INNOVATIVE STRATEGIES REQUIRED FOR ENHANCING TROUBLE-SHOOTING SKILLS OF MODERN ELECTRONIC DEVICES AMONG CRAFTSMEN FOR SELF-RELIANCE IN PORT HARCOURT METROPOLIS

[1]Tambari Mtormabari DEEBOM (PhD)
Department of Vocational and Technology Education, Faculty of Education, Rivers State University, Port Harcourt,
tambari.deebom@ust.edu.ng
[2]Charity Bubelebara OKARDI
Department of Technical Education, Isaac Jasper Boro College of Education, Sagbama Bayelsa State
[3]Eric Nwabueze OGBUJI
Department of Electrical/Electronics, School of Technical Education, Federal College of Education, Technical (FCET), Omoku, Rivers State University

Abstract
The study examined innovative strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis. Three research questions were answered while corresponding null hypotheses were formulated and tested at 0.05 level of significant. The study employs descriptive research survey design. The population of the study was all the electronic workshops in Port Harcourt metropolis. Purposive random sampling technique was adopted to select 75 registered electronic workshops (Port Harcourt City LGA = 25; Obio/Akpor LGA = 50). The instrument for data collection was a self-structured questionnaire tagged "Innovative Strategies for Trouble-Shooting Skills Questionnaire (ISTSSQ)" designed in a four-point modified rating scale. The instrument was validated and tested for reliability using test-retest method. A reliability coefficient of 0.83 was established for the study using Pearson Product Moment Correlation. Data collected were analyzed using mean with standard for research questions while the null hypotheses were tested with z-test. The study found that swapping, section dividing and trapping signals were innovative strategies required by electronic craftsmen in Port Harcourt metropolis for enhancing trouble-shooting skills of modern electronic devices. Based on the findings of the study, it was recommended among others that craftsmen should be expose to these methods of troubleshooting for effectiveness in trouble-shooting activities for maintenance and repairs of modern electronic devices.

Keywords: Innovative Strategies, Troubleshooting, Modern Electronic Devices, Skills, Self-Reliance

Introduction

Nigeria as a nation is rapidly growing in population which has place an increase in demand for food, shelter, clothing, and health care is seriously on the increase while available white-collar jobs are inadequate to absorb the teeming youths after graduation from school to enable graduates tackle the basic need of life (Deebom, Deebom & Raji, 2022). By implication, unemployment rate has been on the increase. The mass unemployment situation has led to series of odd vices like armed robbery, human trafficking, kidnapping, commercial sex and assassinations all over in Nigeria. These activities can be minimized if the people that execute this heinous act are engage in activities or services that create an empowerment avenue for them for self-reliance. Self-reliance could be attained by unemployed persons if fully equipped with a viable skill capable of economic viability.

Skills are procedural principles for manipulating scientific tools and equipment by craftsmen that could be gained through experience and training on skill acquisition and development. craftsmen could not effectively perform its daily activities of repairs, maintained and services devices without possession of relevant skills needed for that task. Skill according to Deebom and Taylor (2020) is described as the ability of an individual (electronics craftsmen) to be able to carry out a specialized jobs such as troubleshooting of electronics devices expertly for self-reliance. Similarly, Okorie (2010) opine that skills are the work people carry out which can be classified into the following fundamental skills: communication skills, computation skills, manual dexterity or motor skill as well as human relation skills.

In this study, skill is defined as ability of electronic craftsmen to effectively carry out a task in troubleshooting of modern devices for maintenance and repairs by manipulating its psychomotor sense with the use of relevant tools and equipment. To this end, it will not be an over statement to say that acquisition of skill should be tailored and directed towards the electronic youths' craftsmen who are still agile as they

are seen as the frontline for development towards actualizing been self-reliant both in rural communities and urban cities including Port Harcourt metropolis (Deebom & Okwelle, 2015). Self-reliance of an individual are achieved through self-employed or been employed by others. It implies that the employee (self or paid) could achieve it either through paper qualifications (certificate) or through skills. Today, there is high growth in digital technology services and products that have created means of employment. This digital technology includes electronic devices such as computer, hi-tech communication devices, radio, television, smart watch, necklace, and other wearable technologies. These wearables technologies are referred to as modern electronic devices.

Modern electronics device are the recent electronics appliances in the trend like Light Emitting Display (LED), Liquid Crystal Display (LCD) and so on. Kuphaldt (2015) stated that modern electronics device are those electronics that use semiconductors components to perform electron control. Modern electronics utilize inorganic materials, such as Silicon (Si) and non-degradable materials like plastic and metals. Inorganic materials are said to be the basis of modern electronic technology. Okonkwo, Ali and Oluka (2020) aver that in modern electronics, several components can be replaced by a single component and through the use of prefabricated building blocks, the engineer simplifies the design process, reducing the total design cycle time and cost. The authors further stated that besides simplifying the design process, modern electronics should be designed in such a way as to improve the performance of the appliance, decrease device voltage stresses, increase efficiency. These modern electronics appliances are used in varieties such as Light emitting Display (LED) television, Liquid crystal display (LCD) television, Digital Video Disc (DVD), Home theatre sound system, Cameras, Mp3 players, among others which makes better living. Modern electronics appliances usually develop fault because of constant or inconstant usage and thereby demands troubleshooting strategies for restoration of the appliances to its functional order.

Modern electronic appliances that are in use today demands troubleshooting and maintenance by electronics craftsmen. Electronic Craftsmen are graduates of technical college. The technicians help engineers with the testing and research of new products or upgrades to new system. These electronic craftsmen that graduated from technical colleges are trained to design, develop, test, manufacture, install, and maintain electrical and electronic devices and equipment such as communication equipment, medical monitoring devices, navigational equipment, computers among others (Alome, Ogumah & Uduafemhe, 2018). The National Board for Technical Education [NBTE] (2011) stated that electronic students at technical colleges should among others on graduation be able to inspect, identify problems, test, diagnose or troubleshoot, and completely repair any fault on modern electronic devices like television, digital video disk, and even wearables. Effective faults detection are achieved through troubleshooting. This implies that there are electronics craftsmen who troubleshoot modern electronics; test, install, and repair the appliances. Hence, it is imperative that the skills of electronic craftsmen in the society would be improved through troubleshooting strategies of modern electronics appliances for effective repairs and maintenance in Port Harcourt metropolis.

Good troubleshooting skills are vital to the electronics craftsmen. Troubleshooting is a systematic approach to problem-solving that is often used to find and correct issues with complex machines, electronics, computers and software systems. Troubleshooting is carried out through observing and carefully followed a step-by-step procedure in order to avoid damage of device. These steps are ensure that the system is faulty or that there is a problem, confirm the Problem in the circuit, consider or carry out visual inspection first, select troubleshooting tools, power up the circuit, check the power supply block, check the individual components, check the main controller, check the loads by metered power supply. These steps may be done using any of the five types or troubleshooting approaches which include the top-down troubleshooting approach, the bottom-up troubleshooting approach, the divide-and-conquer troubleshooting approach, the follow-the-path troubleshooting approach and the swap-components troubleshooting approach.

Troubleshooting is a form of problem solving. Khandpur (2012) stated that troubleshooting is a logical, systematic search for the source of a problem in order to solve it and make the product or process operational again. Troubleshooting demands critical thinking rather than magical thinking of the modern electronics. Troubleshooting of modern electronics appliances is the process of using the appropriate method to determine and remedy the cause of malfunctioning or non-functioning of the equipment. Michael (2010) stated that troubleshooting of modern

electronic appliances is the use of skills and equipment to trace and correct faults in an electronic system. Faults to be traced and corrected can be, "No display of image", "No sound", "unwanted sound", "one speaker playing not the two", "power failure", and so on. In this study, troubleshooting is a step-by-step approach or procedure used by craftsmen to diagnose, check, trace and to identify a fault in electronic devices for effective repairs and services operation. For the fault to be traced and corrected, it needs strategies like swap of components, section troubleshooting, trapping a signal among others. These strategies could be carried out using any approaches of top-down troubleshooting, bottom-up, the divide-and-conquer, the follow-the-path troubleshooting and the swap-components troubleshooting approach.

Swapping is one of the strategies of troubleshooting where the old component is substitute by the new one with the same features. Swap of components usually takes place in a system with identical or parallel subsystems, Swap components are fixed between those subsystems and the technician would observe whether or not the problem moves with the swapped component. If it did, the faulty components have been swapped, and if it did not, the technician will keep searching. Lewandowski, Dounas-Frazer, Kevin, Van De, and MacKenzie (2017) stated that swap of components is a powerful troubleshooting method/ technique that gives the repairer both a positive and a negative indication of the swapped component's fault. The author further stressed that when the bad part is exchanged between identical systems, the formerly broken subsystem will start working again and the formerly good subsystem will fail. Example is the home theatre system which produces no sound on the left speaker, but the right speaker works just fine. Swap respective components between the two channels and observe if the problem will change sides, from left to right. If it does, the technician has found the defective component. For instance, swap the speakers between channels: if the problem moves to the other side (i.e. the same speaker that was dead before is still dead, now that it is connected to the right channel cable) then the speaker is bad. If the problem stays on the same side (i.e., the speaker formerly silent is now producing sound after having been moved to the other side of the room and connected to the other cable), then the speakers are fine, and the problem must lie somewhere else (perhaps in the cable connecting the silent speaker to the amplifier, or in the amplifier itself).

This technique, however, confirmed the source of the problem with 100% accuracy, using no diagnostic equipment whatsoever. Lewandowski, et al (2017) stated that swap component technique is not perfect to trace faulty appliances author stressed that occasionally the electronics technician may swap a component and find that the problem still exists but has changed in some way. This tells the electronics technician that the components are somehow different (different calibration, different function), and nothing more. However, look for other changes in the system as a whole as a result of the swap, and try to figure out what these changes tell about the source of the problem. Lewandowski, et al (2017) stated that swap component technique has the possibility of causing further damage. Suppose a component has failed because of another, less conspicuous failure in the system. Swapping the failed component with a good component will cause the good component to fail as well. Example, suppose that a circuit develops a short, which "blows" the protective fuse of that circuit. The blown fuse is not evident by inspection, and there is no meter to electrically test the fuse, the technician may decide to swap the suspect fuse with one of the same ratings from a working circuit. As a result of this, the good fuse that was swapped to the shorted circuit may blow as well, thereby having two blown fuses and two non-working circuits. The technician has known for certain that the original fuse blown was because the circuit was moved to stopped working after the swap, but this knowledge was gained after the loss of a good fuse and the additional "down time" of the second circuit. Dahl (2018) stated that the technique of swapping identical components should be used only when there is minimal chance of causing additional damage. The author stressed that swap component technique is an excellent technique for isolating non-destructive problems and the technicians should know when best to apply it, otherwise use the troubleshooting techniques like section divide system.

Section divide system usually takes place in a system with multiple sections or stages. Taylor (2018) stated that section divide system is a troubleshooting technique that carefully measures the variables going in and out of each stage until there is uncommon finding. Okonkwo, Alio and Oluka (2020) stated a typical example that, if a radio is not producing a sound at the speaker, divide the circuitry into stages: tuning stage, mixing stages and amplifier stage all the way

through to the speaker(s). Measure signals at test points between these stages and tell whether or not a stage is working properly. Check the proper operation of components along the way through the divide process. test all resistors in each section before plugging them into place, make sure the power supply is regulating voltage adequately before trying to power anything with it, etc. Dahl (2018) stated that it is in human nature to rush to completion of a project, thinking that such checks are a waste of valuable time. However, more time will be wasted in troubleshooting a malfunctioning circuit than would be spent checking the operation of subsystems.

Note also trap signal technique is a troubleshooting technique/strategy usually takes place in shutdown or trip systems. Trap signal strategy is a troubleshooting strategy that uses instrumentation (such as a data logger, chart recorder, or multimeter set on "record" mode), tape recorder, video recorder to monitor a signal over a period of time. Kuphaldt (2015) stated that trap signal strategy is resourceful when tracking down intermittent problems, which have a way of showing up after good troubleshooting. This may be essential for proving what happens first in a fast-acting system. Many fast systems (especially shutdown "trip" systems) have a "first out" monitoring capability to provide this kind of data. Example An alarm system is falsely triggering, and suspicion was due to a specific wire connection going bad. Unfortunately, the problem never manifests itself while the technician was watching it.

Many modern digital millimeters are equipped with "record" settings, whereby they can monitor a voltage, current, or resistance over time and note whether that measurement deviates substantially from a regular value. This is an invaluable tool for use in "intermittent" electronic system failures and hence required by electronics technicians in the informal sector for effective troubleshooting and repairs of modern electronics appliances. The use of these strategies by craftsmen in troubleshooting modern electronic devices build in them levels of competency and enhances self-reliance.

Self-reliance is synonymous with self-sufficiency and self-independency (Adebisi, 2015). It means doing things for ourselves rather than having things done for us. Self-reliance is the personal initiative in the ability and effort to identify, harness and manage effectively and efficiently the personal and collective resources, human or natural in the immediate surroundings in order to uplift one's or a people's life quality, standard and condition of existence (Olayiwola, 2012). The author further noted that self-reliance cautions against dependency-syndrome on the government as the monopoly of development. Self-Reliance is an ability to rely on one's own efforts and abilities. A self-reliant person is one who possesses great creative ability, one who is functional, one who has acquired some values and skills to improve not just himself, but people around him/her; a resourceful individual. Iwele and Ogoegbunam (2015) observed that self-reliance implies being economically independent and self-satisfying, in other words it means the act of fending for oneself without necessary relying on someone else. From the above, it is clearly established that innovative strategies such as swapping, section divide systems and signal trapping if properly used enhances skills in troubleshooting of modern electronic devices. If these strategies are adequate employed by craftsmen, a realizable self-reliance is actualized. Hence, this study seeks to examine innovative strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis.

Statement of the Problem

Rivers State as an industrial State located in the South-South part of Nigeria. The State is made up of 23 Local Government Areas (LGAs) with its capital city in Port Harcourt. Port Harcourt City and Obio/Akpor Local Government Areas are some of the industrial LGAs amongst the 23 LGAs in the State, which houses one major market and zone (Garrison/Ogbunabali) in the State. Due to the nature of the State been industrialized, this attracts investors and foreigners to come and work, do business in the State especially in Port Harcourt metropolis. One of the common businesses is electronic as the world is electronically driven. The Ogbunabali/Garrison market which is also regarded as computer and electronic zone is populated and characterized with electronics activities such as sales of electronics devices, accessories and repairs. One major feature of this market is hip or piled up of scrap electronic items, parts and other accessories as a result of poor repairs and services. This implies electronic craftsmen that carry out repairs of these equipment and devices lack or possess little requisite skill required for proper troubleshooting and repairs of modern these electronics appliances.

It has been observed by Deebom and Abigo (2022) that most graduate of technical college and who

are trained to be electronic technicians and other craftsmen find it difficult to be employed or self-employed or create jobs for others as a result of poor or little skills acquired in repairs of electronic devices. Interaction between the researchers' and electronic users revealed that some of the electronic devices sent to workshop for repair were return and considered beyond repair and should be discarded or abandoned. Similarly, personal observations and experiences of the researchers show that electronic devices such as smart television, DVD machine, washing machines and mobile phones among others were return from electronic workshops on the ground that the craftsmen have tried but could not be able to fix the faults and hence cannot be repair any more. These could be as a result of the fact that the craftsmen have not deployed appropriate techniques in troubleshooting to enable identifying the defective parts for possible repairs. It is based on this observed scenario that this study seeks to examine innovative strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis.

Purpose of the Study

The purpose of the study is to examine innovative strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis. Specifically, the study sought to determine.

1. Swapping strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.
2. Section dividing systems strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.
3. Trapping signals as a strategy required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

Research Questions

The following research questions were answered to guide the study.

1. What are the swapping strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis?
2. What are the section dividing systems strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis?
3. What are the trapping signals strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study.

1. There is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on swapping strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.
2. There is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on section dividing system strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.
3. There is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on trapping signals strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

Methodology

The study adopted a descriptive survey research design. This is because the study collected and analyzed data from electronics craftsmen in Port Harcourt metropolis. Nwankwo (2013) defined descriptive survey research design as that in which the researcher collects data from a large sample drawn from a given population and describes certain features of the sample as they are at the time of the study, and which are of interest to the researcher without manipulating any independent variables of the study. The study was carried out in Port Harcourt metropolis. The population for the study consisted of all electronic craftsmen operating in the study area while purposive

sampling technique was used to select 75 respondents which include 50 electronics craftsmen from Obio/Akpor Local Government Area and 25 electronics craftsmen from Port Harcourt City Local Government Area respectively.

The instrument fir data collection was a self-structure questionnaire tagged "Innovative Strategies in Troubleshooting Skills of Modern Electronic Devices Craftsmen Questionnaire (ISTSMEDCQ)". The instrument was design on a 4-point rating scale with response categories of Strongly Agree (4), Agree (3), Disagree (2), Strongly Disagree (1). The instrument was validated and tested for reliability through test-retest method and a reliability coefficient of 0.83 was established for the instrument using Pearson Product Moment Correlation (PPMC). A total of 75 copies of the instrument was administered and completely return. This indicates for a 100 percent rate of return (RoR). Data collected were analysed using mean with standard deviation to answer research questions while the null hypotheses were tested with z-test. The decision for research questions was to agree any item with mean score of 2.50 and above as an innovative strategy of troubleshooting while items with mean scores below 2.50 were disagree as strategy not required in troubleshooting. Also, for hypothesis testing, if the calculated value of z (zcal) is equal or less than the critical value of z (zcrit) at a degree of freedom, the null hypothesis was accepted while if the calculated value of z (zcal) is greater than the critical value of z (zcrit), the null hypothesis was rejected.

Results

The result of the study is presented in Table 1 – 6 below.

Research Question 1: What are the swapping strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt Metropolis?

Table 1: Mean Response on Swapping Strategies for Troubleshooting Skills

S/N	Item Statement	PHALGA			OBALGA		
		$\overline{X}$	SD	RMK	$\overline{X}$	SD	RMK
1	Swap of identical integrated circuit	3.04	0.83	Agree	3.41	0.60	Agree
2	Swap of identical resistor of the same value	3.10	0.66	Agree	2.89	0.81	Agree
3	Swap of identical capacitor of the same value	2.98	0.71	Agree	3.05	0.77	Agree
4	Swap of diode of the same value	3.01	0.60	Agree	3.33	1.01	Agree
5	Swap of light emitting diode of the same value	2.71	0.84	Agree	3.40	0.60	Agree
6	Swap of transistor of the same value	2.81	0.57	Agree	3.10	0.59	Agree
7	Swap identical switch	3.04	0.80	Agree	2.67	0.91	Agree
8	Swap of identical fuse	2.66	0.65	Agree	3.05	0.63	Agree
9	Swap identical relay	3.26	1.01	Agree	3.44	1.11	Agree
10	Swap of transformer	3.11	0.74	Agree	3.38	0.74	Agree
	Average Mean/SD	**2.97**		**Agree**	**3.17**		**Agree**

Source: *Extracted from Okonkwo, Alio and Oluka*; *2020*

Results in Table 1 revealed that the respondents (craftsmen) agree that all the 10 items listed are swapping strategies required by craftsmen for troubleshooting of modern electronic devices for self-reliance in Port Harcourt metropolis. This was shown in the mean response of the craftsmen that ranges between 2.66 to 3.26 for PHALGA and between 2.67 to 3.41 for OBALGA which are greater than the cut-off points of 2.50 for decision on a four-point scale. The result also revealed that craftsmen in PHALGA have an average mean of 2.97 while OBALGA had an average mean of 3.17. Standard deviation value less than 1.00 indicate that the respondents (craftsmen) were close (homogenous) in responses while standard deviation

value greater than 1.00 shows that the respondents (craftsmen) were far apart (heterogenous) in responses.

Research Question 2: What are the section dividing systems strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt Metropolis?

Table 2: Mean Response on Section Dividing Strategies for Trouble-Shooting Skills

S/N	Item Statement	PHALGA			OBALGA		
		$\overline{X}$	SD	RMK	$\overline{X}$	SD	RMK
11	Input section that's wire	3.06	0.70	Agree	3.17	0.60	Agree
12	Power section, that's power pack	2.97	0.68	Agree	2.96	0.80	Agree
13	Operation section,	3.11	0.77	Agree	3.04	0.77	Agree
14	Amplification section	3.02	0.84	Agree	3.23	1.01	Agree
15	Output section	3.33	1.01	Agree	3.03	0.56	Agree
16	Mixing section	3.68	0.60	Agree	3.63	0.64	Agree
17	Tuning section	3.41	0.73	Agree	3.50	0.74	Agree
	Average Mean/SD	**3.23**		**Agree**	**3.22**		**Agree**

Source: *Extracted from Okonkwo, Alio and Oluka*; *2020*

Results in Table 2 revealed that the respondents (craftsmen) agree that all the 7 items listed are section dividing systems strategies required by craftsmen for troubleshooting of modern electronic devices for self-reliance in Port Harcourt metropolis. This was shown in the mean response of the craftsmen that ranges between 2.97 to 3.68 for PHALGA and between 2.96 to 3.63 for OBALGA which are greater than the cut-off points of 2.50 for decision on a four-point scale. The result also revealed that craftsmen in PHALGA have an average mean of 3.23 while OBALGA had an average mean of 3.22. Standard deviation value less than 1.00 indicate that the respondents (craftsmen) were close (homogenous) in responses while standard deviation value greater than 1.00 shows that the respondents (craftsmen) were far apart (heterogenous) in responses.

Research Question 3: What are the trapping signals strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt Metropolis?

Table 3: Mean Response on Trapping Signals Strategies for Trouble-Shooting Skills

S/N	Item Statement	PHALGA			OBALGA		
		$\overline{X}$	SD	RMK	$\overline{X}$	SD	RMK
18	Use of tape recorder in monitoring noise signal over a period of time.	3.11	0.84	Agree	3.10	0.68	Agree
19	Use of video recorder in monitoring both visual and noise signal over a period of time.	3.04	1.01	Agree	3.24	0.56	Agree
20	Use of digital milliametre to monitor voltage.	2.96	0.65	Agree	3.04	0.70	Agree
21	Use of digital milliametre to monitor current.	3.07	0.63	Agree	2.90	1.01	Agree
22	Use of digital milliametre to monitor resistance.	3.22	0.70	Agree	3.08	0.63	Agree
23	Use of signal detector to trace audio signals.	3.05	0.67	Agree	3.13	0.81	Agree
24	Use of signal detector to trace electrical signals.	3.55	0.84	Agree	3.41	0.66	Agree
25	Use of digital millimeter to monitor the capacitance.	3.36	1.01	Agree	3.17	0.74	Agree
	Average Mean	**3.17**		**Agree**	**3.13**		**Agree**

Source: *Extracted from Okonkwo, Alio and Oluka*; *2020*

Results in Table 3 revealed that the respondents (craftsmen) agree that all the 8 items listed are trapping strategies required by craftsmen for troubleshooting of modern electronic devices for self-reliance in Port Harcourt metropolis. This was shown in the mean response of the craftsmen that ranges between 2.96 to 3.55 for PHALGA and between 2.90 to 3.41 for OBALGA which are greater than the cut-off points of 2.50 for decision on a four-point scale. The result also revealed that craftsmen in PHALGA have an average mean of 3.17 while OBALGA had an average mean of 3.13. Standard deviation value less than 1.00 indicate that the respondents (craftsmen) were close (homogenous) in responses while standard deviation value greater than 1.00 shows that the respondents (craftsmen) were far apart (heterogenous) in responses.

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study.

1. There is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on swapping strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

Table 4: z-Test Analysis on Swapping Strategies for Enhancing Troubleshooting Skills

Groups	X	SD	N	df	α	Zcal	Zcrit	Decision
PHALGA	2.97	0.74	25					
				73	0.05	-1.03	1.99	Accepted
OBALGA	3.17	0.78	50					

Source: *Researcher's Field Result; 2023* Accept Ho if zcal ≤ zcrit, Otherwise Reject Ho.

Result from Table 4 reveals that the calculated value of z (zcal = -1.03) is less than the critical value of z (zcrit = 1.99) at 0.05 level of significance, hence, the null hypothesis was accepted. This implies that there is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on swapping strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

2. There is no significance difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on section dividing system strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

Table 5: z-Test Analysis on Section Dividing Systems Strategies for Enhancing Troubleshooting Skills

Groups	X	SD	N	df	α	Zcal	Zcrit	Decision
PHALGA	3.23	0.76	25					
				73	0.05	0.05	1.99	Accepted
OBALGA	3.22	0.73	50					

Source: *Researcher's Field Result; 2020* Accept Ho if zcal ≤ zcrit, Otherwise Reject Ho.

Result from Table 5 reveals that the calculated value of z (zcal = 0.05) is less than the critical value of z (zcrit = 1.99) at 0.05 level of significance, hence, the null hypothesis was accepted. This implies that there is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on section dividing systems strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

3. There is no significance difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on trapping signals strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

Table 6: z-Test Analysis on Trapping Signals Strategies for Enhancing Troubleshooting Skills

Groups	$\overline{X}$	SD	N	df	α	Zcal	Zcrit	Decision
PHALGA	3.17	0.79	25	73	0.05	0.21	1.99	Accepted
OBALGA	3.13	0.72	50					

Source: *Researcher's Field Result; 2020* Accept Ho if zcal ≤ zcrit, Otherwise Reject Ho.

Result from Table 6 reveals that the calculated value of z (zcal = 0.21) is less than the critical value of z (zcrit = 1.99) at 0.05 level of significance, hence, the null hypothesis was accepted. This implies that there is no significant difference in the mean response of craftsmen in Port Harcourt City Local Government Area (PHALGA) and Obio/Akpor Local Government Area (OBALGA) on trapping signals strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen in Port Harcourt metropolis.

Discussion of the Findings

Findings in Table 1 shows that swapping is an innovative strategy required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis. These strategies include swap of identical integrated circuit, swap of identical resistor of the same value, swap of identical capacitor of the same value, swap of diode of the same value, swap of light emitting diode of the same value, swap of transistor of the same value, swap identical switch, swap of identical fuse, swap identical relay and swap of transformer. The finding of this study agrees with Lewandowski, et al (2017) as noted that swapping of components is a powerful troubleshooting method that give both a positive and a negative indication of the swapped components fault. The author further stressed that when the bad part is exchanged between identical systems, the formerly broken subsystem will start working again and the former good subsystem will fail. The finding of the study also corroborates with Okonkwo, Alio and Oluka (2020) that swapping is an innovative strategy needed by craftsmen for troubleshooting of electronic devices.

Findings in Table 2 revealed that section dividing strategy required for troubleshooting include dividing of power section that is power pack, dividing of input section, dividing of output section, dividing of amplification section, dividing output section, dividing mixing section, dividing tuning section are systems strategies for improving the skills of craftsmen in the troubleshooting of modern electronics appliances. The finding agrees with the study of Taylor (2018) which stated that section divide system is a troubleshooting technique that carefully measures the variables going in and out of each stage until there is uncommon finding. Also, Taylor as cited in Okonkwo, Alio and Oluka (2020) further gave an example that when a radio is producing no sound at the speaker; divide the circuitry into stages: tuning stage, mixing stages, amplifier stage, all the way through to the speaker(s). Measure signals at test points between these stages and one should be able to know whether or not a stage is working properly.

Findings in Table 3 shows that trapping signals is an innovative strategy required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis. These strategies include use of tape recorder in monitoring noise signal over a period of time, use of video recorder in monitoring both visual and noise signal over a period of time, use of digital milliametre to monitor voltage, use of digital milliametre to monitor current, use of digital milliametre to monitor resistance, use of signal detector to trace audio signals, use of signal detector to trace electrical signals and use of digital millimeter to monitor the capacitance among others. The finding of this study is in agreement with Okonkwo, Alio and Oluka (2020) who opined that trapping of signals is a strategy for troubleshooting which include the use of tape recorder in monitoring noise signal over a period of time, use of video recorder in monitoring both visual and noise signal over a period of time, use of digital millimeter to monitor voltage. The finding of the study is also in corroboration with that of Kuphaldt (2015) who found that trap signal technique is a troubleshooting strategy that uses instrumentation (such as a data logger, chart recorder, or multimeter set on "record" mode), tape recorder, video recorder to monitor a signal over a period of time. Keller further

stated that trap signal strategy is resourceful when tracking down intermittent problems, which have a way of showing up after good troubleshooting method.

Conclusion

The study examines innovative strategies required for enhancing trouble-shooting skills of modern electronic devices among craftsmen for self-reliance in Port Harcourt metropolis. The study found that strategies that enhances troubleshooting skills for self-reliance of craftsmen in Port Harcourt metropolis include swapping strategies which include swap of identical integrated circuit, swap of identical resistor of the same value, swap of identical capacitor of the same value and swap of diode of the same value. Other strategies are section dividing systems and trapping of signals which involve the process of dividing of input section, dividing of output section, dividing of amplification section, dividing output section and use of
3. and signals trapping strategies.

tape recorder in monitoring noise signal over a period of time, use of video recorder in monitoring both visual and noise signal over a period of time.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Dealers or electronic shop owners should be able to train their service craftsmen on these skills that are required in troubleshooting of modern electronic devices. This will help in reducing the quantity of abandoned electronic components and parts and devices in most of the electronic shops in Port Harcourt metropolis.
2. Electronic merchants should organize a workshop training for all craftsmen on how to use modern equipment in troubleshooting using swapping, section dividing

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