need to develop a valid and reliable process performance base assessment instrument that will contain the details of operational skills to complete a given task. This will go a long way in solving the problem of poor assessment of practical skills in electrical and electronics engineering trade components in technical colleges of Yobestate.

Significance of the Study

This study has numerous contributions to technical colleges, teachers, students and State Ministry of Education. The developed instrument when used in technical colleges which will serve as a tool through which a reliable assessment of practical skills will be obtained. The instrument therefore, will substitute the conventional approached presently employed in the assessment of students' practical skills which lacked standardized guide

The developed instrument when used will enable teachers identify areas of students weakness in practical skills development in domestic installation processes with the view to help students remedy such weaknesses. It will also provide technical college teachers the opportunity to work and improve on the areas where students have weaknesses. Students will equally built confidence in practical skills acquisition since the use of the developed instrument will avail them the knowledge of assessment modes to be employed by their teachers.

The developed instrument when adopted in technical colleges will serve as a tool for preparing students for external examinations; a function of the State Ministry of Education. Curriculum developers in the State Ministry of Education will also use the developed instrument to identify learning objectives in domestic installation module of technical colleges in Nigeria

Research Questions

The following research questions guided the study:

1. What are the tasks to be considered appropriate for inclusion in acquiring practical skills in Domestic Installation in Technical Colleges of Yobe State?
2. What are the performance objectives necessary to be included in the instrument for assessing practical skills in Domestic Installation in Technical Colleges of Yobe State?
3. How reliable is the developed instrument for assessing student's practical skills in Domestic Installation in Technical Colleges of Yobe State?

II. METHODOLOGY

The study employed instrumentation research design conducted in Yobe State, Nigeria located at between longitude $11^{0}30^{'}$E and latitude $12^{0}00^{'}$N of the Greenwich Meridian. Yobe State occupies a total of 45,502Km bordering Bauchi State to the west, Borno State to the East, Gombe State to the South and Jigawa State to the North with Diffa and Zinder Regions of Niger Republic to its North (Google, 2016). The study had a total population 234, comprising 41 EIM teachers and 202 National Technical Certificate (NTC) III students. A stratified proportionate-random sampling technique was used to determine the three technical colleges used, a purposive sampling technique was used to select the 12 teachers used, while a simple random, sampling was used to select the 96 students that were used in the study

The National Board for Technical Education (NBTE), (2007) curriculum for technical collegedomestic installation and other relevant literatures were used to produce broad major operations expected of domestic installation students at that level. Likewise from the curriculum and related literatures, performance objectives were outlined and put together on a five point rating scale to form a draft Domestic Installation Processes Instrument (DIPI). The draft DIPI was subjected to both face and content validation by three electrical installation lecturers from ModibboAdama University of Technology, Yola, and Adamawa State.

In order to determine the appropriateness of tasks for inclusion into the final copy of the DIPI, an Appropriate Task Operations in Domestic Installation Processes Questionnaire (ATODIPQ) was developed and validated by three practicing teachers in domestic installation from technical college Yola, Adamawa State. The ATODIPQ was then administered on 18 technical teachers in three technical colleges in Yobe State using a five point rating scale that specified level of appropriateness of each operational task to be performed by NTC III domestic installation students.

Based on the data obtained from the teachers' ratings of each item of the ATODIPQ, the DIPI was finally assembled and tried out in five technical colleges in Yobe State using 23 teachers as assessors of 60 NTC III students of 2016/2017 academic session. Data obtained from the try-out was used to determine the reliability coefficient of the DIPI using **inter-rater reliability** method.

III. RESULTS

Research Question 1: What are the tasks to be considered appropriate for inclusion in acquiring practical skills in Domestic Installation in Technical Colleges of Yobe State?

Table1: Teachers' Mean Rating of Operational Tasks of Domestic Installation Appropriate for inclusion in Technical Colleges in Yobe State

SN	Operational TaskN=18	Mean	□	Remarks
1	Interpretation of the distribution system/scale used in working diagram	3.96	0.71	Appropriate
2	Correct usage electrical symbols in a working diagram	4.26	0.54	Appropriate
3	Measuring working diagrams with the aid of scale rule	4.09	0.60	Appropriate
4	Positioning of various accessories on a surface wiring drawing	4.39	0.50	Appropriate
5	Making list of electrical accessories needed for a job from a writing drawing	4.39	0.58	Appropriate
6	Administering first aid	2.15	0.16	Not Appropriate
7	Explaining the distribution system from surface wiring drawing.	4.09	0.60	Appropriate
8	Drawing electrical installation diagram for a living drawing	4.26	0.54	Appropriate
9	Demonstrating the use of plumb-line	3.70	0.47	Appropriate
10	Demonstrating the use of chalk-line	4.26	0.54	Appropriate
11	Demonstrating the use of sprit level	3.83	0.65	Appropriate
12	Carrying out simple surface wiring using appropriate tools	3.61	0.58	Appropriate
13	Observing safety measures required in surface wiring	4.74	0.45	Appropriate
14	Identifying various types of conduit components	4.09	0.60	Appropriate
15	Identifying different types of conduits	4.04	0.21	Appropriate
16	Utilization of various conduit accessories	3.96	0.37	Appropriate
17	Cutting conduit pipes using appropriate tools	3.96	0.37	Appropriate
18	Threading conduct pipes using appropriate tools	3.69	0.70	Appropriate
19	Determining set/bend permissible radial lengths	4.09	0.51	Appropriate
20	Carrying out a simple surface conduit installation highlighting	3.57	0.72	Appropriate

	relevant regulations			
21	Driving and withdrawing nails using hammer	2.24	0.13	Not Appropriate
22	Termination of conductors into socket plugs	2.54	0.21	Not Appropriate
23	Carrying out a simple conceal conduit installation highlighting relevant regulation	3.83	0.49	Appropriate
24	Carrying out the drawing of cables into surface conduct installation using fish wire	4.25	0.69	Appropriate
25	Carrying out the inspection of the conduct installation as required by the IEEE regulation	3.57	0.73	Appropriate
26	Carrying out the required testes of the conduct installation as required by the IEEE regulation	3.83	0.49	Appropriate
27	Maintaining tools used for conduits wiring	3.69	0.70	Appropriate
28	Appropriate utilization of protective devices	3.70	0.47	Appropriate
29	Carrying out electrical connections of ELBCs to the supply authority	3.83	0.57	Appropriate
30	Fixing of circuit breakers	2.54	0.21	Not Appropriate
31	Installing Earth Continuity Conductor (ECC) using all accessories	3.83	0.65	Appropriate
32	Carrying out inspection on all joints made in a simple wiring	3.83	0.65	Appropriate
33	Tightening of all loose contacts	4.39	0.58	Appropriate
34	Demonstrating the use of bell set	3.69	0.70	Appropriate
35	Demonstrating the use of lamp	4.30	0.56	Appropriate
36	Carrying out various installation test	4.74	0.45	Appropriate

Table1 showed the details of the operations generated and teachers' mean responses on the appropriateness of each task. Out of 36 task operations, 32 were found appropriate with means; 3.50 and above. Four task operations were not appropriate having means less than 3.50.

Research Question 2: What are the performance objectives necessary to be included in the instrument for assessing practical skills in Domestic Installation in Technical Colleges of Yobe State?

Table2: Distribution of Performance Objectives for Domestic and Industrial Installation students at Technical College Level in Yobe State

S/N	Performance objective	Tasks to be Observed
1	Ability to choose the appropriate tools/equipment for a given task	Task 1-4
2	Right setting of drawing scale	Task 1
3	Identification of correct drawing materials to be used	Task 1
4	Identification of correct accessories needed for a job	Task 1
5	Correct positioning of accessories	Task 1
6	Ability to identify the desired drawing symbols to be used	Task 1
7	Correct interpretation of working diagrams	Task 1
8	Ability to observe safety rules and precautions	Task1-4
9	Care of tools and equipment during and after the task	Task1-4
10	Exceptionality in carrying out a task	Task1-4
11	Ability to work within stipulated time	Task1-4
12	Right connection/setting of the equipment/tools	Task 2,3 and 4
13	Identification of correct materials to be installed	Task 2 and 3
14	Ability to apply and manipulate tools/equipment correctly	Task 2,3 and 4
15	Ability to identify types and sizes of cables and conductors	Task 2 and 3
16	Ability to handle tools and equipment	Task 2
17	Promptness in starting a given task	Task 3
18	Ability to estimate the desired length of conduit to be used	Task 3
19	Identification of correct material/position to install a protective device	Task 4
20	Ability to identify types and ratings of protective device	Task 4
21	Ability to test the protective device to be installed	Task 4

Table2 showed the distribution of performance objectives for domestic installation students at technical college level in Yobe State. 21 performance objectives as shown in were found to be objectives that teachers often value, observe and assessed in their students during practical work. The table also indicated the number of tasks that

each performance objectives needs to be achieved in carrying out their operations. These performance objectives vary from task to task due to the specific nature of the practical skills operations in each task.

Research Question 3: How reliable is the developed instrument for assessing student's practical skills in Domestic Installation in Technical Colleges of Yobe State?

Table3: Distribution of Reliability Coefficient of the Skills Assessment Instrument in Domestic Installation Processes in Technical Colleges in Yobe State

Item	Reliability (r)	Item	Reliability (r)
1	0.98	17	0.85
2	0.97	18	0.41
3	0.88	19	0.95
4	0.76	20	0.93
5	0.61	21	0.88
6	0.66	22	0.87
7	0.53	23	0.61
Task cluster 1	0.77	Task cluster 3	0.75
8	0.58	24	0.75
9	0.44	25	0.76
10	0.92	26	0.98
11	0.98	27	0.98
12	0.75	28	0.61
Task cluster 2	0.73	29	0.68
13	0.78	30	0.70
14	0.69	31	0.83
15	0.42	32	0.90
16	0.85	Task cluster 4	0.79
		Full length reliability	0.77

Table3 showed the distribution of reliability coefficient of the skills assessment instrument n domestic installation practice in technical colleges in Yobe State. The taled revealed that domestic task clusters 1 to 4 had reliability coefficients ranging from 0.73 to 0.79 while the instrument has full length reliability of 0.77

Findings of the Study

Based on the results of the study, the following emerged as findings of the study:

1. Thirty-two task operations in four task clusters were confound appropriate for inclusion and therefore included into the final copy of the developed instrument for assessing practical skills in domestic installation processes in technical colleges of Yobe State
2. Twenty-one performance specific objectives which varies from task cluster to task cluster were found appropriate for inclusion into the final copy of the developed instrument for assessing practical skills in domestic installation processes in technical colleges of Yobe State
3. Reliability of the instrument for assessing practical skills in domestic installation processes in technical colleges of Yobe State was found to be 0.77

IV. DISCUSSION

Thirty two major operations (tasks) in four task clusters expected of electrical domestic installation students at technical college level in Yobe State based on the NBTE (2004) curriculum for electrical installation practices were determined in the study. The major tasks ranging from the act of working drawing, surface wiring, conduit wiring and installation of protective devices, using different tools, equipment and materials are no doubt tasks expected of electrical installation students at technical college level. The execution of such task by students of the technical colleges as revealed in the study is in line with the assertion of Olaitan (2004) and Omosewu (2000). These authors asserted that technical education students should be able to carry out such task operations successfully and to carry them out under the working condition of the trade. In the same vein Habeshaw and Haberhaw (2003) pointed out that operation such as wiring, installation, terminating, testing etc. are operations expected of electrical installation students.

Performance objectives were also determined as outline in the NBTE (2004) curriculum for electrical installation practice at technical college level. Four broad performance objectives are more or less general or relevant to all the tasks clusters, these are competencies in the choice of tools and equipment; ability to observe safety rules and precautions, care of tools and equipment, exceptionality of a student's knowledge of task and ability

to work within stipulated time. In addition to the above general objectives are specific objectives based on the nature and requirements of each task cluster. The variation both in number and content of the performance objectives was based on expectancy of each task cluster. Thesefindings are in line with the findings of Garba (2012) where specific learning objectives were determined for each task cluster.According to Leighbody and Kidd (2000), teaching practical subjects successfully requires identification of specific performance objectives. The determination of specific performance objectives for the practical skills assessment instrument was in tandem with the above authors as well as the opinion of Gronlund (1999), and Habershaw and Habershaw (2003) that when executing classroom instruction, greater emphasis should be given to specific learning objectives.

A five point rating scale was developed for the practical skills assessment instrument. This is in line with the opinion of many experts regarding the assessment of students' practical performance. Among the experts are Reynolds (2000),Oranu (2007) and Yalams (2001). They pointed out that assessing students' practical competencies cannot be done successfully using mere observation and cursory look; a scale must be used. This is in line with the fact that "one of the major issues in the assessment of students' practical performance is the development of rating scale with weighted values in order of performance" Ezewu (2006). The weighted categories in the scale were developed in order to accommodate the students' individual differences and to communicate to the teachers the level of competencies acquired by a particular student. Olaitan (2004) discussing on learning how to learn, asserts that not all-motor activities are psycho productive; in that not all activities are relative and measurable under a given task. According to Olaitan (2004), psycho productive skills are such measurable skills that produced the expected or required change in behavior of the learner relative to an executed task. Full-length reliability coefficient of the practical skills assessment instrument was 0.77, and reliability coefficient of the four task clusters ranged from 0.73 to 0.79 and that of thirty-two task items ranged from 0.41to 0.98. These revelationsare similar to the results of other works done by the following experts; Ezeundu (2009), Mgboh (1999), Garba (2012), Bukar (2002), Yalams (2001) and Aminu (2015). According to Van Der Len (2004) and Okoro (2004) any reliability coefficient up to 0.40 is considered appropriate. Therefore, the thirty-twotask items found out in the practical skills assessment instrument in domestic installation practices at technical college level in Yobe State have been found to be reliable.

V. CONCLUSION

The major findings of the study serves as a basis for drawing conclusion that the instrument for assessing practical skills in domestic installation processes at the technical college level in Yobe State is a valid and reliable instrument that could be used in assessing students' practical skills in Domestic and Industrial Installation in technical colleges. It is believed that domestic installation teachers in technical colleges of Yobe State now have an objective, comprehensive and systematic instrument to effectively assess students' performance in domestic installation processes. In so doing, the teachers will be able to show proof of the scores and grades that they award to their students. Furthermore, it is believed that students' performance in domestic installation especially the practical aspect will be improved.

Recommendations

The following recommendations were made based on the conclusion of this study.

1. State ministry of Education should impose the use of the assessment instrument in all technical colleges of Yobe state.
2. Technical colleges and domestic installation teachers should acquaint themselves with the knowledge of usage of the assessment instrument.
3. Students of domestic installation in technical colleges should study and practice the tasks and operations in the instrument to enable them know what is expected of them.

Limitations of the Study

The following constraints are considered as limitations of the study

1. Some of the technical colleges do not have fixed practical sessions. The researchers had to seek the cooperation of school authorities in organizing practical sessions with both the teachers and students.
2. Since there was acute shortage of practical sessions, there also was shortage of resources for the conduct of practical sessions. The researchers provided the needed resources for the practical sessions which added to the minimal cost of the study.

Directions for Further Research

Based on the findings and conclusion of the study, further research can be conducted as follows:

1. Development and validation of an instrument for assessing practical skills in Industrial installation, cable jointing and winding of electrical machines in technical colleges inYobe State, Nigeria

2. Development and validation of an instrument for assessing practical skills in Engineering trade related courses in technical colleges in Yobe State, Nigeria

Sources of Funding of the Study

All costs, including that of undertaking the research study, provision of practical materials, transportation and welfare of both researchers and subjects were financed by the authors of the study

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