

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

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***Abstract***

*This study developed a training manual for maintenance of Radio and Digital Versatile Disc (Radio and DVD) Player for electronics craftsmen. Specifically, the study developed appropriate maintenance contents for training craftsmen in the radio 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 adopted the Wheeler's model. The population for the study was 58 respondents which consist 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 has section A and B. Section A solicited information on respondents personal data while section B solicited information on appropriate maintenance contents for training craftsmen in the radio sub-system with 67 structure item that was organised under maintenance objective, task criteria, teaching content and tools and*

materials. Data collected was analyzed using mean for the research question and t-test for hypothesis. After carrying out the analysis, emerging findings revealed appropriate maintenance objective, task criteria, teaching content and tools and materials for training craftsmen in the radio sub-system. Some of the findings on objectives and tasks are; verify DC supply, verify functioning of Audio Frequency (A.F) Amplifiers, test continuity of connector tab pin terminals to radio board, Test surface mounted regulatory transistors terminals. Recommendation made include Radio and DVD player maintenance training module should be included in craftsmen training programme in Nigeria, consequently the developed training manual should be adopted and used for training and retraining of craftsmen in the maintenance of R and DVD player.



## Introduction

One of the electronics equipment that has found application in every home today is the Radio and Digital Versatile Disc (R and DVD) player. This device became the standard equipment for modern Home Theater media given its multi-dimensional function and expansion on the analogue aspect of the Video Home System (VHS) and the non-linear aspect of the Laser Disc by adding improved picture quality, surround sound effect and multiple audio tracks in addition to incorporated radio receiver system. R and DVD 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). The device is a single electronic equipment that consists of the Radio sub-system and DVD system.

The DVD systems is responsible mainly for reproducing the 'video and the audio' information encoded onto the DVD optical disc. It consists of mechanical, power, audio and video sub-systems (Advameg, 2016). The mechanical sub-system consists of a logically assembled plastic and metallic interacting components and associated drivers performing motional function designed to achieve disc intake, ejection and playback function. 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, 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, R 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 505 nanometres or 630

nanometre 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.

On the other hand, 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). The radio sub-system circuit comprises of Radio Frequency Amplifier (R.F), Oscillator and Converter, Intermediate Frequency (I.F) Amplifier, Audio Frequency Amplifier and the loudspeaker (Schweber, 2013). These stages are responsible for radio signal reception, processing and reproduction. Some components that make up the R and DVD player radio sub-system stage are Printed Circuit Board transistors, capacitors, inductors, diodes chip and resistors chip. These components are responsible for the reception, processing and reproduction of radio signals. In the cause of performing these functions the radio sub-system and other sub system components failure is inevitable. As such, in order to keep the R 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 defined as 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 R and DVD player general can be in various forms such as lubricating it moving parts/gears, troubleshooting and replacement of damaged or burnt components, repairing



faults, dusting, using components for the purpose they are designed and following specifications in the operation of the gadget (Ohanu, 2012). The importance of maintenance include; 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 and miniaturised nature of the internal circuitry of R and DVD player require constant maintenance to be conducted on the equipment because components such as Printed Circuit Board bipolar transistors, chip resistor, integrated circuit, rectifier chip are liable to fail or develop fault when in continuous use. The consequences of operational failure of these components may be total system failure, no source voltage, no picture output, no sound, no sound and picture, inability of the laser to pick, poor radio signal reception. Whatever be the nature of fault that the R 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 programme 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 programmes 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 radio, video, audio, power and mechanical sub-systems of R 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 realisation 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 an idea or material (Merriam-Webster, 2017). From the foregoing development in the context of this study refer to the process of building an organised 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 draft manual. This model consists of five stages namely: stating aims and objectives, selection of learning experience, selection of teaching content, organisation and integration of learning experience and teaching content and evaluation. Wheeler's approach involve analysing 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 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 draft manual developed to be used training and retraining of electronics craftsmen.

Despite the importance of training manual to the implementation of the training and retraining programme of craftsmen and women, it is established that there is no such 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 & Ainetor, 2015). Consequently, this has made many electronics craftsmen to be redundant because they lack skills to service modern electronics equipment (R and DVD player inclusive). Since most R 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.

### Research Question

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

### Hypothesis

Ho<sub>1</sub>: There is no significant difference in the mean response between electronics teachers and master craftsmen regarding maintenance contents of radio sub-system.

### Methodology

The study was R&D research and employed the Wheeler's model. The study covers North-Central States of Nigeria. The population for the study was 58 persons which consist of 32 electronics teachers in the 15 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 questionnaire. The specific activity carried out in line with the Wheeler's five steps 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 job objective and specific tasks appropriate to carryout



maintenance on radio sub-system after which analysis of each of the objective for radio 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 analysed to reveal tools and materials and teaching content. These steps led to identification 16 tools and materials and 20 teaching contents for maintenance of radio sub-system. To determine which item is appropriate for inclusion in the training manual the instrument was administered to the respondents and thereafter all items identified for objectives, tasks, teaching content and tools and material that meet the threshold mean were considered appropriate

hence organised to develop the draft Radio sub-system contents after three experts had attest to the appropriateness of the items. A Four Point Rating Scale questionnaire that employed a response options of Highly Appropriate (HA) = 4, Appropriate (A) = 3, Not Appropriate (NA) = 2 and Highly Not Appropriate (HNA) = 1 was the instrument use for data collection. Data collected were analysed using mean and standard deviation for research question and t-test for the hypothesis.

**Results**

The research question and hypothesis were analysed using the data collected.

**Table 1: Mean and Standard Deviation of Respondents on the Appropriate Maintenance Contents for the Radio Sub-system of Radio and DVD Player**

S/N	Contents of Radio Sub-system of Radio and DVD player	$\bar{X}_1$ X	SD <sub>1</sub>	$\bar{X}_2$ X	SD <sub>2</sub>	$\bar{X}_t$	SD <sub>t</sub>	Dec
<b>A</b>	<b>Objectives of Radio Sub-system</b>							
1	Verify DC supply	2.97	0.93	3.37	0.43	3.33	0.84	APP
2	Verify functioning of Radio Frequency (R.F) Amplifier	3.34	0.65	3.08	0.68	3.22	0.67	APP
3	Verify functioning of converter and oscillators and Intermediate Frequency (IF) Amplifiers	2.78	0.90	3.23	0.76	2.98	0.86	APP
4	Verify functioning of detectors	2.97	0.40	3.08	0.56	3.02	0.47	APP
5	Verify functioning of Audio Frequency (A.F) Amplifiers	3.75	0.44	3.42	0.50	3.60	0.49	HAPP
<b>B</b>	<b>Task criteria for Maintenance of Radio Sub-system</b>							
	<b>Verifying DC supply</b>							
6	Test D.C voltage feeder (cable) to radio section continuity	3.31	0.47	3.38	0.57	3.34	0.51	APP
7	Measure the D.C supply voltages to the radio section	3.91	0.29	3.69	0.47	3.81	0.39	HAPP
8	Test connector tab pin terminals to radio board continuity	3.75	0.44	3.23	0.86	3.52	0.70	HAPP
9	Test radio protective devices	3.59	0.49	3.23	0.71	2.88	0.67	APP
10	Test zener diode polarity	2.47	0.50	3.81	0.40	3.07	0.81	APP
11	Test surface mounted regulatory transistors terminals	2.84	0.72	3.23	0.71	3.02	0.73	APP
	<b>Verifying functioning of RF Amp</b>							
12	Gang the tuner circuit	3.84	0.36	3.62	0.49	3.74	0.44	HAPP
13	Identify RF present knob	3.53	0.50	3.15	0.67	3.36	0.61	APP
14	Test RF preset button terminals	2.97	0.82	3.15	0.96	3.05	0.88	APP
15	Preset trimmer capacitor	2.59	0.61	3.31	0.47	2.91	0.65	APP
16	Test capacitance of the trimmer capacitor	3.16	0.51	3.27	0.72	3.21	0.61	APP
17	Test inductors	3.16	0.72	3.08	0.84	3.12	0.77	APP
18	Mount tuner	2.88	0.83	3.50	0.76	3.16	0.85	APP
	<b>Verifying Functioning of Converter, Oscillators And IF Amplifiers</b>							
19	Identify and test terminals of bipolar transistors	3.34	0.70	3.46	0.50	3.40	0.73	APP
20	Identify and test electrolytic capacitors	2.88	0.83	3.35	0.48	3.09	0.62	APP
21	Test ceramics capacitors	3.53	0.76	3.50	0.51	3.52	0.65	HAPP
22	Test resistance of carbon resistors	2.72	0.42	3.50	0.51	3.10	0.68	APP
23	Identify IF coils colours	3.31	0.47	4.00	0.00	3.62	0.58	HAPP
24	Test coils of IF amp	3.38	0.75	3.00	0.56	3.21	0.69	APP
25	Calibrate IF amp	3.28	0.72	3.65	0.48	3.45	0.65	APP
26	Conduct IF IC resistance comparative test	2.78	0.70	3.85	0.36	3.26	0.78	APP
27	Replace IF coil	2.91	0.89	2.85	0.78	2.88	0.83	APP
28	Replace IF IC	3.03	0.59	3.42	0.85	3.21	0.74	APP
	<b>Verifying functioning of detector</b>							
29	Identification of radio detectors	2.88	0.70	3.08	0.74	2.97	0.72	APP
30	Test polarity of detectors	3.13	0.70	3.27	0.72	3.19	0.71	APP



Verifying functioning of Audio Frequency Amplifier								
31	Identify audio IC	3.62	0.49	3.38	0.69	3.52	0.59	HAPP
32	Conduct resistance comparative test on audio IC	3.41	0.49	3.15	0.36	3.29	0.45	APP
33	Test audio transformer coils	3.78	0.60	3.15	0.61	3.50	0.68	HAPP
34	Conduct continuity test on audio jack link to radio board	3.16	0.84	2.96	0.44	3.07	0.69	APP
35	Mount audio IC	3.00	0.98	2.77	0.76	2.90	0.89	APP
36	Mount audio jack link to radio board	2.94	0.87	3.04	0.66	2.98	0.73	APP
<b>C Teaching Content for Radio Sub-system</b>								
<b>DC supply</b>								
37	D.C voltage feeder cable to radio section continuity test	3.09	0.29	3.00	0.74	3.05	0.54	APP
38	Measuring D.C supply voltages to radio section	2.94	0.84	3.31	0.47	3.10	0.71	APP
39	Continuity test for connector tab pin terminals to radio board	3.31	0.69	3.38	0.49	3.34	0.60	APP
40	Radio protective devices continuity test	2.81	0.59	3.04	0.72	2.91	0.65	APP
41	Zener diode polarity test	3.16	0.36	3.12	0.51	3.50	0.43	HAPP
42	Regulatory transistors terminals test	3.56	0.50	3.42	0.50	3.50	0.50	HAPP
<b>RF Amp stage</b>								
43	Identification of gangs	3.13	0.83	3.27	0.45	3.19	0.68	APP
44	Types and calibration of RF preset button	3.66	0.48	3.58	0.50	3.62	0.48	HAPP
45	Trimmer capacitor identification and presetting	3.84	0.36	3.15	0.73	3.53	0.65	HAPP
46	Types of inductors and inductance test	3.25	0.80	3.42	0.64	3.33	0.73	APP
<b>Converter and oscillators and IF Amp stage</b>								
47	Identification of electrolytic capacitor	3.50	0.67	3.00	0.56	3.28	0.67	APP
48	Electrolytic capacitor capacitance test	3.00	0.88	3.62	0.49	3.28	0.79	APP
49	Testing ceramics capacitor	2.66	0.70	3.69	0.47	3.12	0.79	APP
50	Test resistance of carbon resistor	3.13	0.79	3.17	0.70	3.14	0.74	APP
51	IF Amp calibration	3.25	0.71	3.27	0.45	3.26	0.49	APP
52	IF IC resistance comparative test	3.50	0.50	3.35	0.48	3.48	0.60	APP
<b>Detector stage</b>								
53	Testing detectors polarities	2.84	0.57	3.15	0.61	2.93	0.60	APP
<b>Audio Frequency Amplifier stage</b>								
54	Resistance comparative test of audio IC	3.19	0.96	3.54	0.50	3.34	0.80	APP
55	Audio transformer primary/secondary coil test	3.59	0.61	3.65	0.48	3.62	0.55	HAPP
56	Audio jack link to radio board continuity test	3.47	0.62	3.12	0.76	3.31	0.70	APP
<b>D Tools/Materials for Maintenance of Radio Sub-system</b>								
57	Signal generator	3.47	0.50	3.04	0.70	3.25	0.43	APP
58	Frequency counter	2.78	0.70	3.81	0.40	3.24	0.77	APP
59	Frequency generator	3.22	0.90	3.31	0.47	3.26	0.73	APP
60	Cutting knife	2.75	0.84	3.58	0.50	3.12	0.81	APP
61	Variable D.C source	3.44	0.61	3.54	0.50	3.48	0.56	APP
62	Headphone	3.38	0.49	3.31	0.47	3.34	0.47	APP
63	Bench lamp	3.50	0.50	1.92	0.48	2.79	0.93	APP
64	Dummy load	3.31	0.93	3.58	0.50	3.43	0.77	APP
65	Soldering iron	3.16	0.88	3.46	0.64	3.29	0.79	APP
66	Antenna analyser	3.66	0.48	3.15	0.67	3.43	0.62	APP
67	Combination plier	3.53	0.76	3.46	0.50	3.50	0.65	HAPP
68	Long nose plier	3.72	0.68	3.35	0.48	3.55	0.62	HAPP
69	Set of star/flat screw driver	3.44	0.71	3.46	0.50	3.45	0.62	APP
70	Lead sucker	2.84	0.62	3.62	0.49	3.19	0.68	APP
71	Soldering iron	2.81	0.96	3.15	0.78	2.97	0.89	APP
72	Allen keys and asterics	3.56	0.80	3.62	0.49	3.59	0.67	HAPP

**Key:**  $X_1$ =Mean electronics teachers,  $X_2$ =Mean master craftsmen,  $X_3$ =Average mean,  $SD_1$ =Standard Deviation electronics teachers,  $SD_2$ = Standard Deviation master craftsmen, Dec.= Decision, APP=Appropriate and HAPP=Highly appropriate. Contained in Table 1 are the mean scores of the appropriateness of maintenance contents for the radio sub-system of Radio and DVD

player. The average mean result of the items for radio sub-system maintenance objectives, task criteria, teaching content, tools and materials revealed that all the items mean ranges from 2.79 to 3.81. Items number 5, 7, 8, 12, 21, 23, 29, 31, 33, 41, 42, 44, 45, 55, 67, 68, and 72 are rated Highly Appropriate while 54 items are Appropriate. As revealed, all the items mean ratings are above the threshold mean of 2.50 set for data



reporting. This result shows that all the 72 items on maintenance objectives, task criteria, teaching content, tools and materials are appropriate maintenance contents for training craftsmen in the radio sub-system. The standard deviation for these items ranges

from 0.39 to 0.93. 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.

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

S/N	Contents for Training Craftsmen for the Radio Sub-system	Group	N	Mean Difference	t-calc.	df.	t-tab	Decision
1	Maintenance Objectives for Radio Sub-system	Electronics Teachers	32	-1.14	-0.61	56	2.01	Not Sign.
		Master Craftsmen	26	-1.14				
2	Maintenance Task criteria for Radio Sub-system	Electronics Teachers	32	-4.20	-1.07	56	2.01	Not Sign.
		Master Craftsmen	26	-4.20				
3	Teaching content for Radio Sub system	Electronics Teachers	32	-1.27	-0.45	56	2.01	Not Sign.
		Master Craftsmen	26	-1.27				
4	Maintenance Tools/Materials for Radio Sub-system	Electronics Teachers	32	-0.86	-0.33	56	2.01	Not Sign.
		Master Craftsmen	26	-0.86				
<b>t-Total</b>					<b>-2.46</b>	<b>56</b>	<b>2.01</b>	<b>H<sub>0</sub>: Not Sign.</b>

Table 2 is the t-test analysis of the appropriate maintenance contents for training craftsmen in the Radio sub-system of the Radio and DVD player. The table revealed calculated t-test value for radio sub-system in the contents of maintenance objectives, Task criteria, teaching content and tools/materials for radio sub-system to be -0.61, -1.07, -0.45 and -0.33 respectively. This result shows a no significant difference for all maintenance contents for radio sub-system since t-calc. values are less compared to 2.01 critical value at 0.05α df56. Likewise since calculated t-total of -2.46 is less than 2.01 table value at 0.05α (df56), the null hypothesis is hence upheld. There is therefore no significant difference between the mean responses of electronics teachers and master craftsmen regarding maintenance contents for radio sub-system.

**Findings**

1. Radio sub-system maintenance contents for training craftsmen in the Radio and DVD player determined

appropriate in Table 4.5 were 5 maintenance objective, 29 task criteria, 20 teaching components and 16 maintenance tools/materials which consists of the follows items:

- A. Objectives for radio sub-system are; verify DC supply, verify functioning of Radio Frequency (R.F) Amplifier, verifying functioning of converter and oscillators and Intermediate Frequency (IF) Amplifiers, verifying functioning of detectors and verifying functioning of Audio Frequency (A.F) Amplifiers
- B. Task criteria for radio sub-system amongst others include: test D.C voltage feeder (cable) to radio section continuity, measure the D.C supply voltages to the radio section, test connector tab pin terminals to radio board continuity, test radio protective devices, test zener diode polarity, test regulatory transistors terminals, gang the tuner circuit, identify RF present knob, test RF



preset button terminals, preset trimmer capacitor, test capacitance of the trimmer capacitor, test inductors, mount tuner, identify and test terminals of bipolar transistors, identify and test electrolytic capacitors, test ceramics capacitors, test resistance of carbon resistors, identify IF coils colours, identification of radio detectors, calibrate IF amp, test coils of IF amp, conduct IF IC resistance comparative test, test polarity of detectors.

C. Teaching component for radio sub-system are; D.C voltage feeder cable to radio section continuity test, measuring D.C supply voltages to radio section, continuity test for connector tab pin terminals to radio board, identification of gangs, types and calibration of RF preset button, trimmer capacitor identification and presetting, testing ceramics capacitor, IF Amp calibration, IF IC resistance comparative test, resistance comparative test of audio IC, audio transformer primary/secondary coil test, Audio jack link to radio board continuity test amongst others.

D. Tools/materials for radio sub-system are; signal generator, frequency counter, frequency generator, cutting knife, variable D.C source, headphone, bench lamp, dummy load, soldering iron, antenna analyser, combination plier, long nose plier, set of star/flat screw driver, lead sucker, soldering iron and allen keys and asterics.

2. There was no significant difference between the mean responses of electronics teachers and master craftsmen on appropriate maintenance contents for radio sub-system.

### Discussion of Findings

The data presented in Table 1 provided answers to the research question. Revealed in

the Table are appropriate maintenance contents for training craftsmen for radio sub-system in the Radio and DVD player. The identified maintenance contents for training craftsmen for radio sub-system categorized under radio sub-system maintenance objectives, task criteria, teaching content and tools/materials revealed 67 items. Four objectives describe observable unit of activity required to accomplish a job, twenty nine task criteria, 20 teaching content and 16 tools and materials were identified appropriate content for radio sub-system. Finding on maintenance objectives for radio sub-system are craftsmen should possess ability to; verify DC supply, verify functioning of Radio Frequency (R.F) Amplifier, verifying functioning of converter and oscillators and Intermediate Frequency (IF) Amplifiers, verifying functioning of detectors and verifying functioning of Audio Frequency (A.F) Amplifiers. These objectives are in line with (Rudersdorfer, 2013) radio receiver stages. In this light, carrying out maintenance on the radio sub-system therefore translates to the ability of the craftsmen to verifying functions and replacing components that made up the radio receiver stages. Sequence to the identified broad objectives, twenty nine task criteria that stipulate measurable and specific activity a craftsman should do to accomplish the broad objectives were determined. The identified task amongst others include ability to measure the D.C supply voltages to the radio section, test connector tab pin terminals to radio board continuity, test radio protective devices, test zener diode polarity, test regulatory transistors terminals, gang the tuner circuit, identify RF present knob, test RF preset button terminals, preset trimmer capacitor. Finding on task criteria for radio sub-system is in line with the Obianumba (2015) identified task. Obianumba also identified similar maintenance task for radio receiver to include ability to replace power cord, test protective devices, test transistors with multimeter.

Additionally, sequence to Wheeler (1980) advocacy for provision for teaching content



for instruction material, 20 appropriate implementation components was determined for radio sub-system. They include measuring D.C supply voltages to radio section, continuity test for connector tab pin terminals to radio board, identification of gangs, types and calibration of RF preset button, trimmer capacitor identification and presetting, testing ceramics capacitor amongst others. This finding support Okwelle (2013) who enumerated radio teaching content to include presetting tuner, identification of detectors, transistor connection. Tools and materials for radio sub-system include; allen keys and asterics, 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 radio sub-system presented in Table 4.10 revealed 0.33 calculated t-total which is less than 2.01 table value at  $0.05\alpha$  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 4.5 as maintenance contents for training craftsmen in maintenance of radio sub-system.

### **Conclusion**

Following the nation's quest to becoming one of the industrialised 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 objectives, tasks, teaching content and maintenance

tools/materials required for training craftsmen in the maintenance of radio sub-system of the Radio and DVD player.

### **Recommendation**

The following recommendations were made:

1. The National Directorate of Employment and other craftsman training centres should include Radio and DVD player maintenance training module into electronics programme, consequently the developed draft training manual should be adopted and used for training and retraining of craftsmen in the maintenance of R and DVD player.
2. Through public sensitization programmes such as seminars, master craftsmen, technical teachers and craftsmen, technicians should be enlightened and encouraged to use the draft Radio and DVD player training manual as a guide for selection of training tools, training and retraining of craftsmen/artisans or as self-instructional guide for carrying out maintenance on Radio and DVD player.

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