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Assessing the Efficacy of a Self-Developed Guide for Repair and Maintenance of Selected Domestic Electrical Appliances by Technical College Students in Akwa Ibom State

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Abstract: This study assessed the efficacy of a self-developed guide for repair and maintenance of selected domestic electrical appliances by Technical College students in Akwa Ibom state. Three specific purposes, three research questions and one null hypothesis were postulated to guide the conduct of the study. The non-randomized pre-test, post-test quasi-experimental design was adopted for the study. The population consisted of all 1,724 TC II students in Government Technical College Ewet, Uyo Local Government Area, 19 Technical College teachers with major in electrical /electronics and all the eight lecturers in Industrial Technology Education Department in University of Uyo. A 29 item researcher-developed instrument titled "Self-Help Guide for Repair and Maintenance of Domestic Electrical Appliances Questionnaire", Practical instructional tasks and practical checklist developed by the researcher were used to elicit data for the study. The instruments were validated by three experts, two from Industrial Technology Education Department, University of Uyo and one from Government Technical College Ewet, Uyo. A reliability index of 0.88 was obtained using the Cronbach's Alpha procedure. The instrument were administered and data collected in-situ. The data obtained were analysed using mean values to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypothesis at 0.05 level of significance. The findings of the study revealed 15 safety precautions and 14 tools for carrying out repair and maintenance of domestic electrical appliances. The study also revealed a significant difference in performance among students who used and those who did not use the self-help guide for practical repair and maintenance during the experiment. It was recommended that the self-help guide be adopted for teaching and learning practical skills in technical colleges and vocational institutions. Also, that workshops and seminars should be organized by the National Directorate of Employment and related government agencies to enlighten electrical repair and maintenance trainers and other vocational and technical teachers in order to improve their knowledge and skills on the use of self-help guide for repair and maintenance of domestic electrical appliances.

Keywords: Self-help, Repair, Maintenance, Domestic Electrical Appliances

INTRODUCTION

Domestic electrical appliances are important devices used in homes for various day to day functions like cooking, cleaning, purifying, food preservation among others. Majority of household domestic appliances are large machines usually used in the bedrooms, bathrooms, halls and in the kitchens. Buffler (2015) added that another type of small appliances relate to heating and cooling such as: fans, air conditioners, and heaters such as space heaters, ceramic

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heaters, gas heaters, kerosene heaters, and fan heaters. Yet another category is used in the kitchen, including: juicer-mixer, grinders, food processors, electric kettles, clothes pressing irons, coffee makers, dough makers, and electric chimneys. All appliances however, must be maintained and repaired periodically.

Repairs in the view of Bridgestone (2013) are services that are required or necessary when something on a system is not working properly or may have worn-out to the point where a replacement is required to maintain the performance of the system. According to Australian Taxation Office (2012), repairs mean work to make good or remedy defects in, damage to or deterioration of property. Repairs in the context of this study refers to the activities undertaken for the restoration of a broken, damaged or failed component, device, equipment or appliance to an acceptable operating state. The term repair is synonymous but not same as maintenance.

Maintenance is defined as actions necessary for retaining or restoring a piece of equipment, machine, or system to the specified operable condition to achieve its maximum useful life. Electrical appliances maintenance according to Jenn (2021), covers all aspects of cleaning, testing, monitoring, fixing and replacing elements of an electrical system. Few electrical appliances used at home that need the users' attention for routine maintenance include refrigerators, food mixers, blenders, television sets, air conditioner, music players, home theatre, digital players, pedestal and ceiling fan, air purifier, personal computers, vacuum cleaners, water purifier, water heater, digital clocks, food processors, washing machine among others. However, the present study focused on repair and maintenance of microwave oven, electric fan, electric pressing iron, air conditioner, electric blender, electric kettle and electric water heater. Acquisition of skills to effect repair and maintenance of these domestic appliances takes place in vocational institutions such as organised public or private training centers and Technical Colleges spread in all states of the country.

Technical colleges are Technical and vocational Education (VTE) institutions designed to produce craftsmen at the secondary school level and master craftsmen at advanced craft level. The ultimate aim of Vocational and Technical Education training is the acquisition of knowledge, attitude and marketable skills for sustainable development (Udofia *et al*., 2022). The training of VTE students is based on the production of skilful individuals who are proficient in production of goods and services that are not only relevant to themselves but also to the society at large. However, observations from many graduates of technical colleges show that a considerable number of students graduate with insufficient hands-on skills in repair and maintenance of common electrical appliances (Ngozi and Onyebuenyi, 2017). Researchers often attribute these situation to inadequate instructional materials, limited access to practical guides tailored towards local learning conditions and over-dependence on traditional teaching methods. As a result, graduates encounter difficulties performing independent repair tasks which undermine the objectives of technical and vocational education and the large investment on Technical and vocational education programme by both states and Federal government. This therefore calls for the need to develop a self-guide for repair and maintenance of electrical appliances. Okoye and Gangkwi (2024) defined Self-help as an action or process of bettering one's self or overcoming one's problem without the aid of others. Self-help consists of doing things by oneself, to try and solve one's own problems without depending on other people. Wolf and McQuitty, (2011) asserted that variant of self-help is "Do-it -Yourself" (DIY). "Do it yourself" is the method of building, modifying things by oneself without the direct aid of professionals or certified experts. Self-help guide therefore, is a set of documented procedure and instructions which when followed carefully, enables on to carryout repair and maintenance on domestic electrical appliances without the help of an expert.

In-spite of the availability of few instructional manuals which do not only lack step by step procedures suitable for the skill level of students, they also do not align with the curriculum of technical colleges. The absence of a structured guide which is content specific developed to support classroom and workshop instruction may be contributing to the persistent practical incompetence among graduating students. Hence, the need to develop a self-help guide for repair and maintenance of domestic electrical appliances. The researcher therefore developed a repair guide titled 'Self-help guide for repair and maintenance of domestic electrical appliances'. The self-help guide is a concise, explicit and comprehensive guide which provides step by step procedure for repair of common domestic electrical appliances such as microwave, electric fan, electric pressing iron, air conditioner, electric blender, electric cattle, water heater and food processor. At this juncture, it also became expedient to determine if the self-developed guide for the repair and maintenance of electrical appliances can significantly improve the practical performance and skill acquisition of technical college students in Akwa Ibom State.

Purpose of the Study

The main purpose of the study was to determine the efficacy of self-help guide for repair and maintenance of selected home electrical appliances on TC II students in Government Technical College Uyo, Akwa Ibom state. Specifically, the study determined the:

1. safety precautions for repair/maintenance of domestic electrical appliances using the self-help guide
2. tools required for carrying out repair and maintenance using the self-help guide
3. difference in practical task performance between the control and experimental groups on repair/maintenance of selected domestic electrical appliances.

Research Questions

The study provided answers to the following research questions:

1. What are the safety precautions required for carrying out repair/maintenance of domestic electrical appliances using the self-help guide?
2. What are the tools required for carrying out repair/maintenance using the self-help guide?
3. What is the difference in practical task performance between the control and experimental groups when rated on repair/maintenance of selected domestic electrical appliances?

Research Hypothesis

The following null hypothesis was tested at 0.05 level of significance

H_{01}: There is no significant difference in practical task performance between the control and experimental groups when rated on repair/maintenance of domestic electrical appliances.

METHODS

The non-randomized pre-test, post-test quasi-experimental design was adopted for the study. Quasi-experiments are carried out outside the laboratory and are therefore used in educational research since it is simply not possible for an investigator to undertake true experiments especially in random assignment of participants to control or experimental groups. The population consisted of all 1,724 TC II students in Government Technical College Ewet, Uyo Local Government Area, 19 Technical College teachers with major in electrical /electronics and all the eight lecturers in Industrial Technology Education Department in University of Uyo. A 29 item researcher-developed instrument titled "Self-Help Guide for Repair and Maintenance of Domestic Electrical Appliances Questionnaire", Practical instructional task items and practical checklist were developed by the researcher were used to elicit data for the study. The instruments were validated by three experts, two from Industrial

Technology Education Department, University of Uyo and one from Government Technical College Ewet, Uyo. A reliability index of 0.88 was obtained using the Cronbach's Alpha procedure.

***Experimental Procedure**:* Two intact classes with class sizes of 54 and 57 were purposively selected and assigned as control and experimental groups. The self-help guide questionnaire was administered to the teachers and lecturers of Government Technical College Ewet, Uyo and Industrial Technology Education Department, University of Uyo respectively. The practical task items were administered to each group and were rated using the checklist on the first class contact. The results obtained were considered as pre-test scores. For the treatments, class 'A' (control group) was taught by the class teacher using usual lesson plan/note while class 'B' (experimental group) was taught with the intervention of self-help guide. Both groups were taught twice weekly for a period of six weeks, bringing the total intervention period to 12 contacts. At the end of the intervention, same practical task were again administered to both groups and the same checklist was used to measure students' practical performance in both groups. The results obtained were considered as post-test scores. The data obtained were analysed using mean values to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypothesis at 0.05 level of significance.

RESULTS

Safety Precautions Required for Carrying Out Repair and Maintenance Of Domestic Electrical Appliances?

The data for answering research question 1 are presented in Table 1

Table 1: Mean Responses of Respondents on Safety Precautions Required for Repair and Maintenance of Domestic Electrical Appliances

(N = 111)

S/N	Personal and Equipment Safety	Mean	SD	Remark
1	Use hand gloves when handling high voltages	4.55	0.54	Highly Appropriate
2	Use goggles	4.23	0.63	Appropriate
3	Discharge the power capacitors in any appliance before working on it	4.55	0.54	Highly Appropriate
4	Know the wire code of your country	4.22	0.63	Appropriate
5	Protect oneself and equipment from electrical hazard	4.47	0.56	Appropriate
6	Keep tools at the designated place after use	4.09	0.63	Appropriate
7	Identify hazards and risks	4.51	0.50	Highly Appropriate
8	Evaluate hazards and risks	4.46	0.59	Appropriate
9	Control hazards and risks	4.06	0.62	Appropriate
10	Identify moving and static parts of electric appliances	4.44	0.50	Appropriate
11	Choose appropriate tools for the right job	4.55	0.54	Highly Appropriate
12	Do not spill water on work station	4.23	0.63	Appropriate
13	Maintain proper handling of insulated tools and instruments	4.42	0.62	Highly Appropriate
14	Check tools for defects	4.51	0.58	Highly Appropriate
15	Keep the work area clean and dry	4.55	0.61	Highly Appropriate

Data presented in Table 1 show that all the safety precautions required for repair and maintenance of domestic electrical appliances have their mean values ranging from 4.06 to 4.55. This implies that the mean value of each safety precautions is above the cut-off point of 3.50 indicating that all the 15 safety precautions required for repair and maintenance of domestic electrical appliances. Table 1 also reveals that the standard deviations (SD) of the items are within the range of 0.50-0.63. This indicates that the respondents are not far from one another in their responses.

Tools Required for Carrying Out Repair and Maintenance Using the Self-Help Guide

Table 2: Mean Responses of Respondents on tools required for carrying out repairs and maintenance using the self-help guide

(N = 111)

S/N	Tools for Repair and Maintenance	Mean	S.D	Remark
1	Star screw driver	4.53	0.53	Highly Appropriate
2	Flat screw driver	4.44	0.61	Appropriate
3	Voltage tester	4.46	0.59	Appropriate
4	All types of pliers	4.55	0.54	Highly Appropriate
5	Hammers	4.33	0.64	Appropriate
6	Flashlight	4.32	0.61	Appropriate
7	Utility knife	4.53	0.53	Highly Appropriate
8	Insulating tape	4.44	0.61	Appropriate
9	Cleaning brush	4.44	0.61	Appropriate
10	Allen wrench (key) set	4.44	0.61	Appropriate
11	Soldering iron/ lead	4.47	0.59	Appropriate
12	Multi-meter	4.56	0.54	Highly Appropriate
13	Blower for dust removal	4.32	0.65	Appropriate
14	Extension cord	4.30	0.62	Appropriate

Data presented in Table 2 show that all the tools required for carrying out repair and maintenance using the self-help guide have their mean values ranging from 4.30 to 4.56. This implies that the mean value of each tools required for carrying out repair and maintenance is above the cut-off point of 3.50 indicating that all the 14 tools are required for carrying out repair and maintenance of domestic electrical appliances using the self-help guide. Table 2 also reveals that the standard deviations (SD) of the items are within the range of 0.53-0.65. This indicates that the respondents are not far from one another in their responses.

The difference in practical task performance between the control and experimental group when rated on repair and maintenance of domestic electrical appliances

Table 3: Summary of Students' Mean Performance in Repair and Maintenance Practical

N = (111)

Students Group	N	Pre-test Score $\overline{X}1$	Post-test Score $\overline{X}2$	Mean Gain	Difference
Experimental Group	54	29.22	71.09	41.87	26.21
Control Group	57	27.42	43.08	15.66	

Data presented in Table 3 reveal that the post-test mean score of the experimental group who performed the repair practical using the self-help guide is 71.09 with mean gain of 41.87 while the mean post-test score of the control group who performed the practical without the self-help guide is 43.08 with a mean gain of 15.66. The result reveals that the mean gain difference between the scores of experimental and control groups is 26.21. This implies that students who performed the repair practical using the self-help guide performed better than those who did not use the self-help guide.

Hypothesis

There is no significant difference in practical task performance between the control and experimental group when rated on repair and maintenance of domestic electrical appliances.

Table 4: Analysis of Covariance (ANCOVA) on difference in practical task performance between the control and experimental groups when rated on repair and maintenance of domestic electrical appliances

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9578.640	2	4789.320	117.192	0.000
Intercept	6627.537	1	6627.537	162.173	0.000
PRETEST	3.782	1	3.782	.093	0.762
Groups	9406.116	1	9406.116	230.163	**0.000**
Error	1879.890	98	40.867		
Total	166357.000	111			
Corrected Total	11458.531	110			

The analysis of covariance (ANCOVA) in Table 4 shows that p-value of 0.000 is less than 0.05 level of significance. This indicates that there is significant difference in practical task performance between the control and experimental group as rated on repair and maintenance of domestic electrical appliances. The significance difference is in favour of the experimental group who used the self-help guide to carry out repair and maintenance. Hence the null hypothesis is rejected. This implies that students who performed the practical using the self-help guide performed better than those who did not use the self-help guide.

DISCUSSION

The discussions of findings of this study are presented in line with the purpose of the study under the following headings:

Safety Precautions Required for Repair and Maintenance of Domestic Electrical Appliances

The findings of the study revealed that use of hand gloves when handling high voltages, use of goggles, discharging power capacitors before working on appliances, knowledge of one's country wire code, keeping tools in designated places among others were unanimously agreed upon by the respondents as safety precaution to be observed while carrying out repair and maintenance. Working in electrical workshop involves observing all the safety in order to achieve learning outcome or set objective of the programme. This finding supports the opinions of Chukwuedo and Nwachukwu (2014); Dung (2015) who noted that items that satisfy workshop safety practices are relevant and worthy for repair and maintenance of electrical appliances by students. The finding is in agreement with the opinion of Dung (2015) who stated that all the safety skills identified in handling hand tools, operating machine tools, workshop safety and the personal protective equipment are required by electrical installation

students for effective functioning in the workshop. One of the major problems affecting the management of workshop was lack of safety precaution in the workshop. The remote causes of accident in the workshops are as a result of not observing the workshop rules and regulation. The researcher opined that the importance of safety in repair and maintenance of domestic electrical appliances cannot be overemphasized as knowledge on safety afford students to carry out repair without fear of unknown.

Tools Required for Carrying Out Repair and Maintenance Using the Self-Help Guide

Data generated in this study to identify the tools and equipment required for repair and maintenance of domestic electrical appliances showed that all the 14 identified tools and equipment in this study are necessary. This corroborates the findings of Omofonmwan and Chukwuedo (2013) and Okoye and Gangkwi (2024) who found that the tools and equipment needed for skill acquisition in the repairs of digital electronics in the National Open Apprenticeship Scheme (NOAS) of the National Directorate of Employment (NDE) in Edo State were not sufficiently provided to the trainees. The determined tools and equipment were not entirely different from those used in carrying out corrective maintenance of other digital electronic appliances. Literature such as Tokhein, (2005) and Theraja, and Sedha, (2009) have identified these tools and equipment as those needed in the technology of electronic devices and appliance. In line with earlier researchers, the researcher therefore, conclude that these identified tools and equipment are necessary for efficient completion of any work on repair and maintenance of domestic electrical appliances.

Practical Task Performance between the Control and Experimental Group on Repair and Maintenance of Domestic Electrical Appliances.

The finding of this study revealed that there was a significant difference in practical task performance between the control and experimental group as rated on repair and maintenance of domestic electrical appliances. The significant difference was in favour of the experimental group which used the self-help guide to carry out repair and maintenance. This finding is in line with that of Ariba (2016) and Okoye and Gangkwi (2024) who found a significant mean difference between artisans 'skill performance before and after retraining using a developed programme. Similarly, Egbita and Kanu (2015), in a study conducted to measure the effect of a training module in improving knowledge competencies for technical and vocational teachers found that those trained using training module significantly improved more than those that were trained without it. In the researcher's view, the use of the self-help guide facilitated the acquisition of both cognitive and practical skill among technical college students as well as ensuring confidence in independent approach to resolving fault in domestic electrical appliance

CONCLUSION

The study concluded that the self-developed guide is an effective instructional tool for enhancing the repair and maintenance competencies of technical college students in Akwa Ibom State. The guide significantly improved students' understanding of repair and maintenance procedures, safety practices, and maintenance techniques for selected domestic electrical appliances. Students who utilized the guide demonstrated better practical performance and greater confidence in carrying out repair and maintenance tasks compared to those who relied solely on conventional instructional methods.

RECOMMENDATIONS

Based on the findings of the study, the researcher recommends the following:

(i) Self-help guide for repair and maintenance of domestic electrical appliances should be adopted in Technical Colleges and vocational training outfits such as the National Directorate of Employment (NDE) for teaching and learning of repair and maintenance skills.

(ii) Workshops and seminars should be organized by the National Directorate of Employment and related government agencies to enlighten Technical Colleges students, electrical repair and maintenance trainers and other vocational and technical teachers in order to improve their knowledge and skills on the use of self-help guide for repair and maintenance of domestic electrical appliances.

(iii) The guide should be adopted as a tool for developing entrepreneurial competencies among students, enabling them to establish self-employment ventures in appliance repair and maintenance after graduation.

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