DEVELOPMENT OF TRAINING MANUAL FOR MAINTENANCE OF POWER SUB-SYSTEM OF RADIO AND DIGITAL VERSATILE DISC PLAYER FOR ELECTRONICS CRAFTSMEN

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Abstract: This study developed appropriate maintenance contents for training craftsmen in the power sub-system of the Radio and DVD player. One research question and one hypothesis guided the study. The study is Research and Development (R&D) and employed the Wheeler's model for instructional material development. The population for the study was 58 respondents which consisted of 32 electronics teachers in all the accredited science and technical colleges offering electronics trade and 26 master craftsmen with the NDE States head offices in North-Central States of Nigeria. The instrument used for data collection was questionnaire. The questionnaire solicited information on appropriate maintenance contents for training craftsmen in the power sub-system and has 89 structured question items organized under objective, task criteria, teaching content and tools/materials. Data collected was analyzed using mean for the research question and t-test for the hypothesis. Emerging findings revealed appropriate maintenance objective, task criteria, teaching content and tools and materials for training craftsmen in the power sub-system. Some of the findings are; verify AC supply, verify functioning of rectifiers, test the ON/OFF contacts of the main switch, replace and solder rectifier chip. Recommendation made include Radio and DVD player maintenance training module should be included in craftsmen training program in Nigeria and the developed training manual should be adopted for training and retraining of craftsmen in the maintenance of R and DVD player.

Keywords: Radio and DVD player, Power Sub-system, Maintenance, Electronics Craftsman, Training manual and Development.

1. INTRODUCTION

Radio and Digital Versatile Disc player is a dual function electronics equipment that receives radio waves and converts the information carried by the radio waves to a usable form and also decodes information that is encoded onto DVD optical disc produced under the DVD-Video and DVD-Audio technical standards (Rudersdorfer, 2013 and Robert, 2015). This device is a standard electronic equipment for modern Home Theater media that has multi-dimensional functions such as non-linear playback (employing the laser Disc), improved picture quality, surround sound effect and incorporated radio receiver system. Because of the expansion of the Radio and DVD player on the analogue aspect of the Video Home System (VHS) it found application in every home today. The device is a single electronic equipment with dual systems namely, Radio sub-system and DVD systems.

The Radio sub-system is electronics circuits that is designed to receive Frequency Modulated (FM) or Amplitude Modulated (AM) radio wave via the antenna, processes the received waves to extract only the vibrating waves that are in accordance with the desired frequency and subsequently filters the audio information that were added to the radio waves and reproduces the original audio signal via the speakers (Lowe, 2016) whereas the DVD systems is responsible mainly for reproducing the 'video and the audio' information encoded unto the DVD optical disc. The DVD system consists of four sub-systems namely, mechanical, audio, video and power sub-systems (Advameg, 2016). The mechanical sub-system is a logically assembled plastic and metallic interacting components and associated drivers performing motional function designed to achieve disc intake, ejection and playback function. During media production, picture and sound are digitally encoded onto the DVD optical disc in the form of grooves and pits (Life's Good Service Centre, 2007). To watch or listen to the video or sound contained on optical disc as the case maybe, Radio and DVD player requires a device that can read these data called the Laser assembly. The Laser assembly produces a beam having wavelength of about 505nm or 630nm that is focused into a tube containing reflective mirrors electronically designed to allow binary (0 or 1) data stored on an optical disc to be decoded (Rouse, 2016). The circuit that decodes and process the audio information is referred to as the audio sub-system whereas the video sub-system decodes and processes video signal. The power sub-system provides the Direct Voltage that operates the other sub-systems whereas the video and audio sub-systems reproduce the video and audio information contained on the DVD optical disc.

Furthermore, power sub-system is the section that converts the Alternating Current (A.C.) supply to suitable Direct Current (D.C.) required to operate the various units of the Radio and DVD player. The main components of the power sub-system are the transformer, rectifier diode, resistor and filter capacitor (Pong, 2016). The transformer steps down the A.C of 240V to A.C. suitable to operate the Radio and DVD player. The A.C. is thereafter converted to its D.C. equivalent with the aid of the rectifier diodes. The filter capacitor smoothens the output signal from the rectifier. Since different voltages are required to operate the various sub-systems, resistors are used to manipulate the output D.C. voltage as required for the stages. The power sub-system used for Radio and DVD player are Switching Mode Power Supply (SMPS). The SMPS uses rectifier diode, filter capacitor and chopper transformer arrangement to achieve voltage conversion from A.C. to D.C. and split the D.C. to various voltages level needed to operate the other sub-systems through four main stages namely rectifier, filter, stabilization and regulation stages. SMPS uses dedicated components such as the integrated circuits, regulatory transistors, chip rectifiers, relays to perform functions such as voltage switching, voltage regulation, overload protection operations (Luo, Yew, and Joeh, 2016). In the cause of performing these functions and the function of providing audio and video signals, SMPS and other sub system components failure is inevitable. As such, in order to keep the Radio and DVD player in good working condition and increase its life span as well as fix it when it fails there is a need for Maintenance.

Maintenance is the action taken to preserve, restore or keep an item in good working condition (Ogbuanya, 2009). It is a deliberate action plan aimed at ensuring that an item functions continuously and properly to the owners satisfaction. Types of maintenance conducted on power sub-system generally could be in various forms such as troubleshooting and replacement of damaged or burnt components, dusting (Ohanu, 2012). The importance of maintenance includes better conservation of equipment or machine and increased life expectancy of such equipment, thereby eliminating premature replacement of equipment, tools or machinery; equipment downtimes is decreased and the number of major repairs that would have resulted is reduced; it reduces e-waste generation rate by increasing the gadget life span (Goldwasser, 2011). The fragile nature of the Radio and DVD player requires constant maintenance to be conducted on the equipment because components such as surge protectors, relays are liable to fail when in continuous use. The consequences of operational failure of these components may be total picture outage, no sound, no sound and picture. Nevertheless, whatever be the nature of fault that the Radio and DVD player may develop, correcting the fault requires the services of the Craftsman.

Craftsmen in Nigeria education system are graduates of technical college who are trained in a given occupation (Federal Ministry of Education (FME), 2003). Those graduates who studied electronics trade are called electronics craftsmen. The objectives of the electronics trade program is to produce craftsmen who will possess adequate practical skills and knowledge in carrying out installation, maintenance and repairs of electronic gadgets such as radio, television and satellite for self or paid employment (National Business and Technical Examination Board, 2007). Today, due to technological advancement, trend in the society arising from invention of new electronic gadgets, skills acquired by technical college students at graduation is no longer adequate for employment (Ohanu, 2012). However, because of the need to fill the gap in skills acquired and skills required for industrial age employment the National Directorate of Employment (NDE), Industrial Training Funds were established to train and retrain craftsmen. The implementation of these programs requires a training manual.

Training manual is a guide and plan that specifies a number of elements essential to teaching and learning (Aliyu, 2013). The content of a worth-while training manual basically specifies; operational tasks, learning objectives, requirement for implementing the objectives and tool/equipment resources that are required to accomplish an operation (C-STEmp, 2016 and Aliyu, 2013). From the foregoing therefore, training manual in the context of the study refers to a compilation of planned contents which specifies; operational tasks, learning objectives for accomplishing identified tasks, tools/materials, and instructional criterion that serve as a guide in teaching the procedures required to carry out maintenance on power sub-system of the Radio and DVD player. The benefits of training manual as an instructional guide are enormous among which are reduces learning difficulty and training time for new trainees, it ensures training continuity, it ensure consistency in training, it makes easy to find out procedure that are in place to handle respective situations or task, above all it ensure that training is based on skills required (Vorster, 2011). The realization of these benefits is hinged on quality of training manual development.

Development is the act or systematic process of using scientific and technical knowledge to build a material (Merriam-Webster, 2017). From the foregoing development in the context of this study refer to the process of building an organized document called manual. There are several models of development of training manual such as ADDIE model, Tyler’s model, Dick and Carey’s model, Wheeler’s model (Aliyu, 2013). Among these models, the Wheeler (1980) model was found to be most appropriate and was adopted in developing the training manual. This model consists of five stages namely: stating aims and objectives, selection of learning experience, selection of teaching content, organization and integration of learning experience and teaching content and evaluation. Wheeler’s approach involve analyzing the learning outcome and stating the objectives, selecting and sequencing material that will enhance learning experience, selection of teaching content, building learning outcome, materials and contents into a structure and evaluation (UKessay, 2017). The evaluation process appraises the appropriateness of the teaching content and material in enhancing the desired learning outcome. The appraisal process usually involves subject matter experts to determine the appropriateness of the content of the developed manual. Subject matter experts that were used to assess the draft manual developed are master craftsmen and electronics teachers. Master craftsmen are holders of Advance National Technical Certificate whereas technical teachers are engineers, technologists and technicians that teach electronics trade at technical schools. These stakeholders appraised the developed manual developed to be used for training and retraining of electronics craftsmen.

Despite the importance of training manual to the implementation of the training program of craftsmen, it is established that there is no manual on Radio and DVD player maintenance that could be used for training and retraining electronics craftsmen at various craft training centres in order to enhance their employability and improve service delivery (Chukwuedo and Ainetor, 2015). Consequently, this has made many electronics craftsmen to be redundant because they lack skills to service modern electronics equipment (Radio and DVD player inclusive) (Chukwuedo and Ainetor, 2015). Also, since most Radio and DVD player that are not repaired are disposed into the environment, e-waste that constitutes environmental and human hazards is on the increase. Equipping electronics craftsmen with the needed technical requirement to carryout maintenance on Radio and Digital Versatile Disc player will not only help in ensuring continuous usage of DVD player but will also ensure production of competent craftsmen for gainful or paid employment. Thus leading to societal development and curbing various societal menaces. It is against this background that the development of training manual for maintenance of Radio and Digital Versatile Disc player for electronics craftsmen becomes necessary.

1.1 Aim and Objective of the Study

The specific objective of the study was to develop appropriate maintenance contents for training of craftsmen in:

Power sub-system of Radio and DVD player

1.2 Research Question

What are the appropriate maintenance contents for training craftsmen in the power sub-system of Radio and DVD player?

1.3 Hypothesis

HO1: There is no significant difference in the mean response between electronics teachers and master craftsmen regarding maintenance contents of power sub-system.

2. METHODOLOGY

The study was R&D research and employed the Wheeler's model of instructional material development. The study covers North-Central States of Nigeria. The population for the study was 58 persons which consist of 32 electronics teachers in the 11 accredited science and technical colleges offering electronics trade and 26 master craftsmen with the NDE in North-Central States. All the electronics teachers and master craftsmen were used for the study. The instrument used for the collection of data was a four point rating scale questionnaire with the response options of Highly Appropriate (HA), Appropriate (A), Not Appropriate (NA) and Highly Not Appropriate (HNA).

The specific activity carried out in line with the Wheeler's fives steps model that led to the draft manual are; job analysis was carried out to identify the job tasks of Radio and DVD player craftsman. This led to identification of Radio and DVD player maintenance objective and specific tasks appropriate to carryout maintenance on power sub-system. Analysis of each of the objective for power sub-system was done using Task Analysis to reveal the tools and materials and teaching content that will enhance the desired learning experience. Each specific task was analyzed to reveal tools and materials and teaching content. These steps led to identification 16 tools/materials and 26 teaching contents for maintenance of power sub-system. To determine which item is appropriate for inclusion in the training manual the instrument was administered to the respondents and thereafter all the items that meet the threshold mean were considered appropriate hence organized to develop the draft power sub-system manual. The response to the items was interpreted using table of real limit of numbers with reference to the 4-point rating scale. Based on this any item that was within the limit of; 0.50 – 1.49 is Highly Not Appropriate, 1.50 – 2.49 is Not Appropriate, 2.50 – 3.49 is Appropriate and 3.50 – 4.00 is Highly Appropriate. This implies that any item below a threshold mean of 2.50 is Not Appropriate whereas those above 2.50 are Appropriate for inclusion in the manual.

3. RESULTS

Table 4.1: Mean with Standard Deviation of Respondents on the Appropriate Maintenance Contents for the Power Sub-system of Radio and DVD Player

S/N	Contents of Power Sub-system of Radio and DVD player	—	SD1	$\bar{X}_2$	¯D2	$\bar{X}_t$	¯Dt	Dec
A	Objectives of Power Sub-system							
1	Verify AC supply	3.69	0.54	3.35	0.63	3.53	0.62	HA
2	Verify functioning of rectifiers	2.94	0.91	3.54	0.71	3.21	0.89	A
3	Verify functioning of filter section	3.66	0.48	3.31	0.67	3.50	0.60	HA
4	Verify functioning of regulators and stabilizers	3.81	0.53	3.35	0.48	3.60	0.56	HA
B	Task criteria for Maintenance of Power Sub-system							
	Verifying AC supply							
5	Test DVD mains cable continuity	3.50	0.67	3.81	0.40	3.64	0.58	HA
6	Test function of DVD protective fuses, surge protectors	3.56	0.67	3.73	0.45	3.64	0.58	HA
7	Test resistance of choke resistor using multimetre	2.94	0.76	3.46	0.51	3.17	0.70	A
8	Check the availability of AC supply voltage using multimetre	3.47	0.51	3.35	0.56	3.41	0.53	A
9	Test the ON/OFF contacts of the main switch	3.44	0.71	3.42	0.81	3.43	0.75	A
10	Test coils of transformer	3.13	0.75	3.19	0.80	3.16	0.76	A
11	Measure the output voltage of transformer	3.90	0.58	3.00	0.80	3.05	0.68	A
12	Test resistance of high voltage resistors	3.50	0.88	3.54	0.51	3.52	0.73	HA
13	Replace AC supply plug/cord/protective devices	3.53	0.62	3.46	0.51	3.50	0.57	HA
14	Replace ON/OFF mains switch	3.53	0.84	3.19	0.49	3.38	0.72	A
15	Re-core transformer	3.66	0.48	3.04	0.66	3.38	0.64	A
	Verifying functioning of rectifiers							
17	Identify rectifier diodes polarity using multimetre	3.75	0.67	3.58	0.70	3.67	0.68	HA
20	Test rectifier chip polarities	2.91	0.99	2.88	1.03	2.90	1.00	A
21	Mount and solder rectifier diodes	3.19	0.96	3.54	0.58	3.34	0.82	A
22	Replace and solder rectifier chip	3.56	0.62	2.77	0.86	3.21	0.83	A
	Verifying functioning of filters							
23	Test the polarity of filter capacitors	2.63	0.94	3.19	0.40	2.88	0.66	A
24	Measure capacitance of capacitors using analogue multimetre	3.75	0.44	3.23	0.59	3.52	0.56	HA
25	Identify leaked electrolytic capacitor	3.13	0.79	3.50	0.51	3.29	0.70	A
26	Test for capacitor voltage during charge and discharge	3.19	0.82	3.27	0.67	3.22	0.50	A
27	Identify kinds of inductors	2.59	0.79	3.08	0.48	2.81	0.71	A
28	Test inductors using multimetre	3.59	0.56	3.15	0.36	3.40	0.53	A
27	Replace filter capacitor	2.85	0.78	3.44	0.66	3.17	0.77	
	Verifying functioning of regulators and stabilizers							

28	Identify Zener diodes polarity using multimetre	3.66	0.48	3.38	0.49	3.53	0.79	HA
29	Identify (regulators) transistors	2.84	0.57	3.00	0.63	2.91	0.60	A
31	Test transistor junctions of bipolar transistors	3.78	0.75	2.85	0.73	3.36	0.87	A
32	Identify relays	3.94	0.25	2.92	0.94	3.48	0.82	A
33	Test D.C coils of relay	2.75	0.44	3.42	0.76	3.05	0.68	A
34	Test relay open and close contacts on-load and no-load for change over single contact relay	3.31	0.89	3.77	0.43	3.52	0.75	HA
35	Test relay open and close contacts on-load and no-load for change over double through contact relay.	3.53	0.76	3.69	0.68	3.60	0.72	HA
36	Identify chopper transformer with fixed DC input coil	2.59	0.76	3.46	0.86	2.98	0.90	A
37	Identify chopper transformer with varied DC input coils	2.69	1.51	3.54	0.81	3.07	1.03	A
38	Test output and input coils of chopper transformer with fixed Input/output coil and fixed input/variable output D.C coil	3.69	0.49	3.12	0.43	3.43	0.64	A
39	Identify voltage dividers	3.38	0.49	2.92	0.63	3.17	0.59	A
40	Measure voltage dividers output voltages	3.09	0.82	2.85	0.88	2.85	0.84	A
41	Identify analogue single in-line and dual pin IC connections	3.63	0.55	3.08	0.93	3.38	0.79	A
44	Conduct comparative test on analogue single in-line and dual pin IC using multimetre	2.94	0.67	3.35	0.97	3.12	0.83	A
45	Replace relays	2.85	0.61	3.25	0.80	3.07	0.74	A
46	Replace chopper transformer	3.85	0.36	3.16	1.02	3.47	1.01	A
47	Mount single in-line and dual analogue ICs	3.28	0.58	3.38	0.49	3.33	0.54	A
C	Teaching Content for Power Sub-system							
	AC supply							
48	Protective devices test	3.69	0.47	2.81	0.85	3.29	0.79	A
49	Measurement of A.C and D.C voltage using multimetre	3.88	0.34	2.85	0.88	3.41	0.81	A
50	ON and OFF contact test for switches	3.59	0.49	3.38	0.80	3.50	0.65	HA
51	Types of transformers and test for coils of transformer	3.50	0.88	3.35	0.79	3.43	0.84	A
52	Re-coring transformer	3.47	0.67	3.19	0.75	3.34	0.71	A
53	Identification and test for high voltage resistors	2.50	0.88	3.85	0.37	3.10	0.96	A
	Rectifier stage							
54	Identification of rectifier diodes	3.63	0.75	3.54	0.51	3.59	0.65	HA
55	Testing polarities of rectifier diode	3.97	0.17	3.85	0.37	3.91	0.28	HA
56	Rectifier chip polarities Test	3.63	0.55	3.35	0.79	3.50	0.68	HA
	Filter stage							
57	Types of capacitors	3.91	0.30	3.69	0.47	3.81	0.39	HA
58	Testing polarities of filter capacitor	3.56	0.50	3.54	0.65	3.55	0.56	HA
59	Inductor types	3.66	0.60	3.54	0.50	3.60	0.56	HA
60	Test for inductors	3.62	0.49	3.73	0.45	3.67	0.47	HA
	Regulator and stabilizer stage							
61	Zener diode polarities test	2.56	0.80	3.15	0.68	2.83	0.79	A
62	Identification of regulatory transistors	3.53	0.76	3.50	0.51	3.52	0.65	HA
63	Regulatory transistors terminals test	2.75	0.76	3.58	0.50	3.12	0.77	A
64	Types of relays	4.00	2.38	3.38	0.49	3.72	1.08	HA
65	Relays D.C coil test	3.31	1.09	3.58	0.76	3.43	0.95	A
66	Open and close contacts on-load and no-load test of change over single contact relay test	3.03	1.03	3.62	0.49	3.29	0.87	A
67	Open and close contacts on-load and no-load of changeover/double through contact relay test.	3.41	0.76	3.42	0.50	3.41	0.65	A
68	Testing chopper transformer coils.	3.31	1.09	3.69	0.47	3.48	0.88	A
69	Chopper transformer output voltage Test.	3.41	0.91	3.42	0.50	3.41	0.75	A
70	Identification of voltage dividers resistors	3.20	0.46	3.50	0.51	3.38	0.48	A
71	Measuring voltage dividers output voltages	3.75	0.44	3.04	0.77	3.43	0.70	A
72	Identification of analogue single in-line and dual IC pin	3.38	0.49	3.46	0.58	3.41	0.53	A
73	Conducting comparative test on analogue single in-line and dual pin IC using multimetre	3.28	0.88	3.65	0.48	3.45	0.75	A
D	Tools/Materials for Maintenance of Power Sub-system							

74	Long nose plier	3.47	0.57	3.23	0.43	3.36	0.52	A
75	Combination plier	2.97	0.54	3.31	0.83	3.12	0.70	A
76	Sets of star screw driver	2.97	0.59	3.54	0.65	3.22	0.67	A
77	Set of flat screw drivers	3.50	0.62	3.50	0.51	3.50	0.74	HA
78	Allen keys and asterics	3.59	0.62	3.08	0.79	3.36	0.69	A
79	Precision tools	3.28	0.68	3.54	0.76	3.40	0.71	A
80	Brush	3.19	0.82	3.58	0.50	3.36	0.77	A
81	Picker	3.34	0.83	3.23	0.71	3.29	0.56	A
82	Soldering iron	3.56	0.50	3.35	0.63	3.47	0.50	A
83	Lead sucker	3.56	0.50	3.46	0.51	3.52	0.72	HA
84	Neon tester	3.50	0.88	3.77	0.43	3.62	0.49	HA
85	Digital and analogue multemtre	3.78	0.42	3.38	0.49	3.60	0.48	HA
86	Variable D.C source	3.13	0.79	3.00	0.75	3.07	0.76	A
87	D.C test lamp	3.13	1.21	3.69	0.47	3.38	0.98	A
88	Work bench lamp	3.56	0.50	3.50	0.51	3.53	0.50	HA
89	Flat file	3.66	0.60	3.46	0.51	3.57	0.56	HA

Key: HAPP = Highly Appropriate, APP = Appropriate, Dec = Decision

Table 4.1 present the mean scores of the appropriateness of maintenance contents for the power sub-system of Radio and DVD Player. The respondents mean ratings in the contents of power sub-system objective, task criteria, teaching content, tools and materials shows that all the items mean are above 2.50 cutoff mean. The items average means ranges between 3.91 and 2.81 with 61 items rated Appropriate and 28 items Highly Appropriate. The standard deviation of the items ranges from 0.20 to 1.08. This implies that electronics teachers and master craftsmen are homogenous in their responses on the appropriateness of the maintenance contents for training craftsmen in the radio sub-system. This indicates that the 89 items identified for maintenance objectives, task criteria, teaching content, tools and materials are appropriate maintenance contents for training craftsmen in the power sub-system.

Table 2: t-test Analysis of Maintenance Contents of Radio and DVD Player Power Sub-system

S/N	Contents for Training Craftsmen for the Power Sub-system	Group	N	Mean Difference	t-calc.	df.	t-tab	Decision
1	Maintenance Objectives for Power Sub-system	Electronics Teachers	32	-0.75	-0.13	56	2.01	Not Sign.
		Master Craftsmen	26	-0.75				
2	Maintenance Task criteria for the Power Sub-system	Electronics Teachers	32	0.71	0.37	56	2.01	Not Sign.
		Master Craftsmen	26	0.71				
3	Teaching content for Power Sub-system	Electronics Teachers	32	0.84	0.19	56	2.01	Not Sign.
		Master Craftsmen	26	0.84				
4	Maintenance Tools/Materials for Power Sub-system	Electronics Teachers	32	-0.61	-0.25	56	2.01	Not Sign.
		Master Craftsmen	26	-0.61				
t-Total					0.18	56	2.01	H0: Not Sign.

Table 4.6 has the t-test analysis of the maintenance contents for training craftsmen for power sub-system of the Radio and DVD player. The table revealed calculated t-test value for power

sub-system in the contents of maintenance objectives, task criteria, teaching content and tools/materials to be -0.13, 0.37, 0.19 and -0.25 respectively. This result indicates a no significant difference for the contents since t-calculated are less compared to 2.01 critical value at 0.05α (df56). Likewise since 0.18 calculated t-total is less than 2.01 table value at 0.05α df56, the null hypothesis is therefore upheld. As such no significant difference exists between the mean responses of electronics teachers and master craftsmen regarding maintenance contents for training craftsmen in the power sub-system.

4. RESULTS AND DISCUSSION

The data presented in Table 4.1 provided answers to research question one. The Table revealed appropriate maintenance contents for training craftsmen for power sub-system in the Radio and DVD player. The identified maintenance contents for training craftsmen for power sub-system categorized under power sub-system maintenance objectives, task criteria, teaching content and tools/materials revealed 89 items. Specifically, four objectives that describe observable unit of activity required to accomplish a job, thirty-six task criteria which are specific skill or knowledge that craftsmen are to possess to enable them accomplished a repair on the power sub-system were identified appropriate for inclusion in the training manual. Other contents identified appropriate for inclusion in the training manual are twenty-six teaching components that provide specific step for implementing the training manual and 19 various tools and materials.

Furthermore, finding on maintenance objectives for power sub-system are craftsmen should possess ability to; verify AC supply, verify functioning of rectifiers, verify functioning of filters and verify functioning of regulators and stabilizers. These objectives are in line with Luo, Yew and Joeh (2016) SMPS stages. Luo, Yew and Joeh SMPS consists of four stages namely AC supply stage, rectifier stage, filter stage and regulators and stabilizers. In this light, conducting maintenance on the power sub-system translates to the ability to verify the functioning of these stages. Sequence to the identified broad objectives, thirty-six task criteria that stipulate measurable and specific activity a craftsman should do in order to accomplish the broad objectives were determined. The identified task amongst others include the ability of the craftsmen to test DVD mains cable continuity, test resistance of choke resistor using multimeter, test function of DVD protective devices, test the on/off contacts of the main switch, test rectifier chip polarities, test relay open and close contacts on-load and no-load for change over single contact relay, test relay open and close contacts on-load and no-load for change over double through contact relay. For a demonstrable change to be achieved in the maintenance of power sub-system in line with the broad objective Chukwuedo and Ainetor (2015) advocate that task criteria such as the power sub-system should be based on the components that made up the identified stages of power supply. As such, findings on task criteria developed are in line with the identified components that consist the rectifier, filter and regulators and stabilizers which concords also Chukwuedo and Ainetor (2015) maintenance task identified to include ability to test capacitors, diode, transistors with multimetre.

Additionally, finding on teaching component for power sub-system in Table 4.1 include protective devices test, re-coring transformer, measurement of A.C and D.C voltage using multimeter, ON and OFF contact test for switches, types of transformers and test for coils of transformer, identification and test for high voltage resistors, identification and biasing of rectifier diodes amongst others. For a manual to be used for training, Wheeler (1980) advocate that the steps in which the objectives will be implemented should be determined. In line with the broad objectives, teachable units that will inculcate in the craftsmen the desired physical skills required to successfully carryout maintenance on the power sub-system were determined. According to Esiowu (2015) teaching content helps guide the teacher on selection of contents that are productive for achieving learning objective. Finding on maintenance tools/materials for power sub-system presented in Table 4.1 revealed the following maintenance tools/materials for power sub-system; allene keys and asterisk, precision tools, soldering iron, lead sucker, neon tester, variable D.C source, D.C test lamp, work bench lamp and flat file amongst others. This result is in accordance with Ohanu (2012). Ohanu identified tools such as soldering iron, multimeter, magnifying lens as some tools need for conducting maintenance. In the same vein, the t-test analysis of the maintenance contents for training craftsmen on power sub-system presented in Table 4.6 revealed calculated t-test value for power sub-system maintenance in the contents of objectives, task criteria, teaching content and tools/materials to be -0.13, 0.37, 0.19 and -0.25 respectively. This result indicates a no significant difference for all the power sub-system contents since these values are less compared to 2.01 critical value at 0.05α (df56). Likewise, since 0.18 calculated t-total is less than 2.01 table value at 0.05α df56, the null hypothesis is therefore upheld. There is therefore no significant difference between the mean responses of electronics teachers and master craftsmen regarding maintenance contents for power sub-system. This is affirmation that both electronics teachers and master craftsmen unanimously agreed that results in Table 4.1 are maintenance contents for training craftsmen for power sub-system in the Radio and DVD player.

5. CONCLUSION

Following the nation's quest to becoming one of the industrialized nations of the world, production of skilled manpower that will take up the technological challenges of the nation becomes necessary. In this regard, there is increase demand on development of skill competency-based training manual, thus the need for the study. Emerging results from the study provides maintenance task, maintenance objective, teaching content and maintenance tools/materials required for training craftsmen in the maintenance of power sub-system of the Radio and DVD player. It is recommended that the National Directorate of Employment and other craftsman training centers to adopt the developed Radio and DVD player manual in training/retraining of craftsmen consequently master craftsmen should encouraged to use the manual in planning their training contents.

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