A Survey of the Maintenance Practices Amongst Automobile Mechanics in Nigeria

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Abstract

The study determines the maintenance practices among automobile mechanics technicians in Nigeria. The study was a survey research in which data was collected through a 45 items questionnaire on a population of 200 respondents purposively sampled from Zuba in the Federal Capital Territory, Abuja and Kaduna road junction in Suleja Local Government Area, Niger State. Data collected from the research questions were analyzed using Mean and Standard Deviation on a 5-point Likert scale. While t-test was used to test the null hypotheses at .05 level of probability. Findings of the study revealed among others that the commonly used practices by auto technicians in the maintenance of automobiles falls below the standard practice needed for effective maintenance of modern motor vehicles; as a result auto technicians finds it difficult to efficiently maintain and repair modern motor vehicles. The study recommended among others: that there should be regular review of the curriculum of automobile technology and the curriculum for training of automobile teachers to equip the teachers with the technical and pedagogical skills needed to expose the learners to new skills in the automobile workplace. Similarly, the study suggested among others that organizing retraining and workshops to equip auto technicians with requisite mechanical and mechatronics skills is necessary to enable them cope with the new technological changes in modern vehicles.

Introduction

Automobile maintenance is the act or practice of keeping the motor vehicle or automobile in good working condition to make it road worthy. Automobile maintenance practices encompasses all technical and technological activities geared towards ensuring that the motor vehicle works efficiently under various operating conditions of varying engine load and speed (Khurmi & Gupta, 2007).This has made the automobile to become an indispensable means of transportation in modern societies because of the major role it play in people's lives whether used for daily transportation or for pleasure. Emphasis in the automobile industry has been shifted from pure mechanical system to mechatronics. Automobile mechatronics is a field of mechanical engineering that integrates mechanical, electrical and computer-based technologies in the engineering design, production and maintenance of automobiles (Hillier, Coombes & Rogers, 2006). With the new practice, a little mechanical plus mechatronics skill acquisition can make owning an automobile mechanics workshop an excellent way of earning a living, as it now affords experts the opportunity to examine cars with diagnostics tools through which faults are easily detected and repaired.

In today's automobile workshop, the expected maintenance practices has changed from manual method of diagnosing faults to the use of Diagnostic Scan Tools, equipment and machines to enhance accuracy in fault diagnosis and repairs. The change in the expected maintenance practices is due to the various technological innovations in modern motor vehicles intended to increase fuel economy, safety, low

pollution level and improved comfort to occupants. These technological innovations among others includes: On-Board Diagnostics (OBD), Anti-Lock Braking System (ABS), Automatic Brake Differential (ABD), Electronics Differential Lock (EDL), Integrated Starter Generator (ISG), Malfunction Indicator Lamp (MIL), Mechatronics Transmission Module (MTM), Electronics Control Unit (ECU) or Computer Control Module (CCM), Adaptive Cruise Control (ACC), Electronic Battery Sensor (EBS), Sensor and Actuator Systems (SAS), Safety Airbag Systems (SAB), Electronic Ignition System (EIS), Computer Controlled Ignition System (CCIS), Electronic Fuel Injection System (FIS), and Electronics Engine Management System (EEMS) Other innovations include: three-way Catalytic Converter, Electronic Clutch Management, Variable Valve Timing Intelligence (VVT-I), Super Charging and Emission Control Systems, All Wheel Driving Systems (AWS), Active Suspension, Auto-Active Automatic Transmission, Global Positioning System (GPS), Telemetric Information System (TIS), Electronics Traction Control (ETC) Rear Mounted Sensor Parking Assistance, Speed Limit Alarm, Multiplex Wiring among others (Glo-con, 2004-2007; Odigiri & Ede ,2010; Schwaller, 1993; Hillier & Peter, 2004; Maigida, 2013). Their opinion points to the fact that these electronics and electronics systems (or computer control) have become increasingly necessary in motor vehicle to provide comfort to occupants and convenient to other road users. For instance, without electronics control of vehicle systems, emissions from engines could not have been reduced by so much.

Safety is another area where electronics have enabled improvements. The design of motor vehicle is now dependent on micro computers that can analyze data and then help to incorporate improved safety into the basic vehicle structure Kirpal (2006). Safety system such as the anti lock brakes and the airbag system could not function efficiently or reliably without the use of electronics system. Other important improvement worthy of notes is the consumer demand or expectation. Not quite long ago, only the most expensive vehicles had electronics or computer controlled luxuries. However, it is now expected that cheaper high volume vehicles will also have electronically controlled systems including the ABS and airbag systems. Further instances include: air conditioning with electronic control (climate control), electronics seat adjustment, sophisticated in-car entertainment systems (CD and DVD systems), anti theft security system, as well as driver aids such as satellite navigation. It is worthy to note that it is the electronics and computer controlled systems that drives these innovations and makes them more effective and reliable.

The emergence of these new innovations due to technological dynamism, has however influenced the modern automobile industry particularly in terms of changes in designs and operations of many of the automobile systems and sub-systems. There has been a continual evolution in design intended to achieve faster, more reliable, more streamlined, cleaner and safer vehicles with enhanced comfort, fuel economy and longevity. Harnessing new technologies into the vehicles have made the modern automobiles an assembly of a group of sophisticated technologies (Schwaller, 1993). As a result of the increased comfort and safety provided by these new technologies, the demands for automobiles in Nigeria have continued to increase rapidly. Assorted brands of modern automobiles therefore abound today on the Nigerian roads, used for either public or convenience and luxury of personal transportation.
Most of these automobiles in Nigeria are imported Completely Built-Up (CBU) either as

new vehicles or fairly used ones popularly called 'Tokunbo' (MB-ANAMMCO, 2003). Others were imported as Completely Knocked Down (CKD) parts, which are then assembled in the country with little local input in parts (Nna, 2001). The automobiles therefore come in with a wide range of classical and new technologies which need proper maintenance to make them road worthy. This calls for the availability of highly skilled auto mechanics in the automobile workplace. In Nigerian school system, programmes for the education and training of automobile mechanics maintenance personnel (craftsmen, master craftsmen and technologists among others) are carried out in technical colleges, polytechnics, colleges of technology, colleges of education and the university. The technical colleges according to the National Board for Technical Education (NBTE), (2004) conduct examination leading to the award of the National Technical Certificate (NTC) for craftsmen and Advanced National Technical Certificate (ANTC) for master craftsmen respectively. The polytechnics and colleges of technology awards the National Diploma (ND) and Higher National Diploma (HND). Graduates of these institutions are usually refers to as technicians and technologist respectively. The examinations and training are aimed at producing craftsmen and master craftsmen at professional and sub-professional level for the fast growing automobile workplace. The colleges of education and the universities run Nigeria Certificate of Education (NCE) and Bachelor's degree programmes respectively leading to the production of automobile instructors and engineers. Basically the role or function of the automobile mechanic among others is to identify faults in the motor vehicles and repair or fix the faults.

According to the National Board for Technical Education (NBTE) (2001) graduates of automobile mechanics from technological institutions (technical colleges, colleges of technology and polytechnics) should among others should be able to inspect, identify problems, test, diagnose, service and completely repair any fault on the motor vehicle to the manufacturer's specification. The role of the automobile mechanic today involves the use of diagnostic software and mechanical skills to maintain repair and modify automobiles and their various parts or components. In the context of this study, the automobile instructors/lecturers and automobile engineers at the Bachelor's degree level forms the professionals while the sub- professionals includes the craftsmen and master craftsmen, technicians and technologists at the sub degree level who are saddled with the responsibility of maintenance and repairs of modern automobiles characterized by new electronic systems and sub-systems.

These new innovative automobile system and sub-system components incorporated on modern automobiles have changed their configurations and made their maintenance a more complex task to the auto mechanics professionals and sub professionals who are deficient in the requisite auto mechanics skills needed for the maintenance and repairs of modern vehicles. (Schwaller, 1993; Nice, 2001).This was buttressed by (Elobuike, 1999; Agbata, 2000) who through their studies conducted revealed that the products of these programmes lacked the specialized auto mechatronics skills needed for effective performance in self or paid employment of today's automobile industry. Eric (2008) blamed the curriculum for not being adequate and relevant to offer relevant and enough and adequate skills needed to meet the challenges involved in the maintenance of modern automobiles on the Nigerian roads
The deficiency in the maintenance skills among automobile technicians, craftsmen and

master craftsmen resulting from the inadequacy of the curriculum content in technical and technological institutions has resulted to the production of unskilled auto technicians who are incapable of carrying out the required maintenance in the modern car equipped with high tech facilities. These among others have no doubt created problems in the modern auto car resulting in most cases to complete break down to the car or accident on the high way. The frequent automobile accident on roads due to system or component failures has been attributed to poor maintenance practices resulting from bad repairs of modern vehicles by incompetent roadside mechanics auto technicians who are not conversant with both the electronics and mechanical technologies in modern vehicles (Ogwo, 2004).

As a result, measures to keep education and training in tune with the knowledge and skills needed in the world of work, school courses and curricula must be reviewed, enriched and updated regularly in line with changes that are taking place in the automobile industries (Egbuchulam, 2000). Kirpal (2006) is of the view that unless service auto technicians, craftsmen and master craftsmen periodically undergo training and retraining courses in the handling and repairs of modern automobiles to enhance their performance skills, their practices will grow poorer and will continue to negatively affect and threaten human lives, materials and road transportation. Therefore it is paramount for automobile technicians and craftsmen to have adequate practical and theoretical knowledge of the working principle of modern automobile systems and sub-systems to enable effective handling, maintenance and repairs of modern automobiles. With the increasing number of new electronics systems and sub-systems in modern automobiles, intended to improve vehicle emission rate, safety, economy and comfort amongst others make the modern vehicle become complex to maintain, and hence requires individuals who are skillful. Several research studies conducted revealed that the automobile craftsmen, technicians and professionals produced from Nigerian technical and technological institutions lacked the requisite automobile mechatronics skills needed for effective maintenance of modern automobiles. The curriculum for the education and training of automobile maintenance technicians and professionals in these institutions has been blamed by Odigiri and Ede, (2010) to be rigid for several years and thus deficient in its capability of providing needed skills for the automobile workplace The skill gap created between the curriculum and the new technological innovations have made the needed skills for effective maintenance of these new breed of automobiles to continue to elude the products of Nigerian technical and technological institutions.

More so, apart from the unemployment and underemployment suffered by graduates of these institutions, other consequences are that, the auto mechanic technicians demonstrate poor maintenance practices. Agbata (2000) revealed that most modern automobiles suffer disrepair (poor repair) in the hands of these maintenance personnel. Out of ignorance, minor faults are complicated to cause further damage in the automobile electronic system. These among several other reasons call for survey of the maintenance practices among automobile mechanics technicians in Nigeria.

Purpose of the Study

The purpose of the study was to conduct a survey research on the maintenance practices among automobile mechanics' technicians in Nigeria. Specifically, the study:

1. Identify the commonly used practices among auto technicians in the maintenance of automobile.
2. Identify problems associated with the use of modern tools and equipment in the automobile workplace.
3. Determine techniques needed for improved maintenance of modern automobiles in the work place.

Research Questions

The following research questions were posed to guide the study:

1. What are the commonly used practices among auto technicians in the maintenance of automobile?
2. What are the problems associated with the use of modern tools and equipment in the automobile workplace?
3. What are the techniques needed for effective maintenance of modern tools and equipment automobiles in the work place?

Research Hypotheses

The following null hypotheses were tested at .05 level of probability:

HO_1: There is no significant difference in the mean responses of automobile professionals and sub professionals on the commonly used practices among auto technicians in the maintenance of automobile.

HO_2: There is no significant difference in the mean responses of automobile professionals and sub professionals on the problems associated with the use of modern tools and equipment in the automobile workplace

HO_3: There is no significant difference in the mean responses of automobile professionals and sub professionals on the techniques needed for effective maintenance of modern tools and equipment in the automobile work place

Methodology

The study was a survey research design. The design was used to gather opinion on the maintenance practices among automobile technicians in Nigeria. Olaitan and Nwoke (1999) defined survey research design as one in which a group of people or items is studied by collecting and analyzing data from people or items considered to be representative of the entire group. A purposive sampling technique was used to select the study areas which are: Zuba in the Federal Capital Territory (FCT)-Abuja, Kaduna road in Suleja Local Government Area (LGA) in Niger state. These area were chosen because they have high concentration and cluster of automobile maintenance, service laboratories and workshops in which modern vehicles equipped with high tech facilities are maintained. This might be due to the closeness of these areas the seat of the Nigerian government. The population of the study was 200 respondents comprising of 90 auto professionals and 110 sub professionals spread across Zuba FCT-Abuja and Kaduna road in Niger state.

A 45 items questionnaire structured on a 5-point scale was used to collect data from the respondents. The questionnaire was structured to indicate the degree to which respondents agree to each item as Strongly Agree (SA), Agree (A), Undecided (UD),

Disagree (D,) and Strongly Disagree (SD). The response category was assigned numerical values as 5; 4; 3; 2 &1.The questionnaire was validated by three experts from Peugeot maintenance /dealership outlet and automobile technology atinstructors/lecturers from Government Science and Technical College, Orozo in FCT-Abuja, Kaduna Polytechnic, and the Automotive Council of Nigeria, Corrections and observations made by experts were effected before the administration of the instrument. The weighted Mean (X) and Standard Deviation (SD) were used to answer the research questions. Therefore items with mean score below 3.00 were regarded as disagreed while those with mean score at 3.00 and above were regarded as agreed. The t-test statistics was used to test the hypotheses at .05 level of probability.. The t-critical (t-table) value for accepting or rejecting the null hypothesis was ±1.98.

Results
Research Question 1

What are the commonly used practices among auto technicians in the maintenance of automobiles?

Table 1   Mean and Standard Deviation of respondents on the commonly used practices among auto technicians in the maintenance of automobiles.

S/N	ITEM STATEMENT	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	$\overline{X}_t$	SD_t	REMARK
1	Technicians commonly use trial and error method in fault diagnosis and repair practices.	4.75	0.60	3.86	0.40	4.31	0.50	Agreed
2	Technicians usually neglect standard sequence for examining auto problems.	4.67	0.30	3.05	0.10	3.86	0.20	Agreed
3	Technicians commonly use wrong tools and equipment.	4.70	1.20	3.11	0.30	3.91s	0.75	Agreed
4	Technicians adopt obsolete diagnostic procedures in their practices.	4.69	0.36	3.40	0.70	4.05	0.54	Agreed
5	Use of cheap & obsolete equipment in their job.	4.70	1.21	4.03	0.65	4.37	0.93	Agreed
6	Technicians rely on previous experience rather than new techniques.	4.33	0.83	3.82	1.27	4.08	1.05	Agreed
7	Technicians commonly use manual method in trouble shooting operations.	4.68	0.32	4.05	0.81	4.37	0.56	Agreed
8	Technicians rarely carry out follow up maintenance on newly replace parts.	4.34	1.00	3.47	0.72	3.91	0.86	Agreed
9	They are yet to fully embrace new diagnostic scan tools in their practice.	4.00	1.39	4.06	0.63	4.03	1.01	Agreed
10	Technicians rarely obey safety rules & safety practices in their jobs.	4.01	1.29	4.75	0.74	4.38	1.02	Agreed
11	Technicians rarely refer to vehicle manuals in their practices.	4.10	0.75	3.71	0.11	3.91	0.43	Agreed
12	Auto technicians neglect vehicle identification number (VIN) during component selection & replacement.	4.20	1.30	4.01	0.64	4.11	0.97	Agreed
13	Auto mechanics usually neglect the use of gauges for taking tolerance ranges.	4.71	0.45	4.36	0.81	4.54	0.63	Agreed
14	Technicians sometimes neglect road tests for newly replace components.	4.56	0.56	4.70	0.72	4.32	0.64	Agreed
15	Auto electricians commonly neglect the use of electrical/electronic circuit diagrams.	4.71	0.45	4.45	1.05	4.58	0.75	Agreed

Analysis on Table 1 shows that 15 of the items presented had their weighted mean values ranged from 3.86-4.58.This values are above the cutoff point of 3.00 which implies that the respondents agreed to all the items as the commonly used practices among auto technicians in the maintenance of automobile.

Research Question 2

What are the problems associated with the effective maintenance of modern tools and equipment in the automobile workplace?

Table 2: **Mean and Standard Deviation of respondents on the problems associated with theeffective maintenance of modern tools and equipment in the automobile workplace.**

S/N	ITEM STATEMENT	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_t$	SD_t	REMARK
16	Problem of identification and selection of appropriate work tools for new systems.	4.26	0.81	3.92	0.84	4.09	0.58	Agreed
17	Inadequate technical know-how in the use of diagnostic scan tools & equipment.	3.96	0.13	4.41	0.48	4.19	0.31	Agreed
18	Problem of identification and handling of the different sensors in vehicles.	4.29	0.81	3.98	0.59	4.11	0.70	Agreed
19	Inadequate knowledge in identification and handling of the different actuators in vehicles.	4.37	0.54	4.10	0.58	4.24	0.56	Agreed
20	Inadequate knowledge of correct procedures for servicing and repair of new sub systems.	4.67	0.59	3.67	0.70	4.19	0.65	Agreed
21	Inability to use code readers to trace faults in modern vehicles.	4.24	0.92	3.67	1.01	3.96	0.97	Agreed
22	Inability to interpret diagnostic trouble code (DTC).	4.56	0.88	3.11	0.81	3.84	0.85	Agreed
23	Inadequate knowledge of on-board diagnostic (OBD) working principle.	4.53	1.77	4.81	0.74	4.67	1.26	Agreed
24	Shortage of modern tools and equipment in automobile workplace.	4.46	0.73	4.21	1.07	4.33	0.90	Agreed
25	Problem of location, identification and interpretation of vehicle identification number (VIN) during component replacement.	4.65	0.73	4.43	0.90	4.54	0.82	Agreed
26	Inadequate knowledge of the principle of operation of electronic control unit (ECU) in modern vehicles.	4.41	0.52	3.97	0.75	4.10	0.64	Agreed
27	Replacement of new components with less effective older versions.	3.55	0.28	3.06	0.23	3.31	0.26	Agreed
28	Complication of minor faults during repairs.	3.40	0.44	3.23	0.42	3.32	0.43	Agreed
29	Common reoccurrence of previously fixed faults.	3.51	0.44	3.20	0.35	3.36	0.40	Agreed
30	Common electrical damage of sensitive electronic component during trouble shooting operations.	3.57	0.39	3.03	0.23	3.30	0.31	Agreed

The data analyzed in Table 2 revealed that all the items had their mean values ranged from 3.30-4.67.Since the values are above the cutoff point of 3.00 , it indicates that the respondents agreed to all the items as problems associated with the use of modern tools and equipment in the automobile workplace.

Research Question 3

What are the techniques needed for effective maintenance of automobiles on the work place?

Table 3: Mean and Standard Deviation of respondents on the improvement techniques needed for effective maintenance of automobiles on the work place.

S/N	ITEMS STATEMENT	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	$\overline{X}_t$	SD_t	REMARK
31	Regular review of the automobile technology curriculum to cope with new challenges in automobile maintenance.	4.74	0.68	4.65	0.70	4.69	0.69	Agreed
32	Organizing training & retraining courses to upgrade technician's skills.	4.64	0.48	3.73	0.71	4.21	0.59	Agreed
33	Conducting research study to identify new innovations in automobiles to enhance curriculum review.	4.17	1.10	4.80	1.41	4.49	1.25	Agreed
34	Reviewing technical teacher training curriculum programmes for effective implementation.	4.26	1.15	3.06	0.45	3.66	0.78	Agreed
35	Identifying challenges faced by technicians as a result of new vehicles.	4.34	0.96	4.05	0.41	4.19	0.55	Agreed
36	Establishing a standard code of practice to control auto mechanics practices.	4.09	1.39	3.90	1.07	3.99	1.23	Agreed
37	Establishing strong linkage between auto industry & training institutions	3.77	0.36	3.75	0.69	3.76	0.52	Agreed
38	Emphasizing current innovations in automobiles during instructional process.	4.68	0.42	4.10	0.74	4.39	0.68	Agreed
39	Equipping training institutions and centers with modern diagnostic scan tools, equipment, and other modern training facilities.	3.70	1.12	3.45	1.15	3.57	1.13	Agreed
40	Teaching technicians modern diagnostic and service procedures.	4.04	0.78	4.40	0.67	4.22	0.87	Agreed
41	Providing financial aids to qualify technicians to promote maintenance practice.	4.74	1.01	4.12	0.64	4.43	0.83	Agreed
42	Emphasizing computer applications in troubleshooting & maintenance practices.	4.68	0.45	3.40	0.55	3.94	0.51	Agreed
43	Arousing student interest in auto mechanics by introducing pre-vocational subjects at junior secondary school.	4.11	1.36	3.71	1.15	3.91	1.25	Agreed
44	Training workshops in technical colleges & technological institutions should be updated to reflect the workplaces.	4.35	0.96	3.65	1.14	4.00	1.05	Agreed
45	Re-emphasizing the training in technical colleges to be practical based.	4.34	0.96	4.05	0.41	4.19	0.55	Agreed

Table 3 shows that all the items presented had their weighted mean values ranged from 3.57-4.69.This values are above 3.00 indicating that the respondents agreed to the items as the improvement techniques needed to improve maintenance of automobiles on the work place. Their opinions indicates the items are requirements as techniques needed for improved maintenance in the workplace

Research Hypotheses

HO$_1$: There is no significant difference in the mean responses of automobile professionals and sub professionals on the commonly used practices among auto technicians in the maintenance of automobile.

Table 4: t-test analysis of mean responses of respondents on the commonly used practices among auto technicians in the maintenance of automobiles.

S/N	ITEM STATEMENT	$\overline{X}_1$	SD$_1$	$\overline{X}_2$	SD$_2$	t-cal	t-tab	REMARK
1	Auto technicians commonly use trial and error method in fault diagnosis and repair practices.	4.75	0.60	3.86	0.40	0.34	1.98	NS
2	Technicians usually neglect standard sequence for examining auto problems.	4.67	0.30	3.05	0.10	0.88	1.98	NS
3	Technicians commonly use wrong tools and equipment.	4.70	1.20	3.11	0.30	0.62	1.98	NS
4	Technicians adopt obsolete diagnostic procedures in their practices.	4.69	0.36	3.40	0.70	1.25	1.98	NS
5	Auto technicians use cheap & obsolete equipment in their job.	4.70	1.21	4.03	0.65	1.21	1.98	NS
6	Technicians rely on previous experience rather than new techniques.	4.33	0.83	3.82	1.27	0.60	1.98	NS
7	Technicians commonly use manual method in trouble shooting operations.	4.68	0.32	4.05	0.81	0.50	1.98	NS
8	Technicians rarely carry out follow up maintenance on newly replace parts.	4.34	1.00	3.47	0.72	0.59	1.98	NS
9	They are yet to fully embrace new diagnostic scan tools in their practice.	4.00	1.39	4.06	0.63	0.50	1.98	NS
10	Technicians rarely obey safety rules & safety practices in their jobs.	4.01	1.29	4.75	0.74	0.21	1.98	NS
11	Technicians rarely refer to vehicle manuals in their practices.	4.10	0.75	3.71	0.11	1.08	1.98	NS
12	Auto technicians neglect vehicle identification number (VIN) during component selection & replacement.	4.20	1.30	4.01	0.64	1.12	1.98	NS
13	Auto mechanics usually neglect the use of gauges for taking tolerance ranges.	4.71	0.45	4.36	0.81	0.18	1.98	NS
14	Technicians sometimes neglect road tests for newly replace components.	4.56	0.56	4.70	0.72	0.65	1.98	NS
15	Auto electricians commonly neglect the use of electrical/electronic circuit diagrams.	4.71	0.45	4.45	1.05	1.02	1.98	NS

The t-test analysis from table 4 revealed that all the items had their t-calculated (t-cal) values less than the t-table (t-tab) value of ±1.98.This implies that there was no significant difference in the mean ratings of the responses of the respondents on the commonly used practices among auto technicians in the maintenance of automobiles. The null hypothesis of no significant difference in the mean responses of automobile professionals and sub professionals on the commonly used practices among auto technicians in the maintenance of automobile is accepted in all items

HO₂ : There is no significant difference in the mean responses of automobile professionals and sub professionals on the problems associated with the effective maintenance of modern tools and equipment in the automobile workplace.

Table 5: t-test analysis of mean responses of respondents on the problems associated with the use of modern tools and equipment in the automobile workplace.

S/N	ITEM STATEMENT	$\overline{X}_1$	SD₁	$\overline{X}_2$	SD₂	t-cal	t-tab	REMARK
16	Problem of identification and selection of appropriate work tools for new systems.	4.26	0.81	3.92	0.84	0.46	1.98	NS
17	Inadequate technical know-how in the use of diagnostic scan tools & equipment.	3.96	0.13	4.41	0.48	0.89	1.98	NS
18	Problem of identification and handling of the different sensors in vehicles.	4.29	0.81	3.98	0.59	0.78	1.98	NS
19	Inadequate knowledge in identification and handling of the different actuators in vehicles.	4.37	0.54	4.10	0.58	1.43	1.98	NS
20	Inadequate knowledge of correct procedures for servicing and repair of new sub systems.	4.67	0.59	3.67	0.70	1.23	1.98	NS
21	Inability to use code readers to trace faults in modern vehicles.	4.24	0.92	3.67	1.01	0.64	1.98	NS
22	Inability to interpret diagnostic trouble code (DTC).	4.56	0.88	3.11	0.81	0.56	1.98	NS
23	Inadequate knowledge of on-board diagnostic (OBD) working principle.	4.53	1.77	4.81	0.74	0.55	1.98	NS
24	Shortage of modern tools and equipment in automobile workplace.	4.46	0.73	4.21	1.07	0.54	1.98	NS
25	Problem of location, identification and interpretation of vehicle identification number (VIN) during component replacement.	4.65	0.73	4.43	0.90	0.35	1.98	NS
26	Inadequate knowledge of the principle of operation of electronic control unit (ECU) in modern vehicles.	4.41	0.52	3.97	0.75	1.06	1.98	NS
27	Replacement of new components with less effective older versions.	3.55	0.28	3.06	0.23	1.16	1.98	NS
28	Complication of minor faults during repairs.	3.40	0.44	3.23	0.42	0.32	1.98	NS
29	Common reoccurrence of previously fixed faults.	3.51	0.44	3.20	0.35	0.77	1.98	NS
30	Common electrical damage of sensitive electronic component during trouble shooting operations.	3.57	0.39	3.03	0.23	1.32	1.98	NS

The t-test analysis from table 5 revealed that all the items had their t-calculated (t-cal) values less than the t-table (t-tab) value of ±1.98.This implies that there was no significant difference in the mean ratings of the responses of the respondents on the problems associated with the use of modern tools and equipment in the automobile workplace.. Therefore the null hypothesis of no significant difference in the mean responses of automobile professionals and sub professionals on the problems associated with the use of modern tools and equipment in the automobile workplace is upheld.

HO₃ : There is no significant difference in the mean responses   of   automobile professionals and sub professionals on the improvement techniques needed to improve maintenance of automobiles on the work place.

Table 6:   **t-test analysis of mean responses of respondents on the improvement techniques needed for effective maintenance of automobiles on the work place**

S/N	ITEM STATEMENT	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	t-cal	t-tab	REMARK
31	Regular review of the automobile technology curriculum to cope with new challenges in automobile maintenance.	4.74	0.68	4.65	0.70	0.44	1.98	NS
32	Organizing training & retraining courses to upgrade technician's skills.	4.64	0.48	3.73	0.71	0.83	1.98	NS
33	Conducting research study to identify new innovations in automobiles to enhance curriculum review.	4.17	1.10	4.80	1.41	0.67	1.98	NS
34	Reviewing technical teacher training curriculum programmes for effective implementation.	4.26	1.15	3.06	0.45	1.26	1.98	NS
35	Identifying challenges faced by technicians as a result of new vehicles.	4.34	0.96	4.05	0.41	1.17	1.98	NS
36	Establishing a standard code of practice to control auto mechanics practices.	4.09	1.39	3.90	1.07	0.65	1.98	NS
37	Establishing strong linkage between auto industry & training institutions	3.77	0.36	3.75	0.69	0.53	1.98	NS
38	Emphasizing current innovations in automobiles during instructional process.	4.68	0.42	4.10	0.74	0.56	1.98	NS
39	Equipping training institutions and centers with modern diagnostic scan tools, equipment, and other modern training facilities.	3.70	1.12	3.45	1.15	0.66	1.98	NS
40	Teaching technicians modern diagnostic and service procedures.	4.04	0.78	4.40	0.67	0.23	1.98	NS
41	Providing financial aids to qualify technicians to promote maintenance practice.	4.74	1.01	4.12	0.64	1.19	1.98	NS
42	Emphasizing computer applications in troubleshooting & maintenance practices.	4.68	0.45	3.40	0.55	1.15	1.98	NS
43	Arousing student interest in auto mechanics by introducing pre-vocational subjects at junior secondary school.	4.11	1.36	3.71	1.15	0.27	1.98	NS
44	Training workshops in technical colleges & technological institutions should be updated to reflect the workplaces.	4.35	0.96	3.65	1.14	0.87	1.98	NS
45	Re-emphasizing the training in technical colleges to be practical based.	4.34	0.96	4.05	0.41	1.22	1.98	NS

The t-test analysis from table 6 revealed that all the items had their t-calculated (t-cal) values less than the t-table (t-tab) value of ±1.98.This implies that there was no significant difference in the mean ratings of the responses of the respondents on the improvement techniques needed to improve maintenance of automobiles on the work place. Therefore the null hypothesis of no significant difference between the professional and sub professional automobile technicians on the techniques needed for improved maintenance of automobiles in the workplace was upheld.

Findings of the Study
The following were the major findings of the study
On the commonly used practices among auto technicians in the maintenance of automobiles, findings revealed amongst others that:

1. Technicians neglect standard sequence for examining auto problems and commonly use trial and error method in fault diagnosis and repair practice.
2. Technicians commonly use wrong tools/equipment and manual method in trouble shooting operation.
3. They prefer cheap and obsolete equipment and procedures and are yet to fully embrace new diagnostic scan tools in their practice.
4. Technicians rarely obey safety rule and safety practices in their jobs.
   Regarding the problem associated with the use of modern tools and equipment in the automobile workplace, the study among others exposed the following problems:
5. Problem of identification and selection of appropriate work tools for new system and sub system.
6. Inadequate knowledge of on-board diagnostic (OBD) principle and poor technical know-how in the use of diagnostic scan tools and equipment.
7. Inadequate knowledge of correct procedures for serving and repair of new sub systems.
8. Shortage of modern tools and equipment in automobile workplace.
9. Complication of minor faults during repairs due to efficiency in performing skills.
   On the improvement techniques needed to improve maintenance of automobiles on the work place, the study revealed among others the following:
10. Regular review of the automobile technology/ automobile teacher training curriculum for effective implementation.
11. Conducting research study to identify new innovations in automobiles to enhance curriculum review.
12. Establishing strong linkage between auto industry and training institutions for availability of new information and retraining course to upgrade technician's work skills.
13. Equipping training institutions and centres with modern diagnostic scan tools, equipment and other modern training facilities.
14. Providing financial aids to qualify technicians to promote maintenance practice.
15. All the null hypotheses postulated to guide the study were upheld

Discussion of Findings

Analysis from Table 1 revealed that the respondents agreed with all the 15 items to be among the commonly used practices amongst auto technicians in the maintenance of automobiles. For instance, the respondents agreement with item 1 that: auto technicians commonly use trial and error method in fault diagnosis and repair practice, is in agreement with Odigiri and Ogwo (2013) statement that; when automobiles with technological innovations such as auto-active automatic transmission, electronic fuel injection and variable valve timing intelligence developed faults, they suffer trial and error attempts for faults diagnoses and repairs in the hands of auto technicians and craftsmen who possesses obsolete skills.

The respondents view on item 2 shows that technicians do not follow standard sequence in examining auto problems. Alan (2003) lamented on the adverse effects of this common practice on modern automobiles and identifies solution in defining auto problem as: define the problem; obtain all facts relevant to the problem; examine all facts critically; consider all the likely causes and decide which to follow, act on the decision; and follow up the development. Acceptance of item 4 shows that technicians adopt obsolete diagnostic procedures in their practices. This view agrees with Schwaller (1993) who posited that the automotive service personnel of today must understand not only the components, nomenclature and operations but must also understand the correct diagnosis and service procedures for each system in the vehicles.

The opinions of the respondents on item 10 shows that technicians rarely obey safety practices in the automobile workplace and this has always resulted to automobile accidents on highways and accidents in the workplace. The was supported by Jain (2010) who attributed the high rate of accidents to poor attitude of workers towards safety practices, poor attitudes of employers towards provision of safety awareness training courses and incomplete instructions on safe practices and technical know-how on the operation of tools, equipment and machines.

The acceptance of all the items on Table 2 revealed that all the items are valid as regard to the problems associated with the use of modern tools and equipment in the automobile workplace. Item 16 on the problem of identification and selection of appropriate work tools for new system; is as a result of the desire for automakers to achieve new legal and industry standard; necessitating the incorporation of many new sub-systems and system components into modern automobiles, thereby making modern vehicles more sophisticated and complex to maintain (Nice, 2001; Schwaller, 1993; Hillier & Peter 2004). They added that correct identification and selection of appropriate work tools is an imperative step to effective maintenance of modern automobiles.

The views of the respondents on item 27 and 28 shows that technicians sometimes ignorantly replace new components with less effective or older component, this no doubt complicates minor faults during repairs. This was buttressed by Elobuike (1999) Odigiri and Ogwo (2013) who are of the opinion that the trial and error practice of technicians in most cases result in damages to functional systems and subsystems of the vehicles and even greater damages to faulty systems. They further added that whenever new systems are replaced with less effective or older version performance of the car is usually adversely affected.

The acceptance of the 15 items in Table 3 shows that the set back in automobile maintenance practices can be improved upon when most of the measures outlined in Table 3 are considered. The opinions of the respondents on item 31 and 32 concerning regular review of the automobile technology curriculum and involvement in retraining courses was supported by Okorie (2000) who stated that the new technologies in modern automobiles demand new work skills, and therefore new educational requirements. He added that common reactions to such changes in technology and occupational skills have been the re-training of workers in order to update/upgrade their technical knowledge and vocational skills. This in turn usually require regular review of automobile technology curriculum so that school programs can reflect the automobile work place (UNESCO –Nigeria, (2011).

Also the acceptance of item 34 shows that regular review of the technical teacher training curriculum is necessary for effective implementation. This is true because no educational programme can rise above the quality of its teachers, and no teacher can offer what he or she does not have. The learning contents of the curriculum for training technical teachers on automobile technology should be regularly updated and upgraded to incorporate the new technological innovations in automobiles in order to equip teachers with technical and pedagogical skills they will need to facilitate teaching and learning of the new work skills (Ogwo,2004; Odigiri & Ogwo ,2013: & Maigida,2013).

On the hypotheses, the study found out that there was no significant difference in the mean ratings of the responses of the respondents on: the commonly used practices among auto technicians in the maintenance of automobiles; the problems associated with the use of modern tools and equipment in the automobile workplace, and the improvement techniques needed to improve maintenance of automobiles. Hence the opinions of the respondents did not differ in all the items identified. The implication of the study is that the commonly used practices among auto technicians in the maintenance of automobiles is not satisfactory significant to cope with the new technologies in modern automobiles. As a result the technicians are faced with a lot of problems in the use of modern tools and equipment, which calls for the need to initiate improvement techniques needed to improve maintenance of automobiles in the work place. Therefore the three null hypotheses were upheld for all the items.

Conclusions
Based on the findings of the study, it is obvious that the commonly used practices among auto technicians in the maintenance of automobiles falls below the standard practice needed for effective maintenance of modern automobiles. The problems associated with the use of modern tools and equipment in the automobile workplace is also numerous due to the deficiency in standard performance skills and obsolete skills possess by most auto technicians. Therefore, there is need to equip the auto technicians with the requisite mechanical and mechatronics work skills to enable them cope with the new technological innovations in the modern motor vehicle so as to improve their maintenance and repair practices.

Recommendations
Based on the findings of the study, the following recommendations were made
    1.   The National Board for Technical Education (NBTE) should develop

modalities to monitor and ensure that instructions in the new technological innovations in automobiles are fully and regularly implemented in technical and technological institutions so as to enable students to acquire the new work skills and technical knowledge for effective maintenance of modern motor vehicles.

2. The National Universities Commission (NUC), National Commission for Colleges of Education (NCCE), curriculum planners and developers should regularly update and upgrade the curriculum of automobile technology and the curriculum for training of automobile teachers to incorporate the new technological innovations in automobiles in order to equip the teachers with the technical and pedagogical skills needed to facilitate teaching and learning of new work skills.

3. Periodically retraining courses to update and upgrade the work skills of technicians should be organized.

4. Establishing strong linkage between auto industries and training institutions to enhance availability of new technological information and training.

5. Government at various levels, relevant ministries and industries, wealthy Nigerians and other stakeholders should collaborate to fund and supply adequate automobile training facilities to vocational and technical training institutions and training centers.

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