MAINTENANCE PRACTICES IN MOBILE PHONES FOR TRAINING PROSPECTIVE ELECTRONIC TECHNOLOGISTS

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Abstract
This study determined the maintenance practices in mobile phones for training electronic technology students and in turn required of electronic technology graduates from technical colleges in Nigeria for self-employment. The study determined the mobile phone faults for diagnosis and the practical skills in the repairs of mobile phones. These formed the two research questions, out of which one hypothesis was formulated and tested. Descriptive survey research designed was employed, using 17 electronic technology teachers and 50 mobile phone technicians in Edo State. Questionnaire validated by experts, with reliability coefficient of 0.905 was the instrument used for data collection. The mean and standard deviation were used to answer the research questions while t-test statistic was used to test the hypothesis. It was found that it is necessary and required to train electronic technology graduates from technical colleges on mobile phone fault diagnosis and practical skills in the repair of faults in mobile phones. It was recommended that the teaching of maintenance practices in mobile phones should be properly integrated into the curriculum of technical colleges and at the same time be effectively implemented through electronic technology teachers' capacity building in maintenance repairs of mobile phone.

Keywords: Mobile phones, maintenance, repairs, electronic technology, technical colleges

Introduction
Electronic technology is one of the lucrative and life-long fields of study that virtually every human endeavor depends on. It is the study of scientific application of the flow of electrons to the functionality and operation of electronics or electronic circuits, devices and appliances. Ogbuanya (2009) stated that electronic is a branch of science which deals with the motion, emission and behaviour of current as free electrons especially in vacuum, gas or photo tubes and special conductors or semiconductors. Electronic technology with its related appliances has been basically grouped into two, namely analogue and digital electronics. In recent times, digital electronics are taking over in terms of use, probably because of their simplicity, portability, durability, low cost and power saving ability.

Digital electronics deal with electronic products or appliances which function on the principle of logic gate and logic decisions with the use of integrated circuits (ICs) as their main component (Theraja & Sedha, 2009). Modern electronic products such as pocket personal computer (PC), personal digital assistant (PDA), MP3 players, digital cameras, digital camcorders, mobile phones, digital dictionaries and digital translators, compact disc (CD) players, digital versatile disc (DVD) players, liquid crystal display (LCD) television, DVD home theatre sound systems, laptop computers and the likes, make use of ICs extensively. Amongst the digital electronic appliances used in Nigeria, mobile phone is apparently the most widely used appliance by Nigerians. This may be likened to its value and necessity, hence the need for training competent maintenance technicians to carry out repairs in mobile phones at their downtime. Interchangeably used, mobile phones or cell phones or cellular phones are low powered transceiver that provide voice telephone service to mobile users, and are of three bands – single, dual and tri bands (Daniel, 2005). Mobile phones are electronic devices with inbuilt software. These devices have lots of electronic parts such as integrated circuits (ICs), resistors, capacitors, coils, relay, diodes and transistors.

The operation and functionality of digital electronic products in general and mobile phones in particular depend on direct current (dc) voltage supply obtained and converted from alternating current (ac) voltage supply. In

addition, mobile phones are made up of mechanical, electrical and electronic devices with expiration capacity; hence they are not expected to last indefinitely when used in various places and conditions. Since these appliances must attain a level of down-time (the period devices, components or appliances are not working because of breakdown of faults), it is therefore necessary to carry out maintenance on mobile phones.

Maintenance is the total attention and care given to an appliance or a system in order to continue functioning well, both at its up-time and down time. It is simply the action taken to restore or keep an item in good functional order. According to Ogbuaya, (2009) it involves all the activities taken in order to prolong the service life of the item. There are basically three types of maintenance usually carried out in any system. These are predictive, preventive and corrective maintenance. The practices engage in identifying faults and remedying the faults in an appliance to prolong the service life of the appliance is contextually termed maintenance practices. One of the important maintenance practices in mobile phone necessary for self-employment is the corrective maintenance, which can also be termed equipment repair maintenance or breakdown maintenance or simply repairs.

Generally, repairs are carried out when there exist faults in an appliance. Mobile phones are prone to developing faults when used like other appliances. Faults in mobile phones are generally grouped into two. According to Gsmindia (2013), Blogger (2011) and Archninja (2010) mobile phone faults are classified into hardware and software faults, but because some of the software faults are common with the phone settings, a third classification of mobile phone faults known as setting fault is considered. The hardware faults are associated to printed circuit board (PCB), batteries and any other electronics or hardware parts. These faults include no signal, battery empty, mic, vibration, keypads and earpiece faults, just to mention but a few. Software faults are associated to faults emanating from the operating system (OS) of the mobile phone. Some of the faults are dead set, auto restart, camera failure and booting problems. Setting faults are faults related to the setting of the mobile phone, and these include call diverts, SIM lock, no network and phone slow. These

categories of faults can definitely be remedied by employing the right repair principles.

Repairs in the document of Bridgestone Michellin Pirelli (2013) are services that are required or necessary when something on a system is not working properly or may have worn to the point where a replacement is required to maintain the performance of the system. According to Australian Taxation Office (2012) repairs mean work to make good or remedy defects in, damage to or deterioration of the property. It involves fixing faults in an appliance or a system. Repairs in the context of this study involves the activities taken for the restoration of a broken, damaged or failed component, device, equipment, part, or appliance to an acceptable operating or stable state. The skills involved in maintenance of digital electronic appliances are commonly acquired in Nigeria through the non-formal and/or the formal educational system. The non-formal education involves the apprenticeship system or practice of learning, which according to Omofonmwan (2011) is a contractual agreement undertaken by a master craftsman and an apprentice whereby the apprentice is trained in a prescribed work process through practical experiences under the supervision of the master-craftsman. Perhaps, the more acceptable and preferable educational system is the formal education approach, which is characterized as a system with fixed curriculum and a cadre of certified teachers with standard pedagogical methods for skill acquisition. One of the levels through which maintenance skills in mobile phone can be acquired is the secondary education, of which technical colleges in Nigeria are grouped under this level.

According to Nwachukwu, Bakare and Jika (2011) technical college provides students through training with the relevant and adequate knowledge, skills and attitude for employment under the guidelines of a teacher in related occupations. In order to achieve these objectives, various trades or occupations are learnt at the technical colleges. Ede, Miller and Bakare (2010) identified that students in technical colleges are trained in auto mechanics, woodwork, plumbing, electrical installation and maintenance work, radio and television (RTV) and electronics, computer craft and mechanical trades. These trades are meant to prepare

graduates in different areas, of which electronic technology graduates are also prepared.

Electronic technology prospective graduates from technical colleges are the required craftsmen and technicians in the field of electronic technology. These set of graduates have been or should have been exposed to the rudiments and practical skills in electronic technology including theoretical knowledge, but with more emphasis on psychomotor skills. Electronic technology graduates are expected to go into the world of work as demand driven semi and middle manpower for employment or become self-employed in electronics works in order to earn a living and contribute significantly to technological advancement.

The technical college curriculum is planned and implemented such that electronics works are taken into consideration. The NABTEB Syllabus (2007) and the document of NBTE (2011) identified two trades where maintenance skills are taught in technical colleges. These are Electronic Works and Appliance Maintenance and Repairs trades. One of the missing appliances in these trades is the mobile phones. It is therefore necessary that this study identify some of the necessities in the maintenance of mobile phones needed to be integrated into the trades in order to produce demand driven technicians for maintenance of mobile phones.

Statement of the problem
In recent times, the use of digital electronic products such as mobile phones has increased, but there seems to be relatively inadequate qualified and competent technicians to repair these products when they are in bad conditions. The relative inadequacy of technicians in maintenance repairs of mobile phones may be traced to inadequate inclusion of such skills in the curriculum of the school system as early as necessary. This may be the reason why majority of the available technicians perform maintenance repair tasks on trial and error basis as they were never or rarely exposed to such skills while in school and hence may not possess the adequate knowledge and skills needed to carry out such repairs.

The foregoing implies that there is need to identify the maintenance skills required by electronics technology students of technical college to carry out basic repairs of mobile

phones in order to enhance their preparation as competent craftsmen, advance craftsmen and technicians who will perform the required repairs, otherwise there will be continuous waste of electronic products when there is breakdown. In addition, the problem of employment has continued to mount. If better skills are acquired by graduates of technical colleges in the repairs of devices such as mobile phones, it will contribute to increasing a shift from youth unemployment to self-reliance.

The common breakdown of these appliances, the relative continual production of incompetent manpower to perform effective maintenance repair tasks in mobile phones and the problem of youth unemployment can raise many questions in mind. One question the researchers ask is: is it not time to introduce practical skills in repairs of mobile phone in the curriculum for teaching and learning in practical classes in technical colleges in Nigeria? The study therefore identified the maintenance practices required of electronic technology graduates from technical colleges which will help them earn a living after graduation.

This study determined the maintenance practices in the repairs of mobile phones required for training electronic technology students (prospective graduates) in technical colleges in Nigeria for self-employment after graduation, with emphasis on common faults for diagnosis and on-the-job practical skills in maintenance of mobile phone. The following research questions were raised and answered in the study.

1. What are the common faults in mobile phones diagnosis necessary for training electronic technology graduates from technical colleges?

2. What are the on-the-job practical skills in the repairs of mobile phones required of electronic technology graduates from technical colleges?

Methodology
The study employed the descriptive survey research design in which the opinions of a representative sample of mobile phone technicians from the world of work and the electronic technology teachers in technical colleges in Edo State are sought in order to make generalization of the findings to other electronic technology graduates from technical colleges in

Nigeria. The population of the study comprised all the mobile phone technicians and the 17 electronic technology teachers in the four functional technical colleges in Edo State. The sample size of the study was 67, which comprised all the 17 electronic technology teachers and 50 mobile phone technicians who were selected using convenience sampling technique.

The instrument for data collection was a five point scaled questionnaire made up of two sections which were in line with the research questions. The first section was scaled as very highly necessary (VHN), highly necessary (HN), averagely necessary (AV), slightly necessary (SN) and not necessary (NN), while the second section was scaled as very highly required (VHR), highly required (HR), moderately required (MR), slightly required (SR) and not required (NR). In both scales, the response categories were assigned numerical values of 5, 4, 3, 2 and 1 respectively. The questionnaire was validated by three experts, and its reliability

coefficient of 0.905 was determined using Cronbach alpha formula.

The data were collected personally by the researchers. The data collected were analyzed using mean and standard deviations to answer the research questions while the t-test statistic was used to test the hypothesis at 0.05 level of significant. The decision rule for the research question was based on real limit of values. Items with mean responses within the range of the real limit of values: 1.00 to 1.49, 1.50 to 2.49, 2.50 to 3.49, 3.50 to 4.49 and 4.50 to 5.00 were remarked as VHN/VHR, HN/HR, AN/MR, SN/SR and NN/NR respectively. The items with probability (p) values less than or equal to 0.05 were remarked significant (S) while items with p-values greater than 0.05 were remarked not significant (NS).

Data presentation and analysis
The data analyses are presented in tables with respect to the research questions and the hypothesis.

Research question 1: What are the common faults in mobile phones diagnosis necessary for training electronic technology graduates from technical colleges?

Table 1: Mean and standard deviations of common faults in mobile phones diagnosis necessary for training electronic technology graduates from technical colleges

S/N	Necessary Diagnosable Faults in Mobile Phones	Mean	SD	Remarks
	Some of the Hardware Faults			
1	Dead set (not powering on)	3.91	.668	HN
2	No charging	4.26	.528	HN
3	Battery empty	4.36	.510	HN
4	Auto charging	4.04	.484	HN
5	No signal/Low signal	4.08	.662	HN
6	Voice problem	4.04	.588	HN
7	Vibration problem	4.23	.541	HN
8	Ringer problem	4.32	.468	HN
9	Backlight problem	4.32	.468	HN
10	No network access	4.22	.559	HN
11	Hanging problem	4.23	.541	HN
12	Insert SIM card	3.86	.585	HN
13	Keypad problem	3.90	.605	HN
14	Display problem	4.30	.545	HN
15	mic fault	3.95	.468	HN
16	Earpiece fault	3.64	.653	HN
17	Keypad fault	4.29	.456	HN
18	Phone off when make calls	3.89	.614	HN
19	Call drop	3.86	.673	HN
20	Auto restart/Auto turn off	3.95	.575	HN
	Some of the Software Faults			
21	No signal/Low signal	4.08	.662	HN
22	Dead set (not powering on)	3.91	.668	HN

23	Booting problem	3.96	.631	HN
24	Contact service	3.82	.897	HN
25	Test mode	4.25	.548	HN
26	Not charging	4.26	.528	HN
27	Switching on and off	3.82	.690	HN
28	Button not responding	4.16	.496	HN
29	Select option on its own	3.91	.514	HN
30	Ring out on its own	3.88	.605	HN
31	Run extremely slow	3.70	.737	HN
32	White screen, solid or flashing on and off	4.16	.654	HN
33	Some applications not working	4.18	.690	HN
34	Camera not working (display fault)	4.12	.605	HN
35	Phone restart when send SMS or MMS	3.93	.628	HN
36	SIM not valid/ insert SIM	3.89	.562	HN
	Some of the Setting Faults			
37	Call divert	3.78	.651	HN
38	SIM lock	4.08	.662	HN
39	Security code	4.18	.481	HN
40	Country lock	3.59	.620	HN
41	Configuration of SMS	4.08	.547	HN
42	Configuration of GPRS	4.05	.724	HN
43	Configuration of call	3.78	.651	HN
44	Unable to send SMS	4.26	.528	HN
45	Phone is slow	3.71	.677	HN
47	Phone restart when make a call	3.90	.557	HN
48	Only incoming call	3.90	.505	HN
49	No network	4.22	.559	HN
50	Stuck your phone	3.74	.746	HN

Source: Fieldwork, 2013.   HN: Highly Necessary

Table 1 shows that the mean values and standard deviations of the responses ranged from 3.59 to 4.36 and .456 to .746 respectively. This means that the mean values for all the 50 fault diagnosis related item in mobile phones are highly necessary for training electronic technology graduates from technical colleges in the maintenance of mobile phones. The values of the standard deviations reveal that the responses of the respondents are relatively in consensus, homogenous and clustered around the mean responses. The table also reveals that a particular fault can be classified under more than a fault, as in the case of dead set, not charging and no network faults.

Research question 2: What are the on-the-job practical skills in the repairs of mobile phones required of electronic technology graduates from technical colleges?

Table 2: Mean and Standard Deviations of the Practical Skills in the Repairs of Mobile Phones Required of Electronic Technology Graduates from Technical Colleges

S/N	Practical Skills in Mobile Phone Repairs	Mean	SD	Decision
1	Identify the tools/equipment to carry out repairs of mobile phone	4.82	.386	VHR
2	Ability to use the tools/equipment to carry out such repairs	4.84	.373	VHR
3	Ability to identify the components/parts of mobile phones	4.69	.467	VHR
4	Disassembling of phones	4.51	.612	VHR
5	Assembling of phones	4.52	.612	VHR
6	Fixing LCD screen viewing related problems	3.99	.564	HR
7	Removal and replacement of keypads	4.31	.556	HR
8	Fixing overheating problems	3.79	.808	HR
9	Flashing/reprogramming of phones	3.93	.841	HR
10	Removal and installation of main board/mother board	4.18	.796	HR

11	Unlocking of phones	3.97	.651	HR
12	Repairing charging ports	4.24	.605	HR
13	Repairing faults in motherboard	3.70	.628	HR
14	Fixing power problems	4.10	.654	HR
15	Fixing charging problems	4.09	.484	HR
16	Repairing logic/R.F. board assembly	3.61	.758	HR
17	Resolving no or poor network issues	3.88	.591	HR
18	Fixing SIM card rejection or non-recognition	3.97	.778	HR
19	Repairs of flip problems	3.84	.687	HR
20	Fixing audio-speaker (ear-piece) problems	4.13	.672	HR
21	Fixing faults in audio-microphone (mouth-piece)	4.21	.565	HR
22	Repairing low or no audio response of headsets	4.24	.464	HR
23	Fixing calls and vibration difficulties	3.91	.712	HR
24	Fixing board non-illumination problems	3.99	.749	HR
25	Repairing USB ports	4.12	.445	HR
26	Fixing constant board illumination	3.91	.733	HR
27	Fixing memory cards problems	4.04	.506	HR
28	Fixing antenna port problems	3.97	.706	HR
29	Fixing hands-free port problems	3.90	.741	HR

Source: Fieldwork, 2013.   VHR: Very Highly Required, HR: Highly Required

The data presented in Table 2 shows that the mean values and standard deviations of the responses ranged from 3.61 to 4.84 and .373 to .841 respectively. The data shows that the mean values ranging from 4.51 to 4.84 for items 1 to 5 corresponds to very highly required (VHR), while the mean values ranging from 3.61 to 4.31 corresponds to highly required (HR) of the practical skills in the repairs of mobile phones. The values of the standard deviations show that the responses of the respondents are relatively in consensus, homogenous and clustered around the mean responses.

Hypothesis: There is no significant difference in the mean responses of electronic technology teachers and mobile phone technicians as regards on-the-job practical skills in the repairs of mobile phones required of electronic technology graduates from technical colleges in Nigeria for self-employment.

Table 3: The t-test comparison of the Mean Response between Electronic Technology Teachers and Mobile Phone Technicians on the Practical Skills in the Repairs of Mobile Phones Required of Electronic Technology Graduates from Technical Colleges

s/n	Practical Skills in Mobile Phone Repairs	Teachers (n=17)		Technicians (n=50)		t-cal	P	Decision
		X_1	SD_1	X_2	SD_2			
1	Identify the tools/equipment to carry out repairs	4.82	.393	4.82	.388	.032	.975	NS
2	Ability to use the tools/equipment to carry out repairs	4.82	.393	4.84	.370	-.156	.877	NS
3	Ability to identify the components/parts of mobile phones	4.65	.493	4.70	.463	-.401	.690	NS
4	Disassembling of phones	4.47	.624	4.52	.614	-.283	.779	NS
5	Assembling of phones	4.53	.624	4.52	.614	.054	.957	NS
6	Fixing LCD screen viewing related problems	3.76	.664	4.06	.512	-1.672	.108	NS
7	Removal and replacement of keypads	4.18	.636	4.36	.525	-1.179	.243	NS
8	Fixing overheating problems	3.71	.772	3.82	.825	.500	.619	NS
9	Flashing/reprogramming of phones	3.53	1.125	4.06	.628	-1.834	.081	NS
10	Removal and installation of main board/mother board	4.24	.664	4.16	.842	.335	.739	NS

11	Unlocking of phones	3.76	.664	4.04	.638	-1.522	.133	NS
12	Repairing charging ports	4.06	.556	4.30	.614	-1.504	.143	NS
13	Repairing faulty motherboard	3.76	.752	3.68	.587	.478	.635	NS
14	Fixing power problems	4.12	.697	4.10	.647	.095	.924	NS
15	Fixing charging problems	4.06	.659	4.10	.416	-.301	.764	NS
16	Repairing logic/R.F. board assembly	3.35	1.115	3.70	.580	-1.228	.234	NS
17	Resolving no or poor network issues	3.82	.529	3.90	.614	-.458	.625	NS
18	Fixing SIM card rejection or non-recognition	3.59	1.125	4.10	.580	-1.802	.088	NS
19	Repairs of flip problems	3.76	.752	3.86	.670	-.491	.625	NS
20	Fixing audio-speaker (ear-piece) problems	4.00	.707	4.18	.661	-.954	.344	NS
21	Fixing faults in audio-microphone (mouth-piece)	4.06	.659	4.26	.527	-1.274	.207	NS
22	Repairing low or no audio response of headsets	4.06	.429	4.30	.463	-1.963	.059	NS
23	Fixing calls and vibration difficulties	3.71	.985	3.98	..589	-1.083	.292	NS
24	Fixing board non-illumination problems	3.59	1.121	4.12	.521	-1.887	.075	NS
25	Repairing USB ports	4.18	.529	4.10	.416	.610	.544	NS
26	Fixing constant board illumination	3.59	1.121	4.02	.515	-1.534	.142	NS
27	Fixing problems associated to memory cards	3.82	.726	4.12	.385	-1.605	.125	NS
28	Fixing antenna port problems	3.88	.806	4.00	.677	-.612	.543	NS
29	Fixing hands-free port problems	3.59	.939	4.00	.639	-1.680	.108	NS

Source: Fieldwork, 2013.   NS – not significant

Data presented in Table 5 reveal that the t-values for all the items ranging from -1.963 to .610 are not significant (NS) at .05 level of significance, with the probability values (p) ranging from .059 to .975 since the p-values are greater than .05. The null hypothesis is therefore upheld for all the items, hence there is no significant difference between the mean responses of electronic technology teachers and the mobile phone technicians as regards the on-the-job practical skills in the repairs of mobile phones required of electronic technology graduates from technical colleges in Nigeria.

Findings
Data analyzed for research question one revealed that the 50 items identified in the study as common faults in diagnosing mobile phones are highly necessary for training electronic technology prospective graduate in technical colleges. The findings of this study are in consensus with that of Ibezim, Ohanu and Shodeide (2013) which found that entrepreneurial empowerment skills are required of mobile phone technicians and engineers in mobile phone audio faults repairs. The findings are also in agreement with the findings of Jackie (2012) which found that the common faults in mobile phone are required of technicians to gain proficiencies in carrying out repair tasks.

The findings of research question two revealed that the 29 on-the-job practical skills identified in this in study are highly required of electronic technology graduates from technical colleges for self-employment. With respect to the corresponding hypothesis, the data presented in Table 3 revealed that electronic technology teachers of technical colleges and mobile phone technicians did not differ in their mean responses on the extent to which the 29 identified practical skills in the repairs of mobile phones are required of the electronic technology graduates from technical colleges for self-employment. The null hypothesis was therefore upheld for all the identified practical skills in the repairs of mobile phones.

Conclusion and recommendations
The prevalence in the use of mobile phones in Nigeria has continued to increase, yet the maintenance practices and skills of the devices at their down-time seems not professionally increasing. It was therefore found in this study that it is highly necessary and required of electronic technology graduates from technical colleges in Nigeria to part-take in the professional technicians in the maintenance of mobile phones. In line with the findings, it is recommended that in-service training should be

organized for the electronic technology teachers of technical colleges in mobile phones maintenance competences for capacity building in order that the trade be integrated into the curriculum, and the same time be effectively implemented.

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