SKILLS IMPROVEMENT NEEDS OF AUTOMOBILE TECHNICIANS FOR EFFECTIVE MAINTENANCE OF MODERN AUTOMOBILE IN PLATEAU STATE

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(INDUSTRIAL TECHNICAL EDUCATION)
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This Thesis has been approved for the Degree of Masters in Industrial Technical Education (Mechanical Technology) by the Department of Vocational Teacher Education, University of Nigeria, Nsukka

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CERTIFICATION

Machief, Patrick Ezekiel a postgraduate student in the Department of Vocational Teacher Education, with registration number PG/M.ED/08/49570 has satisfactorily completed the requirements for the degree of masters in Industrial Technical Education (Mechanical Technology). The work embodied in this thesis is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

_____	_____
DR. T.C. Ogbuanya	**Machief, Patrick Ezekiel**
Supervisor	***Student***

DEDICATION

This piece of work is dedicated to my wife Mrs. Rhoda P. Machief and our children Fatisen, Saltifat and Fatsaf whose support and encouragement have been a source of motivation in carrying out this study. I also dedicate this work to my loving Mother, Saratu Ulan Ezekiel.

ACKNOWLEDGEMENTS

I express special thanks to my supervisor Dr. T.C. Ogbuanya whose thorough supervision of this study has brought it to a reality. May the good Lord bless you madam.

My thanks to Dr. E. O. Ede and Dr. E. A. C. Etonyeaku, the content and design readers respectively, for guiding me into the right track of doing this work. My gratitude goes to my wife and children whose support made it possible to go through in this tedious but wonderful programme. This intellectual work is a contribution of many minds. Therefore, I remain grateful to all individuals and my lecturers too numerous to mention; who in one way or the other encouraged or assisted me during the course of this study.

I express my deep sense of gratitude to the Lord God Almighty by whose grace and mercy this work was made possible, His name forever be praised.

Machief, Patrick Ezekiel

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ABSTRACT

The study was carried out to investigate the skills improvement needs of automobile technicians for effective maintenance of modern automobile in Plateau State. Survey research design was used for the study. The population for the study was 65 practicing automobile technicians and 14 lecturers/instructors from Federal College of Education (FCE) Pankshin and Plateau State Polytechnic (PSP) Barakin Ladi. A structured questionnaire was used as instrument for data collection. Three research questions and three null hypotheses aided the study. Cronbach alpha method was used to determine the reliability coefficient of the instrument which yielded 0.85. Weighted mean and improvement needed index (INI) was used to analyze the data for answering the research questions while t-test statistic was used to test the hypotheses of no significant difference at 0.05 level of significance. It was found that automobile technicians need improvement in twenty seven skills for servicing modern automobile engine and its support systems, thirteen skills for diagnosing faults in modern automobile engine and its support systems and nine skills for repairing faults on modern automobile engine and its support systems. The study also found that: (i) there was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education and practicing automobile technicians in Plateau State on skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems (ii) there was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education, and practicing automobile technicians in Plateau State on skills improvement needs by the automobile technicians for diagnosing faults in modern automobile engine and its support systems (iii) there was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education, and practicing automobile technicians in Plateau State on skills improvement needs by the automobile technicians for repairing faults on modern automobile engine and its support systems. It was recommended that all the automobile technicians should be retrained on how to service, diagnose faults and repair all kinds of modern automobiles; it was also recommended that government and individuals should donate modern tools and equipment to automobile technicians in the study area.

CHAPTER I

INTRODUCTION

Background of the Study

The responsibilities of the automobile technician in the maintenance sector have evolved from simple mechanical repair work to a high-level technology-related work as a result of the complexities of technological innovation on the modern automobile. Today, integrated electronic devices, systems and complex computers regulate and enhance the operation and control of modern automobile engine and all other systems that make it work (Bellis, 2010).

Automobile comprises wheeled vehicles of diverse shapes and capacity, controlled by a driver, used for the transportation of people and goods from one place to another; they include cars, buses, trucks and all categories of motor vehicles on the public roads in Nigeria and the whole world over. Giri,(2010) defined Automobile (automotive or motor vehicle) as a self-propelled vehicle used for transportation of goods and passengers on land. Odigiri (2010) explained that Automobile is a generic term for a self-propelled, trackless, personal or public carrier that encompasses passenger cars, recreational vehicles, taxis and buses used to transport people in cities, on highways or across country. Erjavec (2004) and Giri (2010) asserted that because of many years of pioneering research and

development, modern automobile has evolved as a complex piece of machinery, which incorporates dependable mechanical, electrical and electronic devices that enable it to perform in a safe, economical and efficient manner. The modern automobile is thus today's motor vehicle with so many computerised complex technological innovations for safe, economical and efficient performance.

The Nigeria automobile industry is made up of few automobile assembly plants like Anambra Motor Company (ANAMMCO) Enugu, Peugeot Assembly Nigeria (PAN) Kaduna, R.T. Brisco Lagos and a few others, and out of these only PAN Kaduna is wobbling on its own feet (Musa, 2010). Other sectors of this industry are automobile merchandise, transportation, spare parts dealership/sales and maintenance. Thus automobile maintenance sector in Nigeria is one of the major automobile industries since most of the modern vehicles are imported into the country and they have to be maintained for satisfactory and optimal utility. Abah (2010) noted that the ability of the Nigerian automobile technician to maintain this modern fleet of imported vehicles will boost the country's conservation of foreign exchange that would have gone into foreign countries for the importation of expatriate skills. Being the lifeline of the automobile maintenance industry in Nigeria, Automobile technicians are expected to have skills and to be knowledgeable in modern automobile

technology and tools in order to be able to effectively carry out maintenance work on all parts, a variety of automobile models or may specialise in specific areas such as repairs of components, systems or body; they can be self-employed or employed by automobile manufacturing industry and auto fleet maintenance sections of ministries, institutions, transport companies and the likes of these. Osuala (2004) refers to a technician as a worker whose job requires knowledge and the use of scientific and mathematical theory. Wyman (2007), describes a technician as somebody who is skilled in industrial techniques or in the practical application of science and technology. Rea (2010) describes a technician as a person trained or skilled in the technical details of a particular art or science, especially one skilled at operating, maintaining, or repairing equipment, in contrast to the theory or informational content of a craft.

In Nigeria the technician is a person who has completed two years training in any branch of science and technology in a Monotechnic, Polytechnic, college of technology or related institution; or an individual who has professional experience recognised as equivalent to the period of training (Federal Government of Nigeria (FGN) 2004). In this context therefore, the automobile technician is a person trained and has the knowledge or professional experience in the skills and techniques related

to automobile technology and maintenance. The auto-technician thus specialises in automobile maintenance, and is expected to even make modifications on automobile components and can work in any branch of the automobile industry.

Maintenance is the specific approved steps and precautions one takes to care for an equipment, machinery or facility which will ensure that such an item attains its optimal functional utility and lifespan (Olaitan, Igbo, Ekong, Nwachukwu & Onyemachi, 1999). Harms, Kroon and Weigel (2002) on the other hand see maintenance as the routine function that is carried out on industrial plants, equipment, and other machines including automobiles, in order to keep them in good operating condition. Abdullahi (2002) defined maintenance as an art of carrying out systematic supporting services on any device equipment or being which may involve the systematic supply of necessary materials for routine servicing (often referred to as routine/preventive maintenance), diagnoses and repairs of faults. Abdullahi further observed that the absence of, or improper maintenance leads to under-utility, failure or total breakdown. In the context of this study therefore, maintenance is all the tasks involved in routine care and all repairs, carried out on a vehicle whether major or minor, to keep it in safe working conditions in order to get the best out of it and prolong its lifespan. Effective maintenance is the modern accepted

standard practice which entails satisfactory servicing, exhaustive diagnoses of faults, satisfactory and complete repairs of any diagnosed faults (Wyman, 2007; Bellis, 2010; Giri, 2010). Maintenance on modern automobile can thus be grouped according to the tasks involved; these are servicing, diagnosing faults and repairing the diagnosed faults (Jain, 2010). Automobile technicians' will thus need skills improvement in order to carry out effective maintenance on the modern automobile engine and its support systems.

Skill is expertness, practical ability, dexterity and tact in performing a task (Okorie, 2000). Skill also means the ability to do something well, usually gained through training and experience (Brickman, 2008). Osinem and Nwoji (2010) explained skill as a manifestation of acquired knowledge i.e. knowledge that is translated into practical activity. The authors further defined skill as the ability to perform an act expertly or that expertness, practiced ability, proficiency that a person displays in the performance of a task or well-established habit of doing something, which involves the acquisition of performance capability through repetitive performance of an operation. Skill is therefore the knowledge, ability, expertness or dexterity that a person acquires and is able to put into practice or to perform satisfactorily an expected task. The technician thus needs skills improvement in line with the modern acceptable standard tasks of

automobile maintenance outlined as servicing, diagnosing, and repairs of the modern automobile.

Servicing the modern automobile engine and its subsystems is a form of routine/preventive maintenance which is carried out periodically. Servicing involves inspection of components and systems, monitoring of performance, changing of some components before failure occurs as a result of poor performance, and lubrication-oil change (Abdullahi 2002). Automobile maintenance technicians carry out servicing in form of routine/preventive maintenance periodically. Erjavec (2004) points out that during this maintenance activity, they inspect systems and components for any wear or malfunction, they also carry out engine tune ups, lubrication service and replace or modify worn out parts before they cause breakdowns which may result to damage of the vehicle and/or create unsafe conditions for the user(s); they accomplish these tasks usually by following a checklist, which comes along with the vehicle. The checklist is technical information which points out essential maintenance activities to be carried out on each component or system to ensure that they examine every critical part, particularly troublesome parts or areas (Ede 2001). Giri (2010) observed that lack of regular servicing on the modern automobile may lead to systems malfunction which could lead to underperformance or

total failure. If such a situation arises there will be need for diagnoses and repairs.

Diagnosing and repairing faults go hand in hand. Faults in the automobile engine and its support systems have to first be diagnosed before they can be effectively repaired. Giri (2010) observed in line with this that a fault or malfunction leads to failure or breakdown of the system; therefore, faults have to be diagnosed and repaired or fixed. The author further defined diagnosis as the process of determining and establishing exactly what the problem is when there is a breakdown, failure or malfunction. Automobile maintenance technicians are expected to carry out these tasks which are indices of corrective maintenance, when it requires that they will need to diagnose i.e. determining the cause of operating errors in a system, localizing the errors and deciding what action to take; this is followed by repairs or fixing of such errors which are referred to as faults or defects; these could be minor or major repairs on a vehicle which is not performing satisfactorily or when it is completely broken down (Erjavec, 2004; Wyman, 2007; and Giri 2010). Repairs in general is a corrective measure which may involve minor or major overhauling of various components of a system when such components or system fail, perform below expectation or show a sign of imminent failure. Writers like Abdullahi (2002), Erjavec (2004) and Giri (2010) refer to

repairs as corrective maintenance. Abdullahi (2002) further asserts that repairs involve mending, rehabilitation and overhaul of the various components/systems. Erjavec (2004) noted that technicians use variety of modern diagnostic tools in their work and other common hand tools, to work on small parts and in hard-to-reach places. Technicians will therefore need skills improvement in order to diagnose faults on the automobile engine and it's supporting systems in order to repair or fix the detected faults or defects.

The ability to improve skill and update technological knowledge is very necessary for the automobile technician to effectively maintain, the modern automobile with its many technological innovations and sophistication; however, these skills improvement needs have to be identified. This will agree with the assertion of Osinem and Nwoji (2010), that there is need for workers to acquire new training in order to acquire or develop skills to meet up with the challenges of the dynamisms of the features of modern technology, which involves development of new ideas, new tools, new equipment, new gadgets and new techniques of operation and production.

Statement of the Problem

The modern automobile maintenance industry is already becoming more than what the roadside mechanic can handle. The industry is daily becoming more technologically oriented with many computerised systems, thus making it more sophisticated. In addition to sophistication is the ceaseless influx of modern cars into the country. Abah (2010) stated that almost on a daily basis quite a number of new and fairly used vehicles (including the modern vehicles) are imported into the country.

The tasks expected of the automobile technician are to satisfactorily service the automobile engine and its support systems, to exhaustively diagnose any faults, and to completely repair or fix any problem on the motor vehicle. The efficiency of the automobile technician will depend on the skills, knowledge, and understanding he possesses of the modern automobile and its technological innovations. Erjavec (2004) and Bellis (2010) have noted that the majority of the roadside mechanics lack the knowledge and are deficient in skills needed to fix anything right on the modern automobile. In fact, the modern automobile use highly computerised technological complex systems, which enhance and monitor the performance of the vehicle; however, the technicians seem to lack the corresponding knowledge and skills to carry out the maintenance tasks required of them.

Due to deficiency of maintenance skills, some technicians have caused more damages to their clients' vehicles than repairs; some clients' vehicles have overstayed at the maintenance shop for several months and in some cases, they are almost abandoned with no solution to the problem. This causes a lot of inconveniences, economic loses and regrets on the side of the clients. Inability of some of these technicians to precisely fix most of these problems, have also caused accidents and vehicle breakdown on the highways leading to injuries which may either result in incapacitation or even fatality. Since Plateau State is an extraction of the society, it is reasonably assumed that the automobile technicians in Plateau state have deficiency in the skills needed for effective maintenance of modern vehicles and thus the need for improvement arises.

Purpose of the Study

The study aimed at investigating the skills improvement needs of automobile technicians for effective maintenance of modern automobile in Plateau State. Specifically, the study seeks to determine the skills improvement needs of automobile technicians for:

1. Servicing modern automobile engine and its support systems
2. Diagnosing faults in modern automobile engine and its support systems

3. Repairing faults on modern automobile engine and its support systems.

Significance of the Study

The findings of this study will be of benefit to the following: National Board for Technical Education (NBTE), National commission for colleges of Education (NCCE), formal and non formal vocational training organs and other skill acquisition and enhancement program sectors like the National Directorate for Employment (NDE), owners of modern automobiles, owners of road transport business including travellers, the practicing automobile technicians and the society at large.

The NBTE and NCCE are the regulatory bodies for Monotechnic, Polytechnics and Colleges of education. They could use the findings from this study, if published, to prepare suitable training packages/modules for modern practices thus enhancing an effective automobile maintenance industry.

The findings of the study would also be of importance to formal and non formal vocational training organs and other skill acquisition and enhancement program sectors like the National Directorate for Employment (NDE). The formal vocational training organs like technical colleges, relevant technology training centres, monotechnics, polytechnics, colleges of education (technical) will benefit if these skills are identified

and included in their training programme or curriculum. The curriculum will be used in the training to equip the student-trainee with adequate skills to handle the maintenance of modern automobile. The non formal vocational education like the apprenticeship system and the NDE could benefit by improving their skills in line with the identified skills with respect to the innovations in the modern automobile.

Owners of modern automobiles and owners of road transport businesses will benefit because their vehicles will be effectively maintained by skilled Nigeria technicians within the country. Many owners of modern vehicle encounter regrets due to poor maintenance, waste of time in repair garages, waste of resource without satisfactory results and in some cases more damages are encountered than maintenance (Bayo 2010). Effective maintenance will thus translate into a boost in the nation's economy, since the vehicles will be put into gainful economic function. Besides, there will be no need to either park the vehicle or sponsor an expert technician from abroad for the repairs. Effective maintenance will prevent road accidents on the high way as a result of vehicle breakdowns due to poor maintenance. Road travellers will therefore travel with more confidence and safety to their destinations.

Finally practicing automobile technicians will benefit from the study, if published, by using it as reference point to improve their skills in line

with innovations in automobile and thus creating a more global standard in the maintenance sector. A skilled automobile technician will effectively maintain modern automobiles; this will improve the entrepreneurial competencies of the auto-maintenance technicians thereby improving the socio-economy of the society. Skilled auto-technicians could confidently expand their services by establishing adequate auto-maintenance workshops at different locations in the country. These could also serve as training ground for prospective technicians at the craftsman/apprenticeship level. An effective and entrepreneurial modern automobile maintenance network can be built on adequately equipped workshops with proper machinery, tools and other facilities, availability of spare parts and skilled technicians with adequate entrepreneurial competencies (KPMG 2008). It is obvious that an auto-maintenance workshop that provides effective maintenance and services will attract and retain more customers than one which renders poor services.

Research Questions

The study provided answer to the following research questions:

1. What are the skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems?

2. What are the skills improvement needs of automobile technicians for diagnosing faults in modern automobile engine and its support systems?
3. What are the skills improvement needs of automobile technicians for repairing faults on modern automobile engine and its support systems?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

HO_1: There will be no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau State on the skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems.

HO_2: There will be no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau State on the skills improvement needs of automobile technicians for diagnosing faults in modern automobile engine and its support systems.

$H0_3$: There will be no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau State on the skills improvement needs of automobile technicians for repairing faults on modern automobile engine and its support systems.

Delimitation of the Study

The study was delimited to skills improvement needs of automobile technicians to perform modern accepted standard practice which entails satisfactory servicing, exhaustive diagnoses of faults, satisfactory and complete repairs of any diagnosed faults on modern automobile engine and its support systems in Plateau State of Nigeria.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of related literature for this study is presented under the following sub-headings:

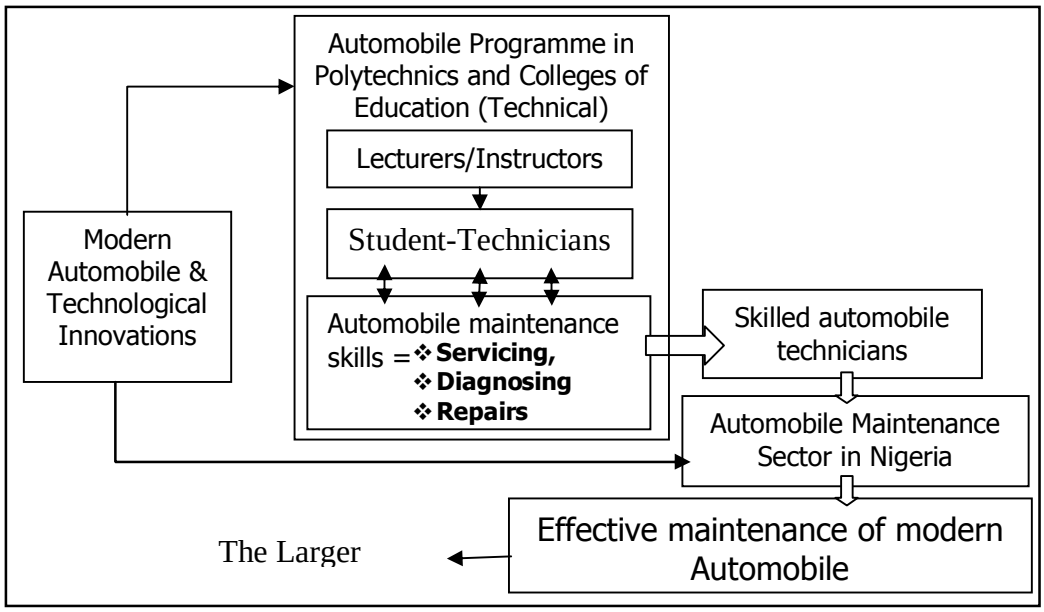
1. Conceptual Framework
    - Modern Automobile and Technological Innovations
    - Automobile Programme in Polytechnics and Colleges of Education (Technical)
    - Automobile Maintenance Skills
    - The Automobile Technician
    - An Overview of The Automobile Maintenance Sector in Nigeria
2. Theoretical Framework
3. Related Empirical Studies
4. Summary of Related Literature Reviewed

CONCEPTUAL FRAMEWORK

A concept is the meaning of a term, phrase or word that a researcher uses or intends to use in his study or investigation. Eboh (2009) defines concept as an idea, thought or devolution of abstract system of thoughts by which science investigates, interprets and understands particular segments of reality or phenomena. The writer further asserts

that a concept is the means through which a researcher manipulates studies, organizes and isolates the properties of objects or phenomena and gives names to such properties. Concepts can be represented on a framework in order to give direction to the study. This representation is often referred to as conceptual framework.

A conceptual framework is the researcher's own position on the problem; it consists of a system of concepts, assumptions, and beliefs that supports and gives direction to the study; it also shows the relationship of the different constructs that he wants to investigate; This can be represented in a visual (schema) or written product to explain the main concepts to be studied, graphically or in narrative form (Robson, 2002). According to Khan (2007), the conceptual framework may represent a model of what the researcher intends to study or be an adaptation of a model used in a previous study, with modifications to suit the inquiry. Eboh (2009) asserts that the conceptual framework gives a schematic description and illustration of the causative mechanisms and relationship deducible from the research problem. The conceptual framework for this study may be represented as shown in the schemer below.



Source: schematic diagram designed by the researcher (2011)

Modern Automobile and Technological Innovations

One of the fascinating technologies today is the automobile also known as motor vehicle, car or automotive (Harms, Kroon & Weigel 2002). By definition, an automobile/car is a wheeled vehicle that carries its own motor and transports passengers (Bellis 2010). Giri (2010) defined automobile as a self-propelled vehicle used for transportation of goods and passengers on land. Odigiri (2010) on the other hand described automobile as a generic term for self-propelled, trackless, personal or public carrier, which encompasses passenger cars, recreational vehicles, taxis and buses used to transport people on highways or cross-country. Automobile is therefore the generic name that covers all sorts of motor vehicles of diverse shapes and capacities that ply cities, highways and rural

areas. Automobiles are traditionally driven on four wheels, but there are variances of two, three or more wheels depending on their purpose.

The automobile is in itself a system made up of other subsystems. A system consists of a collection of interacting parts which are connected together to perform a particular function in unitary or part of a larger system; when it is divided into smaller systems these smaller systems are called subsystems (Giri 2010). Conventionally the automobile system is made up of the following components and sub-systems (Adebayo 2004): the chasses, the body, the engine (the power unit) and its essential systems such as the fuel system, the ignition system, the cooling system, and the lubrication system, the transmission system, the suspension and steering system, the braking system and the electrical system. O*Net (2010) explain that in the modern automobile systems other components and sub-systems are added such as: emission control system (added to the power unit), the computer control system (often referred to as brain box), the airbag, internet access.

The Automobile was conceived from horse-drawn carriages; The horse-drawn carriage was a cart/wagon mounted on two or four wheels and pulled by horse(s) through ropes thus the power to pull the cart was the horse(s) (Fetherston 2007). The writer further observed that the development of a power unit i.e. the engine in the 1760s and early 1800s

replaced the horse(s) and gave birth to what was then called the horseless carriage which has developed into the modern automobile.

Many names are associated with the development of the Automobile. Prominent among these are: Nicholas Cugnot French in 1769, Richard Treveitluck an English in 1802, Oliver Evans an American in 1805, Etienne Linois a French in 1860; Others include Dugald Clark a Scotsman in 1880, Dr. N.A. Otto a German in 1866, Carl Benz a German in 1866, and Henry Ford an American in 1896 (Hillier and Pittuck 1991 and Bellis 2010).

The Automobile has developed into a global modern industry rolling out millions of new cars and trucks in different models, which are all over the world. These different models are made with complex technological innovations that transform them into what is referred to as the modern Automobile. These have created challenges for the Automobile technicians in terms of the skills needed for the maintenance of the modern automobile (Bellis 2010).

Technological innovations are the technological improvements and enhancements made on, products, systems, ways of manufacturing, ways of solving problems, and even ways of usage (Harms, Kroon & Weigel, 2002). Sagar (2006) sees technological innovation as the process through which new (or improved) technologies are developed and brought into widespread usage. Cleveland (2006) on the other hand points out that

technological innovation encompasses improvement in a process as well as developing entirely new process of technology through research, development, demonstration and deployment; these are seen widely spread in areas of energy and transportation. Technological innovations can be seen in the automobile from its emergence as a horse driven cart, to a simple mechanical machine known then as the horseless carriage, and to the modern automobile a complex machine. These according to Giri (2010) culminate years of research and development. Wyman (2007) asserts that technological innovations on the automobile are the technological improvements, which have brought comfort, safety, smoothness of operation, ease of maintenance, strength, durability, cleaner and more economic services, higher output in terms of fuel consumption and power production, and have raised the social standards of owners of automobiles. Wyman (2007) further explains that innovation is also a key to resolving most of the global challenges that the automobile industry faces; without innovations by the auto industry, the entire concept of individual mobility is put at risk, because there will be no new skills for manufacturing and maintenance leading to no growth. Erjavec (2004) explains this further by observing that in the beginning and many years following, the automobile looked like the horse-drawn carriage that it was designed to replace and that by 1919, about 90% of automobiles had

carriage-like open bodies (*see diagram fig.1. below*). Wyman (2007), however, has identified innovations which become potential for commercial blockbusters, such as hybrids, sequential multistage turbochargers, light-emitting diodes, intelligent driver-machine interfaces or electro-mechanic braking technologies. Although Wyman (2007) also points out that electronics remains the biggest enabler of/and driver behind 60 percent of all innovations, the focus is shifting from single to system innovations, i.e. new functions and controls in a car through the networking of existing components and modules. Almost all areas of a car will improve as a result of technological innovations e.g. fuel efficiency, emissions, safety and security, seamless connectivity and infotainment, driving dynamics and performance, comfort, space and flexibility resulting in more value for the cost.

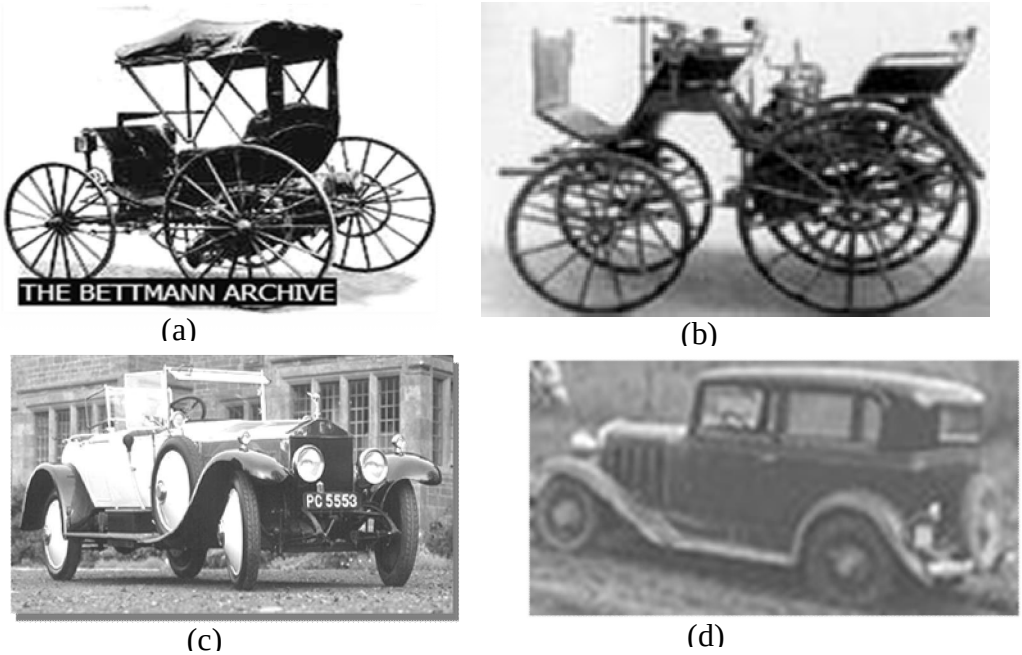


Fig1. Early Automobile: *(**a** and **b**) Horseless Carriage 1893, (**c**) Rolls-Royce Silver Ghost 1909, (**d**) Model A Ford Circa 1930*
(Source: Microsoft Encarta 2008)

Technological innovations on the automobile have continually affected its shape, body style and engine technology e.g. the early vehicles had their engines conventionally mounted at the rear with very tall tyres; with later innovations, most engines are mounted in front with rationally sizable tyres (*see fig.1 above)*. Some of the technological innovations were brought about because of human developments, customer needs and demands, roads terrain, organisation of automobile manufacturing into industries, concern for safety and the environment, and other technological demands and discovery. These made the automobile more practical, more affordable, more comfortable, more durable, more

beautifully shaped, lighter, safer, faster and a contemporary modern vehicle as shown in fig. 2.

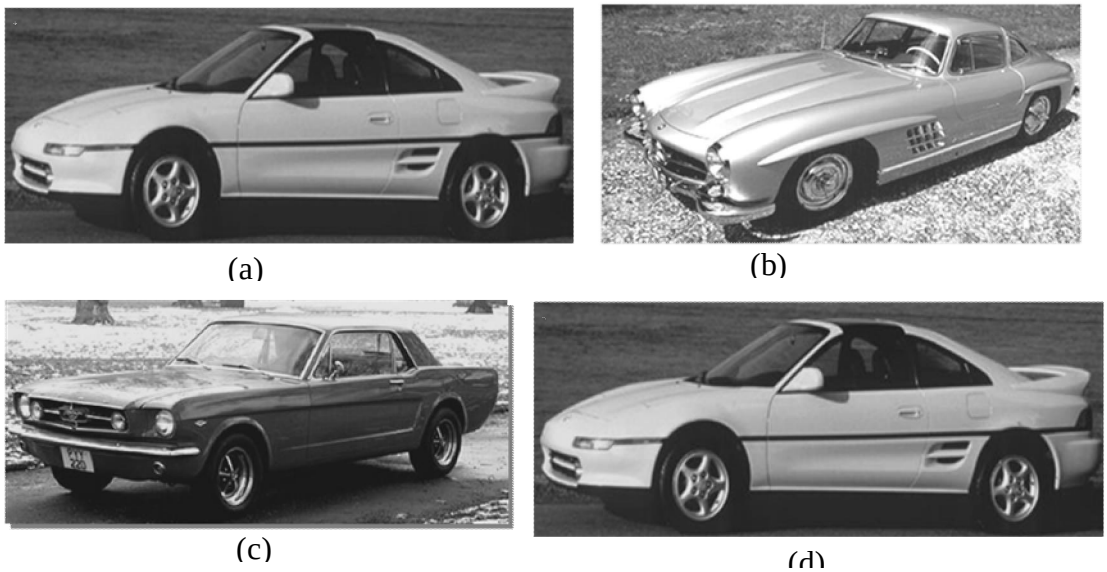


Fig.2. Later Innovations in Automobile: (Contemporary Modern Vehicles)
(a) *Studebaker Champion; two-door sedan 1940. Features included automatic transmission, sealed-beam headlights, and tubeless tires.* ***(b)*** *Gullwing; Mercedes-Benz 300SL 1957; features included compact and stylized bodylines, its doors opened upward into the shape of a gull's wings.*
(c)*Mustang; Ford 1964, features included a small, fast design, excellent handling, a powerful engine, and a distinctive look.* ***(d)*** *MR-2 Turbo T-bar Toyota, 1992. Features included light, aerodynamically shaped, compact, reliable, and inexpensive.* (Source: Microsoft Encarta, 2008).

Wikipedia (2011) describes technological innovations in automobiles to mean all the technologies incorporated into the modern and contemporary automobile, giving rise to higher efficiency and improved fuel consumption, mileage, alternate energy and fuel sources, computer assisted systems and more room for research and development.

The Modern Automobile is thus a highly sophisticated machine incorporating numerous efficient and dependable mechanical, electrical, electronic and computerised components and systems. The modern

automobile carries so many high technological innovations some of which are florescent dash boards, computerised gears, automatic wind screen wipers, with electronic and computer devises used to control the engine and its support system. In the view of Giri (2010), these innovations make the modern automobile to perform better, gives high comfort, run cleaner, faster and more economical than those in the past did.

The following technological innovations are found in the modern automobile: electronic controls used to activate shifting in transmissions, Anti-lock Braking Systems (ABS), steering systems, suspension systems and to provide protection and comfort for the passenger (Dangana 2006). Other new technologies and innovations that come with each model year of the automobile manufacture as observed by Erjavec (2004) is that about 80% of all functions on modern automobiles are controlled by electronics, computer controlled systems, automated steering system, fully active/automated suspension systems, vehicle diagnostic systems (On-Board Diagnostics (OBD II & III)), computerised lighting and other accessories, computer controls on the engine, its support system and functions, global navigation/positioning and satellite tracking systems (GNS/ GPS), emission control systems, fuel economic systems, owner identifier gadgets for security purpose, internet access and other high-tech

features integrated into the functions of the vehicle and even the body materials and shape has been innovated technologically.

The following technological innovations and advancements are made by General Motors (GM), the American prominent modern automobile manufacturing industry, as enumerated by Howell (2008): first crash-test dummies, first electric self-starter, first child-restraint system, first fully automatic transmission, first computerized crash test, collapsible steering column, first integrated chassis control system, catalytic converter and advanced virtual reality technology.

Technological innovations on the automobile will continue to take place so long as research and development in this area is continuous. This will continually make modern vehicles more complex, e.g. computerised systems are taking over the opening and closing of valves by the engine crankshaft, air/fuel ratio and mixture control thus improving the efficiency of the engine and the performance of the car (Goms 2009). The full incorporation of the computer in automobile technology will indeed improve maintenance strategy as well. This thus raises the need for competent technicians to meet the challenges that come along with these innovations in the automobile industry most especially the automobile maintenance sector of the industry. Users of modern automobiles will expect value services for what they own and pay for at the point of

maintenance. This will give them a sense of confidence when there is need to visit the maintenance technician and that any fault in their vehicle will definitely be fixed rightly at the first visit and in good time.

Automobile Programme in Polytechnics and Colleges of Education (Technical)

Polytechnics and colleges of education (technical) are technology education tertiary institutions saddled with the responsibility of producing skilled technicians and teachers of technology (FGN, 2004). The Polytechnics give training to impact the necessary skills for the production of technicians, technologists and other skilled personnel who are expected to feed into the economy of the nation. Colleges of education (technical), vocational/technical education departments of colleges of education and schools of technical education of Polytechnics, are saddled with the responsibility of the production of technical teachers, with the intellectual and professional background adequate for teaching vocational and technical subjects at the Junior secondary schools (NCCE 2008). Besides being trained as technical/technology teachers, these graduands can be self employed since they also acquire the same skills as the technicians and technologists in their core subject areas. The automobile technology programs offered at these institutions equip the graduands with skills to be able to enter into the automobile industry.

Skill is the ability to carry out a task or perform an act expertly with dexterity and it is normally acquired through practice. Okorie (2000) defined skill as expertness, practical ability, dexterity and tact in performing a task. Ogwo and Oranu (2006) viewed skill as a motor habit which depends on the individual's knowledge and understanding of the technical information used on the job or in a particular trade. Osinem and Nwoji (2010) viewed skill as a manifestation of knowledge i.e. knowledge that is translated into practical activity. In other words it is knowledge put into practical use. The authors agree with Osinem (2008) when he explained that skill composes two components i.e. knowledge and activity. The knowledge component has to do with theories and technical information of a system, trade or occupation while the activity component has to do with motor and perceptual skill.

Learning of vocational skill in this contemporary technological era where technology seems to rapidly control the individual and society embraces the cognitive, affective and psychomotor realms of learning (Chapman, 2009). This is in line with Blooms taxonomy model of learning i.e.

1. Cognitive domain (development of the intellect i.e. knowledge or the thinking faculty)

2. Affective domain (feelings, emotions and behaviour i.e. attitude or feel)
3. Psychomotor domain (manual and physical application i.e. doing or activity)

These vocational and technical institutions must ensure the development of these faculties in their curriculum of training in order to produce skilled automobile technicians with ample opportunity to specialise as technicians who can fit into:

- ❖ Automobile maintenance
- ❖ Automobile merchandise
- ❖ Automobile body work
- ❖ Fuel service station
- ❖ Spare parts dealership

This implies that the automobile maintenance technician who desires to relevantly work successfully on the modern automobile must develop his skills all round. Osinem (2008) asserts that cognitive skills will assist in the process of acquiring the technical knowledge required in the trade or occupation in order to apply to real and observable situation. Ogwu and Oranu (2006) explained that the affective skills relate to the ways of feeling and general behaviour that reflect on an individual's values, emotions, motives and interests. The authors further observed that the

implication here is that the prospects of a person's occupational success is determined by his affects i.e. his will to learn, aspire for high quality work and to execute tasks to logical conclusions. This also helps the technician to be able to hold up to occupational ethics and how he relates to others or how he reacts to challenges of a trade or occupation. Psychomotor or manipulative skills are those things that the technician is expected to do or perform tasks expertly and effectively; they involve the movement of the parts of the body such as fingers, hands/arms, legs, body, and head with good coordination (Osinem, 2008). These are very necessary for the automobile technician.

Skills are not always general structures but are tied to specific tasks and concepts (Osinem 2008). The automobile technician must thus be skilled in tasks related to automobile trades or industry. The maintenance technician who passes through any of these technical institutions acquires skills to enable him to perform the tasks involved in automobile maintenance. However, with the sophistication of the modern automobile as a result of technological innovations, graduates of these institutions will need skills improvement to satisfactorily service, to exhaustively diagnose faults, and completely carry out repairs of any diagnosed faults on modern automobile engine and its support systems.

Automobile Maintenance Skills

Maintenance is the specific approved steps and precautions one takes to care for an equipment, machinery or facility which will ensure that such an item attains its optimal functional utility and lifespan (Olaitan, Igbo, Ekong, Nwachukwu & Onyemachi, 1999). Harm, et al (2002) on the other hand see maintenance as the regular servicing, care and repairs of tools and machines used in a workshop, factory/industrial plants and equipment, including automobiles, structures and property in order to keep them in good operating/working condition. Word net web (2010) defined maintenance as the caring activity involved in keeping something in good working order. In the context of this study therefore, maintenance is all the tasks involved in routine care and all repairs, carried out on a vehicle whether major or minor, to keep it in safe working conditions in order to get the best out of it and prolong its lifespan. Writers like Erjavec, (2004), Wyman, (2007) and Giri, (2010) point out that modern automobile maintenance activities are made up of regular servicing of the engine and its subsystems, diagnosis of faulty systems/components and corrective measures taken to make the system/component work normally again or repairs of the faults.

Automobile maintenance can be preventive, corrective or scheduled. Preventive maintenance is the regular services carried on tools, machines, industrial plants, equipment, structures or even office equipment to keep

them in good working condition and prevent them from major breakdowns and expensive repairs (Jain, 2010). The author further defined preventive maintenance as a planned process, normally done on a periodic basis with a line up of activities, which are expected to be carried out. The aim of which is to reduce wear and tear by taking timely action before failure of the objects occur and thus optimising their utility and prolonging their lifespan. According to Brain (2000) and Olson (2008), doing regular engine service can help to avoid future repairs; this kind of maintenance is preventive in nature. Jain (2010) further explain corrective maintenance to mean the services carried out when there is a breakdown or a fault (whether minor or major) in the tools, machines, industrial plants, equipment, structures or office equipment to bring it back to life or good working condition. Corrective maintenance may involve replacement of worn out parts or faulty components in a system; this normally involves diagnostic measures taken in order to detect and isolate the faulty system or component for the repairs (Abdullahi, 2002). Scheduled maintenance on the other hand according to Jain (2010) is the services carried out in form of general maintenance during shutdown periods for the purpose of repairs and major services in order to increase optimisation of the machinery, equipment, plant, structure or a particular system; this is done

periodically, particularly, on machinery and other equipment in an industry, firm or factory.

General maintenance involves tasks, and support resources. (Stasz 2001 and Jain 2010) identified three elementary maintenance tasks and four support resources as follows:

1. *Elementary maintenance tasks* - made up of diagnosis phase, restoration phase, and check-out phase

- The diagnosis phase – this has to do with the dictation, confirmation and localisation of failure in a system due to faulty or worn out parts or components. This will require diagnostic skills by the maintenance technician
- The restoration phase – this stage is also referred to as repairs. It has to do with isolation of the faulty system, part or components for disassembly, repairs or replacement and reassembly of the system or parts concerned. This will require mechanical skills by the maintenance technician
- The check-out phase – this has to do with testing of the tool, machine or equipment concern to ensure satisfactory performance as a result of phases i and ii.

2. Maintenance support resources – made up of personnel and training, technical manuals, diagnostic equipment and other tools and provision of spare parts.

- Personnel and training – this is made up of properly and adequately trained technicians and other personnel who are required to be versed with maintenance requirements of equipment, their design and technology. Provision is also to be made for further training in order to keep abreast with technological innovations and advancements.
- Technical manuals – these are made up of checklists for maintenance and other information on operation. Technical manuals must thus contain information such as: description of the machine, tool or equipment, working principle and theory, procedure of operation, testing, fault diagnostics, repairs and preventive maintenance schedules; Others are reference data, which should cover checklists for preventive maintenance, difficult tasks, frequent and expected areas to watch out for likely faults and all that is needed for effective maintenance.
- Diagnostic equipment and other tools – Stasz, (2001) further explain that this is made up of all the equipment and tools required for effective maintenance and that is essential for the operation of the machine in question. This will also include all the necessary hand tools

e.g. wrenches, screwdrivers, cranes, pulley removers. Other special tools like measuring and monitoring tools such as pressure gauges, meters, and oscilloscopes should also be made available. Some other special fixtures like modern on-board-diagnostic computerised equipment (OBD II), analysers, fixtures for overhauls, diagnosis and repairs of major components and systems.

- Provision of spare parts – for effective maintenance, spare parts, consumables and all other related essential inventories for immediate replacement should be made available.

In line with the preceding review, automobile maintenance is all the care that is given to the modern automobile to keep it in the correct working condition in order to get the optimal performance, maximum safety and durability. Erjavec (2004) and Giri (2010) pointed out that the automobile maintenance industry is basically concerned with preventive and corrective maintenance. The authors further explained that preventive maintenance involves services done on the vehicle regularly in order to keep it in safe working condition. During preventive maintenance on modern automobiles, technicians are provided with checklists which they follow in the cause of carrying out maintenance work as specified by manufacturers and such checklists may be added to by experienced technicians if they are not exhaustive enough (Howell 2008). Corrective

maintenance on the other hand involves the services carried out by the technician when there is a breakdown or a fault is detected in the cause of operation or during routine services (Erjavec, 2004 and Giri, 2010). It is thus required of the technician to have the requisite skills in order to effectively carry out maintenance tasks on the modern automobile.

A number of maintenance skills needed by an automobile technician to work on the automobile engine (power unit), its essential systems and components as suggested by Adebayo (2004) and Odigiri (2010) include conducting engine performance tests to determine needed repairs, removing and mounting engine cylinder head, inspecting, replacing fans, covers, gaskets and seals; He/she should be able to remove and reassemble the engine with the correct torque and gaskets, inspect and repair lubrication system, perform cooling system tests, determine needed repairs, and replace cooling system components such as radiator, thermostats and hoses, inspect, replace, and adjust drive belts and hoses; It is also expected of a technician to perform oil lube service on normally aspirated and turbo-charged engines, conduct engine performance test using engine analyser to determine needed repairs; The technician should inspect, repair or replace electronic ignition components, perform on board computer system diagnoses (OBD), diagnose electronic injection system problems and determine needed repairs; diagnose emission control system

and determine needed repair. Erjavec (2004) and Giri (2010) approached the modern automobile maintenance in a more technical way. In this approach, the authors grouped the skills according to the tasks involved for effective maintenance of the modern automobile as servicing, diagnosing and repairs.

Servicing of the modern automobile engine and its essential system/components include all preventive routine maintenance tasks expected to be done on the engine and its support systems; It involves following service manual for inspection of systems and components, testing and adjustments of components change and/or modification of worn out components before any partial or total breakdown of the vehicle occurs; It also involves lubrication service (oil lubrication service), and engine tune-up; engine servicing may at times require that the engine is removed and disassembled to enhance engine performance (Erjavec 2004) and (Giri 2010). For the automobile technician to effectively service modern automobile engine and its essential systems/components, Fetherston (2007) stressed that it is necessary to have the knowledge and understanding of how the engine works; He/she should also have knowledge of materials, circuit boards, processor chips and computer application. Writers like Starz (2001), Erjavec (2004), Olson (2008) and Giri (2010) pointed out the need to equally be able to read, understand

and interpret charts and service manual, read journals and surf the internet for relevant contemporary technological knowledge to enable the him to be able to carry out checklist service on the engine, carry out engine tune-ups, and use modern digital and measuring instruments and tools e.g. he/she should be able to read, understand and interpret pressure gauges, dial gauges and practically use the oscilloscope to set the ignition timing. In addition to these the automobile technician should posses the following skills; ability to inspect, test and identify wear on the engine components, ability to inspect, to replace and/or adjust drive belts. The authors further enumerated skills the technician will need for servicing the automobile engine to include, ability to inspect cooling system components (radiator, thermostat and hoses), ability to inspect coolant, drain, flush and refill cooling system with recommended coolant, ability to perform oil and lubrication services on the engine, ability to inspect and adjust cylinder valves, ability to identify and isolate abnormal sounds, ability to remove and reinstall engine cylinder head using correct torque specification, ability to work within stipulated time, ability to identify genuine spare parts, ability to follow procedures, observe and adhere to safe practices like wearing of safety wares and cleanliness. According to Abdullahi (2002) regular service will prolong the life of the automobile

engine for optimal performance before any failure occurs and in the case of any failure, it will be easier to diagnose for repairs.

Diagnosis is a noun from the transitive verb diagnoses which means to find out what is the nature and cause of a fault after careful examination or inspection of the entire system (Fetherston 2007). Erjavec (2004) explained diagnosis to be a way of looking at systems that are not functioning properly or the way they should and to find out why. Diagnosing faults on the modern automobile engine and its essential systems/components is therefore carried out in order to determine needed repairs. Rea (2010) describes diagnosis as the maintenance task which has to do with competencies that will lead to identifying the nature and cause(s) of any error that inhibits the performance of a system which are manifested as faulty components, problems in vehicle performance, unsatisfactory performance or even total failure of the vehicle. Rea (2010) further points out that in diagnostic approach, it is essential for the technician to first get the description of the problem from the owner of the vehicle and then builds on his abilities of basic communication skill, be able to analyse issues, make decision to test and examine the systems and components concerned to ensure their functionality; Giri (2010) points out that there are varieties of diagnostic equipment and tools that suit each

situation which range from basic electrical diagnosis to engine systems analysers and OBDs.

Therefore, for a technician to diagnose faults on the engine and its supportive sub-systems he must have an understanding of how the system works and how it should work or else it will be difficult to understand what diagnosis is or even how to diagnose any problem on the modern automobile engine. Erjavec (2004) enumerates the following steps as a general guide to diagnosing of faults on the modern automobile engine:

- Gather information about the problem
- Verify that the problem exists
- Thoroughly define what the problem is and when it occurs
- Research all available information and knowledge to determine the possible cause(s) of the problem
- Locate the problem by testing
- Continue testing to pinpoint the cause(s) of the problem
- Locate and repair the problem then verify the repair

Bellis, (2010) noted that on some of the modern automobiles with computerised engine controls have self-diagnostic systems. This, according to the author, makes diagnosis on such vehicles much easier. However, it will take a skilful technician to carry out such diagnoses.

Skills for diagnosis of faults in the modern automobile engine and its supportive systems will include the following: ability to clearly communicate with vehicle owners, ability to read and understand journals to update knowledge on latest technological development in automobile, ability to read and understand blue prints/technical drawings, and charts, ability to think critically and to possess investigative attitude, ability to be initiative, ability to handle well modern diagnostic equipment (i. e. perform On-Board- Diagnoses (OBD)), ability to critically analyse and interpret faults from diagnosis results, knowledge of computer controls on the engine and other systems, knowledge and understanding of how the engine and other systems work, ability to conduct engine testing, inspection and examination, ability to inspect components and the systems essential to engine performance for wear e.g. lubrication system and components, ignition system and components, fuel system and components, cooling system and components and starter circuit and components; Others are ability to conduct engine performance test using engine analyser, ability to distinguish abnormal sounds in the engine and localise such sounds to specific components or systems, ability to confidently determine needed repairs on components and systems being diagnosed, ability to select the right tools for the expected repairs, and ability to observe safe diagnostic procedures and regulations (Wyman

2007, Oslon 2008, Howells 2008 and Giri 2010). In this modern approach diagnosis is followed by repairs a corrective measure which is taken to remedy the problem and bring the vehicle back to life and optimal performance (Erjavec 2004 and Giri 2010).

Repairing faults on the modern automobile engine and its essential system/components include all the tasks involved in taking decisions on what actions to take in order to correct the fault or solve the problem correctly after diagnoses (Erjavec 2004). Repairs may involve complete overhaul, where the engine is removed, disassembled for the purpose of correcting a diagnosed fault, reassembled and mounted back (Giri 2010).

The automobile technician is expected to acquire/posses the following skills for repairs of the modern automobile engine and its essential system/components: ability to determine the needed repairs, ability to choose the right tools needed for the expected repairs, ability to use precision measuring devices for modern automobile repair work, ability to read, understand and follow sequentially assembly blue prints, repair manuals and specifications (Stasz 2001, Erjavec 2004 and Wyman 2007). The authors also note that the automobile technician should also be able to remove the engine for overhaul, disassemble and re-assemble the engine in correct sequence, remove and replace cylinder head using correct torque, and be able to test assembled engine, verify and certify

performance; it is also expected that the technician should be able to repair and replace damaged components/parts in engine and systems, diagnose and carry out needed repairs on the emission system, identify genuine engine spare parts and components, to think creatively in order to carry out modification (technological design to generate or adopt equipment and technology to serve user need (Wyman 2007)). The technician should also be knowledgeable and understand the implications of new technical innovations and information to apply to current and future problem solving, decision making and be able to understand and adhere to modern procedures and safe working procedures and regulations (Rea 2010, Giri 2010 and Wright 2011). Automobile maintenance technicians should be skilful enough and be able to follow all the maintenance provisions enumerated above. If any aspect of maintenance is neglected, it may lead to major breakdown which may be detrimental to the user (Erjavec 2004 and Giri 2010). All routine checks must thus be strictly and skilfully adhered to for optimal performance, safety and durability.

Skill is very vital to the stakeholders in the automobile industry be it manufacturing, merchandising, spare parts dealership, transportation, filling station service or maintenance technician. For the automobile maintenance technician whose main work is to service automobiles,

diagnose faults in the automobile systems and completely repair or fix any fault on the automobile, it is required of him to have the needed skills to accomplish these tasks. These skills should be based on sound understanding and knowledge of the trends of technological innovations on the automobile, through on-the-job experiences and continuous training in new technologies being introduced by modern automobile manufacturers (Erjavec 2004).

The Automobile Technician

The product of the automobile programme from the Polytechnics Colleges of technology and similar institutions is the technician who is the lifeline of the auto maintenance industry (FGN 2004). He/she is the support resource without which no any meaningful maintenance will be achieved as noted by Jain (2008). An automobile technician is expected to be knowledgeable and have skills to work on all parts or on a variety of automobile make/model or may specialise in specific areas such as repairs of automobile systems, components, bodywork or models. In Nigeria the automobile technician works in the automobile manufacturing firms, automobile dealership/merchandise, filling stations, local government, state government or federal government automobile fleet workshops, transportation companies, automobile parts dealership/merchandise and private maintenance workshops (Abah 2010, and Bayo 2010). Osuala

(2004) refers to a technician as a worker whose job requires knowledge and the use of scientific and mathematical theory. Brickman (2008), describes a technician as somebody who is skilled in industrial techniques or in the practical application of science and technology. Wikipedia (2010) on the other hand defines a technician as a person trained in the skills and techniques related to specific branch of engineering with relative practical understanding of the general concepts. The Dictionary net (2010) describes a technician as a person trained or skilled in the technical details of a particular art or science, especially one skilled at operating, maintaining, or repairing equipment, in contrast to the theory or informational content of a craft.

The Federal Government of Nigeria (2004) defines a technician as a person who has completed a two years training in any branch of science and technology in a Monotechnic, Polytechnic, and college of technology or related institution; It also explained that a technician could be an individual who has professional experience recognised as equivalent to the period of training. The automobile technician is therefore a person trained and has the knowledge or experience in the skills and techniques related to automobile technology and maintenance. He specialises in automobile maintenance, sometimes modifies automobile components and can work in any branch of the automobile industry.

The Nigerian society commonly refers to anyone who carries out repairs on automobile as mechanic; they are most often found at the roadside corners and they fix their vehicle faults (Bayo 2010). Kazaure, (2010) notes that with the rapid advancement in technology, mechanics will need to have a broader base of knowledge than in the past; they are also expected to be more organised and catch up with modern global practices. Thus, lately and globally the term automobile mechanic is being used less frequently and is being replaced by the euphemistic title "automobile technician" (Bellis 2010). According to Erjavec (2004), the mechanic may be skilful but lacks the technical knowledge which the technician has. Mechanics do go through apprenticeship programs by which they can learn the auto mechanics trade, while technicians do attend a formal vocational institution to become an Auto Maintenance Technician (U.S. Department of Labour 2010). In Nigeria the technician is the product of a Monotechnic, Polytechnic or College of education (technical).

Goms (2009) sees a technician as a more technologically oriented person who works with the pulse of technological innovations and developments. He also describes an automobile technician as one who has mechanical curiosity, eager to learn, aims at solving challenging problems, has high skill level in automobile technology and maintenance work, a

market niche specialist and with a very good educational background. Goms further asserts that in America, some automobile technicians are university degree graduates while some have other tertiary diplomas in automobile technology and repairs or have experience in varying tertiary education.

In America for example they have legislatures in place for standards in the automobile maintenance industry. In line with this they have bodies like Automobile Youth Education Society (AYES), Automobile Service for Excellence (ASE), National Automobile Technicians Education Foundation (NATEF) etc; these bodies are responsible for monitoring, certification of automobile technicians and accreditation of vocational and training institutions (Wright 2011). In Nigeria however, there are bodies like National Automobile Technicians Association (NATA), National Automotive Council (NAC), which do not have enough legislative backup to accredit or to train and certify the Nigerian practising technicians and the informal sector (Musa 2010).

As earlier on pointed out, the automobile technician may work on all systems or specialise in one system of modern automobile or model. The automobile technician needs skills improvement to enable him to work on any of these conventional systems of the automobile as pointed out by Adebayo (2004) and Erjavec (2004): the chasses and under vehicle works,

the body, the engine (the power unit) and its essential systems such as the fuel system, the ignition system, the cooling system, and the lubrication system, the transmission system, the suspension and steering system, the braking system and the electrical/Electronic system, emission control system (added to the power unit), the computer control system (brain box), the airbag and other accessories. It is also pointed out that those who would specialise in any of these systems or components require advanced training, continuous retraining in that particular field in order to acquire skills and they must have the desire to work and succeed in order to remain relevant in the face of the technological innovations in automobile (Erjavec 2004).

An Overview of the Automobile Maintenance Sector in Nigeria

The automobile maintenance industry in Nigeria is said to offer strong attraction to the ever growing population who find it difficult to secure employment in the formal sector of the economy. However, it is asserted that this population is adversely affected by a low level of awareness, motivation and lack of capital with the majority of those entering the sector through the apprenticeship system (Bisiriyu 2010). This makes the sector to remain at the rudimentary level. The story is told (Bayo 2010), of an automobile technician, in Jos Plateau state, who caused damage to the computer control unit (brain box) of a modern automobile

owner (a Lincoln Navigator worth N7m) due to ignorance of that technology. The car which was merely jerking was taken to the workshop and the technician in his attempts to fix the fault, tampered with and damaged the computer control system. This technician was indeed ignorant of the technological innovations on the modern automobile, lacked the skills to approach the problem and had no knowledge of or ability to use modern diagnostic tools to diagnose and repair the problem.

Dangana (2006) highlighted a number of characteristics of the automobile maintenance sector in Nigeria to include small scale operations, limited capital, high demand for cheap skills with an effective apprenticeship system at that level with a lot of sense of ingenuity and resourcefulness, constrained with undifferentiated work structure, lack of sufficient capital for growth and have limited access to new technological development in the trade due to ignorance.

In Nigeria there are no indigenous automobile manufacturing companies but only few assembly plants like Anambra Motor Company (ANAMMCO) Enugu, Peugeot Assembly Nigeria (PAN) Kaduna, R.T. Brisco Lagos, STYRE Motors Bauchi and a few others and out of these only PAN Kaduna is wobbling on its own feet Musa (2010). Other automobile industries are automobile merchandise, transportation, maintenance and spare parts dealership/sales. For the fact that there are no indigenous

automobile manufacturing companies and no globally standardise automobile maintenance outfits which could work in collaboration for the effective maintenance of these fleets of vehicles; this makes the automobile maintenance sector to be one of the major automobile industries in Nigeria because most of the modern vehicles are imported into the country thus posing the challenges of maintaining them for optimal utility.

In line with these developments, the Federal government is realising the need and importance of revitalising the automobile maintenance sector to meet up with the challenges of maintaining the modern automobile. This is seen in its recent call to stakeholders of the automobile maintenance sector to raise auto maintenance standard to meet global requirements. In its bit to achieve this, the Federal government together with NAC and other stakeholders in the Nigerian automobile industry in collaboration with the German Technical Cooperation (GTZ) came out with a new curriculum at Abuja, Federal Capital Territory, to enable trainees in both formal and informal sector develop the needed skills to face the challenges of technological innovations in the modern automobile (Musa 2010). This, according to Kazaure (2010), is a laudable effort as the new curriculum imbibes the modular concept of Competency Based Education and Training (CBET) which will replace the curriculum for the award of

Federal Labour Trade Test, Grades III, II and I certificates of the Federal Ministry of Labour and Productivity.

This will also give opportunity for younger people entering into the apprenticeship programmes and other vocational institutions including those who are already in the vocation to be equipped with necessary skills needed for the trade. Abah (2010) noted that the ability of the Nigerian automobile technician to maintain this fleet of imported modern vehicles will boost the country's conservation of foreign exchange that would have gone into foreign countries to the importation of expatriate skills. This may be the needed impetus for the development of the automobile industry in Nigeria but without the necessary skills and the desire for skills improvement, it will definitely be difficult if not impossible to break through.

Theoretical Framework of the Study

A theory is a statement or set of postulated ideas that is intended to explain a concept or phenomenon. According to Ezeji (2001) a theory consists of a set of statement(s) or proposition(s) which is/are made in order to explain some phenomenon and it provides the principles that govern learning processes. Ezeji further explains that a theory provides explanation to and governs learning processes in two ways:

i. Serves as a means of systematizing information which is contained in an area of knowledge thereby leading to the discovery of unknown facts

ii. Summarises information in such a manner that is easily used to explain a given concept.

Theoretical framework is the relevant theory/theories that serve as the basis for conducting a particular research. It presents the theory/theories which explain why the problem being studied exists and explains the principles that may lead to finding the solution. Wikipedia (2011) explains theoretical framework as a logically structured representation of the concepts, variables and relationship that are involved in a scientific study with the purpose of clarifying and identifying what will be explored, examined, measured or described. Gall, Gall and Borg (2007) define theoretical framework as the specification of set of theories that is inferred from observed phenomena of other theorist.

Following the explanation of a theory and theoretical framework given above, this study will be built on the following theories:

Theory of Technical and Vocational Skill Development (TTVSD)

In a research report carried out for city and guilds centre for skills development by Faraday, Overton and Cooper, (2011) on the importance of skill update and effective teaching in vocational education, it was

established that: skills development is a key factor in the employability of workers and the sustainability of enterprises; it is one of the objectives of skills development systems to ensure that the skills acquired match the skills valued in the workplace; skills development systems must also help workers and enterprises adjust to change and handle new conditions by constantly improving their skills to meet up with climatic change, globalization, demographic trends, technological innovation and/or financial crisis. This was built on the theory of technical and vocational skill development (TTVSD) by Stevenson (2003).

TTVSD was developed by Stevenson (2003) based on Buford Stefflre's ten propositions in search of a theory of vocational development. TTVSD states that "Improvement needs in skills development underlie vocational choice, development, employability, mobility and sustainability of socio-economy of every progressive society". This theory is relevant to this study because technological innovations in the modern automobile are complex and each sub-system of the modern automobile is indeed a challenge to the automobile maintenance industry in Nigeria. This can be seen by the calls made by stakeholders in the industry to the Nigerian automobile maintenance technicians to upgrade their skills in order to meet up the challenges posed by modern automobiles in terms of maintenance (Abah 2010).

Cognitive-Field Theory (CFT)

The Cognitive-Field Theory (CFT) was developed by Robert Theus in the year 1968, from cognitive psychology, as a positive approach to learning and it states that "A persons insights collectively constitute the cognitive structure of his life space" Theus (1968) explained cognitive structure to mean the way of perception of a person's psychology of himself and his social world; while life space refers to the person's world which consists of all his facts, concepts, beliefs, expectations, development of language, motions actions and social interactions.

In relation to this study, CFT and cognitive psychology explains a person's ability to see elements of a problem situation in new relationship i.e. if a person is faced with a new problem situation he takes a logical step to get an insight into the problem and react intelligently to solve it. Technological innovation comes with its new problem situation which demands that the modern automobile maintenance technician must see it in cognitive-field perspective. He needs to develop new skills, change his perspectives of the old skills and work on improving on them in order to meet up with the challenging situation.

Related Empirical Studies

Stasz (2001) conducted a study on skills acquisition for improvement of maintenance needed by automobile technicians in the automobile

mechanics trades. Four research questions were developed. The researcher adopted the survey research method, with a population of 79 automobile technicians trained through the formal vocational institutions and 81 automobile mechanics trained through apprenticeship system drawn from 23 automobile workshops. Instrument for data collection were face validated by three experts. Cronbach alpha method was used to determine reliability coefficient of the instrument and 0.81 was obtained. The data collected for the study was analysed using the mean and one way analysis of variance (ANOVA) and correlation coefficient. The result of the study revealed that changes in workplace and procedure as a result of technological innovations raise many concerns about the adequacy of workers skills in that country. Stasz carried out his study in far away Tonga (a country in the South Pacific Ocean). Similarly the present study seeks to determine the skills improvement needs a Nigerian automobile technician will require to maintain modern automobiles which influx the country on a daily basis. It is also similar to the present study in its methodology particularly the population, research design, method and instrument of data collection and analysis.

Mcloglin and Clark (2001) carried out a study on competencies and challenges in the technological arena. Three purposes and research questions were developed to guide the study. A survey method was used

with a population of 920 technicians in the automobile industry in France. A structured questionnaire was used for data collection. The instrument for data collection was face validated by three experts. Cronbach alpha method was employed to determine reliability coefficient and 0.87 was obtained. The data was analysed using mean and standard deviation. The result revealed a concern for the challenges posed by the influence of technological changes on the entire technical workforce in basic maintenance tasks, job content, work organisation and effectiveness. Although Mcloglin and Clark carried out their study in France, their research work is related to the present study because it deals with competencies and challenges which come along with innovations in the technological arena with particular reference to the automobile industry, using similar research design but with a larger population since it covers the whole automobile industry in France. Their study dealt with the whole automobile industry in France which is wider and more inclusive than the present study which is narrowed to the maintenance sector of the automobile industry in Nigeria. Besides, Nigeria is a developing country while France is a more advanced and developed country.

Vrienten (2002) carried out a study on improving learning in Computer Based Drafting Programme. The population was made up of 30 students who had no prior knowledge of Computer Assisted Design (CAD).

The instrument for data collection was a workbook developed for the course; the students were required to complete the course objectives within an allotted time of 25 hours of class time. The study revealed that with the technological advancement in computer assisted learning, there is the need to enhance the strength of cognitive structure in order to increase students' motivation, curiosity and interest in problem solving using CAD. Although Vrienten's study is in the field of drafting, it is related to the present study because an automobile technician is expected to have the ability to read, understand and interpret designs of automobile systems. This study is also similar to the present study because it deals with technological advancement in skill acquisition process but it differs in research design and population. Vrienten concentrated only on a particular program i.e. computer aided design (CAD), for the students and did not involve those who are already practicing in that field.

Rumbarger (2002) conducted a study on the potential impact of technology on skills requirement for the future jobs. The study adopted the survey method with a population of 1018 with no sampling in Tokyo Japan. A structured questionnaire was used to collect data. The data was analysed using frequency and percentage scores. The result revealed that new technological innovations are yielding an increased array of new components which are incorporated into modern machineries including the

automobile. These come up with challenging methods and techniques for the stakeholders in the industries. Rumbarger's study was carried out in Japan which is a leading automobile manufacturing industry in contrast to Nigeria a consumer nation. This research work has similarities to the present study in research design, instrument for data collection and the subject of technological innovations with reference to the array of new skills needed to meet up with the industrial challenges.

Buchanan (2004) carried out a study on new trends in industrial and automobile maintenance and processes. The population comprised of 123 auto technicians and 230 technicians in computerised operations in a biscuit making factory in the United States of America with no sample taken. The survey method was used. The instrument for data collection was a structured questionnaire validated by three experts in the production industry. Data analysis was carried out using percentages and rank order. The t-test statistic was used to test the hypotheses at 0.05 level of significance. The result of the study revealed that the overall pattern of knowledge and skills required by the factory technicians in terms of maintenance has changed significantly due to technological advancements. Buchanan's research work was carried out in the USA; it is related to the present study particularly in the automobile maintenance sector. However Buchanan carried out his study to also determine the skill

required by the biscuit production industry, the basic variable is the skills development in relation to the technological innovations. The study is similar to the present study in the population which is manageable without sampling, research design, instrument for data collection was also a structured questionnaire but it differs in the method of data analysis. While Buchanan used percentage and rank order to analyse his data the present work seeks to use mean and t-test statistic for the analysis of the data to be collected.

Dangana (2006) conducted a study on the technical skills improvement needs of Auto-electronic technicians in the maintenance of modern day automobiles in Niger State of Nigeria. The study adopted the survey research method, with a population of 239 Auto-electronic technicians. The instrument used to collect the data was the questionnaire and the data collected was analysed using mean and standard deviation. The hypotheses were tested using the t-test statistic at 0.05 level of significance. Some of the findings of the study revealed that with the accelerated pace of technological development in electronics and its application on the modern automobile there is need for the improvement of skills by the automobile electronics technicians. Some of Dangana's specific findings include need for knowledge of car battery voltage regulation, proficiency in identifying functions and relationship between

sensors, use of electronic sensors and need for the ability to read and interpret electrical circuits. Dangana suggested that auto-electronic technicians should enrol into evening courses at Polytechnics and Colleges of Technologies in order to update their knowledge with current developments in their fields. Although Dangana's work was carried out in Nigeria, it was more inclined to electronic technicians. However, taking a closer look at the technological innovations electronic is an applied phenomenon and cannot exist on its own in the modern automobile maintenance industry (David 2010 and Abah 2010). According to Goms (2009) the modern automobile is growing into a combination of mechanical and electronics technology which is referred to as mechatronics giving rise to the need for the automobile maintenance technician to study and acquire skills in both mechanical and electronic components and systems. Dangana's work dealt with skills improvement needs by auto-electronic technicians while the present study seeks to determine the skills required for effective maintenance of the modern automobile engine. Dangana's methodology is similar to the present study in terms of the population, research design, instrument and method of data collection and analysis.

The approach adopted in this study agrees with what Erjavec (2004), Giri (2010) and other modern automobile technologist and

engineers agitate for. The required skills are grouped as pointed out in the literature review above to include those skills required for servicing of the modern automobile engine, those skills required for diagnoses of any and every fault on the modern automobile engine, and those skills required for complete repairs of the diagnosed faults on the modern automobile engine.

Summary of Related Literature Review

The literature review for this study revealed that technological innovation in the automobile industry has been very fascinating. Technological innovation has turned the automobile into a global modern industry which has produced millions of motor vehicles and circulated them worldwide. The many evolutionary technological innovations and advancements have turned the one time horseless carriage into today's modern automobile. One of the outstanding technologies is the computerisation of many sub-systems of the automobile designs and operations. This has affected the automobile industry especially the auto-maintenance sector so much so that many maintenance technicians will be required to update their skills or be phased out with the old technology. There is therefore the need to identify the skills improvement needs that are required for an effective automobile maintenance to meet up with these challenges in Nigeria.

The review also revealed that in Nigeria there are no automobile manufacturing industries except few assembly plants thus, the bulk of the modern automobiles are imported. The automobile maintenance industry therefore gains popularity in Nigeria and offers a strong attraction to the teaming unemployed population. However, this sector is affected by a low level awareness, motivation, need for improvement on the old skills and lack of required skills for the effective maintenance. This leaves the sector at the rudimentary level.

Several studies have been conducted on the need for improvement of skills but none of them has delved into the skills improvement needs of practicing automobile maintenance technicians for effective maintenance of the modern automobile engine with reference to Servicing (preventive maintenance carried out on the automobile), Diagnoses of faults (process of corrective maintenance which leads to the determination of the specific problem when there is a breakdown) and Repairs of the diagnosed faults (part of corrective maintenance carried out to remedy any diagnosed breakdown). This study therefore seeks to find out the areas of skills improvement needs by practicing automobile technicians for satisfactory preventive maintenance referred to as servicing, effective diagnoses of faults and complete repairs of the modern automobile. This is in line with modern accepted standard practice globally.

CHAPTER III

METHODOLOGY

This chapter describes the research design, area of the study, the population for the study, instrument for data collection, validation of the instrument, reliability of the instrument, method of data collection, and method of data analysis.

Design of the Study

The study adopted the descriptive survey research design to determine skills improvement needs of automobile technicians for effective maintenance of modern automobile in Plateau State. Survey design according to Osuala (2005) is a design which studies the characteristics and focuses on people, the vital facts about people and their beliefs, opinions, attitude, motivation and behaviour. The design is therefore suitable because the study solicited information from lecturers of

automobile technology/workshop instructors in tertiary institutions in Plateau state, and practicing automobile technicians in the automobile maintenance industry in Plateau state.

Area of the Study

The study was carried out in Plateau state of Nigeria. Being the home of peace and tourism where many people visit on a daily basis from other parts of the country, Plateau state is in the north central part of Nigeria, it is the gateway that joins the north eastern and the north western parts of the country. Besides these, Plateau state has a proximity to the federal capital territory and many people from all over the country settle and carry out their businesses.

Population for the Study

The population for this study is 79 respondents, made up of 65 practicing automobile technicians from 20 registered automobile maintenance workshops and 14 lecturers/instructors from Federal College of Education (FCE) Pankshin and Plateau State Polytechnic (PSP) Barakin Ladi (source: Plateau State Ministry of Commerce, Industries and Tourism, and institutions concern).

Sample and Sampling Technique

There was no sampling since the population is small and manageable. The summary of the population distribution is presented in Tables 1 and 2 (Appendix D page 103).

Instrument for Data Collection

A structured questionnaire containing 63 items was used to collect data for this study (see Appendices A,B and C). The questionnaire contains four sections (A, B, C, D). Section A sought to collect personal information of the respondents; the items in this section have options and blank spaces to enable the respondents to complete or check (√) appropriately. Section B was designed to determine the skills improvement needs of the automobile technician for servicing of modern automobile engine, section C was designed to determine skills improvement needs of the automobile technician for diagnosing faults on the modern automobile engine and section D was designed to determine the skills improvement needs of the automobile technician to completely repair the diagnosed faults or problems on the modern automobile engine. Sections B, C, D of the questionnaire is therefore divided into two categories i.e. Part I sections B_I, C_I, D_I to take care of the required category and Part II sections B_{II}, C_{II}, D_{II} to take care of the performance category. Both categories were made up of 4-point response scale with corresponding assigned values of 4, 3, 2 and 1.

The required category of the questionnaire is made up of Highly Required (HR)=4, Required (R)=3, Averagely Required (AR)=2, Not Required (NR)=1; while the performance category is made up of High Performance (HP)=4, Average Performance (AP)=3, Low Performance (LP)=2 and No Performance (NP)=1. The respondents were required to select one item by a check (√) against the response category which best suits their opinion.

Validation of the Instrument

The instrument was face validated by three experts, two from the Peugeot Assembly of Nigeria (PAN) Kaduna and one from a Polytechnic in the Federal Capital Territory (FCT) Abuja. Validity of an instrument is concerned with whether the instrument a researcher uses actually measures what it intends to measure (Eboh, 2009). Each validate was given a copy of the instrument and requested to identify any area of ambiguity and to proffer suggestions to improve its validity.

Reliability of the Instrument

The questionnaire was trial tested on 3 lecturers/workshop instructors from college of education Akwanga, and 7 practicing automobile technicians randomly selected from Keffi Township all in

Nasarawa State. The choice of Nasarawa State is simply because it was part of Plateau State. The data obtained from the trial test was analyzed using Cronbach Alpha reliability coefficient (α) to establish the internal consistency of the instrument. Cronbach alpha reliability is considered based on the fact that, the questionnaire is a multiple response type. The responses were computed using Statistical Package for Social Sciences (SPSS) version 16 and the overall reliability coefficient of 0.85 was obtained, this, according to Cohen, Manion, and Morrison (2009) is considered highly reliable.

Method of Data Collection

The instrument was administered to the respondents and collected by the researcher and two research assistants. The research assistants were taught how to administer the instrument to enhance high return rate of the instruments. A total of 79 x 2 (for required and performance categories), copies of the questionnaire were administered to 65 practicing automobile maintenance technicians, 14 lecturers/workshop instructors of automobile technology from Federal College of Education (FCE) Pankshin and Plateau State Polytechnic (PSP) Barakin Ladi. The practicing automobile technicians were treated as one group, while the lecturers/instructors as the other group.

Method of Data Analysis

Data collected from the respondents were analysed using weighted mean and improvement needed index (INI) for both required and performance categories in order to answer the research questions. The improvement needs were determined as follows:

i. The mean ($\bar{x}_r$) of the required category was determined for each questionnaire item

ii. The mean ($\bar{x}_p$) of the performance category was also determined for each item

iii. The performance gap (PG) was determined by calculating the difference between the means of the required category and the performance category i.e. **PG** = $\bar{x}_r - \bar{x}_p$

iv. Where the value of PG is positive (+), it means that improvement is needed in that particular skill item because the performance of the automobile technicians in that item is lower than what is required.

v. Where the value of PG is negative (-) or zero (0), it means that no skill improvement is needed in that particular skill item because the performance of the automobile technicians in that item is more than or equal to what is required

The analysis was done using the statistical package for the social sciences (SPSS) version 16.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter presents the data collected and analyzed for the study. The analyzed data were used for answering the research questions drawn from the study.

Research Question 1

What are the skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems?

The data for answering research question 1 are presented in Table 1

Table 1
Performance Gap Analysis of the Mean Responses of Respondents on the Skills Improvement Needs of Automobile Technicians for Servicing the Modern Automobile Engine and its Support Systems N = 79

S/N	Skill Items	$\overline{X}_r$	$\overline{X}_p$	PG $\overline{X}_r - \overline{X}_p$	Remarks
1.	Understand how the engine system works	3.78	3.41	-0.37	INN
2.	Understand circuit boards	3.24	3.01	-0.23	INN
3.	Understand processor chips	2.94	2.49	-0.45	INN
4.	Understand computer application	3.27	3.20	-0.07	INN
5.	Identify engineering materials	3.07	3.37	-0.30	INN
6.	Read charts and service manuals	3.40	2.85	0.55	IN
7.	Understand charts and service manuals	3.27	3.26	0.01	IN
8.	Interpret charts and service manuals	3.33	3.10	0.23	IN
9.	Carry out checklist service on the engine	3.15	3.00	0.15	IN
10.	Inspect electronic ignition system components	3.27	3.05	0.22	IN
11.	Use oscilloscope to set ignition timing	2.92	2.65	0.27	IN
12.	Carry out engine tune-ups	3.11	2.09	1.02	IN
13.	Carry out inspection for wear on the engine components	3.39	2.45	0.94	IN
14.	Test and identify extent of wear on the engine components	3.34	2.85	0.49	IN
15	Use pressure gauges and to determine cylinder pressure	3.15	2.88	0.27	IN
16	Understand pressure gauges and to determine cylinder pressure	3.10	2.23	0.87	IN
17	Interpret pressure gauges and to determine cylinder pressure	2.98	2.02	0.96	IN
18	Inspect drive belts	2.96	3.11	-0.15	INN
19	Adjust drive belts	2.84	2.67	0.17	IN
20	Replace drive belts	3.03	2.94	0.09	IN
21	Inspect cooling system components (radiator, thermostat and hoses)	3.39	2.87	0.52	IN
22	Inspect coolant in the cooling system	3.32	2.52	0.80	IN
23	Drain, flush and refill cooling system with recommended coolant	3.13	2.83	0.30	IN
24	Perform oil and lubrication services on the engine	3.62	3.02	0.60	IN
25	Inspect and adjust cylinder valves	3.35	2.99	0.36	IN
26	Use dial gauges	3.08	3.06	0.02	IN
27	Interpret engine analyser tests	3.17	2.92	0.25	IN
28	Identify and isolate abnormal sounds	2.19	3.37	-1.18	INN
29	Remove and reinstall engine cylinder head using correct torque specification	3.39	2.11	1.28	IN
30	Use modern/digital measuring instrument and tools	3.32	2.07	1.25	IN
31	Work within stipulated time	2.97	2.65	0.32	IN
32	Identify genuine spare parts	3.46	3.02	0.44	IN

33	Read journals of automobile technology and innovations	3.11	3.37	-0.26	INN
34	Surf the internet for relevant contemporary technological knowledge	3.34	2.99	0.35	IN

Key: IN – Improvement Needed: INN- Improvement Not Needed

Data in Table 1 revealed that 27 out of 34 items had performance gap values ranged from 0.01 to 1.28 and were positive indicating that automobile technicians need improvement in 27 skills for servicing the modern automobile engine and its support systems. Eight items have negative performance gaps of -0.37, -0.23, -0.45, -0.07, -0.30, -0.15, -1.18 and -0.26 indicating that improvement is not needed by automobile technicians in the eight items. Generally, automobile technicians need improvement in all the 34 skills in servicing the modern automobile engine and its support systems but less emphasizes on the eight items with negative performance gap values.

Research Question 2

What are the skills improvement needs of automobile technicians for diagnosing faults in modern automobile engine and its support systems?

The data for answering research question 2 are presented in Table 2

Table 2
Performance Gap Analysis of the Mean Responses of Respondents on the Skills Improvement Needs of Automobile Technicians for Diagnosing Faults in Modern Automobile Engine and its Support Systems **N = 79**

S/N	Skill Items	$\overline{X}_r$	$\overline{X}_p$	PG $\overline{X}_r - \overline{X}_p$	Remarks
1.	Understand journals to update knowledge on latest technological development in automobile	2.88	3.43	-0.57	INN
2.	Read and understand blue prints/technical drawings, and charts	3.35	3.11	0.24	IN
3.	Think critically and to possess investigative attitude	3.37	2.93	0.44	IN
4.	Handle well, modern diagnostic equipment (i. e. perform On-Board- Diagnoses (OBD))	3.72	3.27	0.45	IN
5.	Critically analyse and interpret faults from diagnosis results	3.24	3.00	0.24	IN
6.	Understand computer controls on the engine	3.24	2.05	1.19	IN
7.	Understand how the engine and other systems work	3.48	3.26	0.22	IN
8.	Conduct engine testing, inspection and examination	3.50	3.30	0.20	IN
9.	Inspect lubrication system and components,	3.46	3.03	0.43	IN
10.	Inspect ignition system and components,	3.30	2.99	0.31	IN
11.	Inspect fuel system and components,	3.24	2.65	0.59	IN
12.	Inspect cooling system and components	2.03	3.25	-0.80	INN
13.	Inspect starter circuit and components	2.74	3.45	-0.71	INN
14.	conduct engine performance test using engine analyser	3.41	2.85	0.56	IN
15	distinguish abnormal sounds in the engine	2.43	3.29	-0.86	INN
16	localise such sounds to specific components or systems	3.24	3.01	0.23	IN
17	Confidently determine needed repairs on components and systems being diagnosed	3.43	2.99	0.44	IN

Data in Table 2 revealed that 13 out of 17 items had performance gap values ranged from 0.20 to 1.19 and were positive indicating that the automobile technicians need improvement in 13 competencies for diagnosing faults in modern automobile engine and its support systems. Four items have negative performance gap of -0.57, -0.80, -0.71 and -0.86

indicating that improvement is not needed by automobile technicians in the four items. Generally, automobile technicians need improvement in all the 17 competencies in diagnosing faults in modern automobile engine and its support systems but less emphasizes on the four items with negative performance gap values.

Research Question 3

What are the skills improvement needs of automobile technicians for repairing faults on modern automobile engine and its support systems?

The data for answering research question 3 are presented in Table 3

Table 3
Performance Gap Analysis of the Mean Responses of Respondents on the Skills Improvement Needs of Automobile Technicians for Repairing Faults on Modern Automobile Engine and its Support Systems N = 79

S/N	Skill Items	$\overline{X}_r$	$\overline{X}_p$	PG $\overline{X}_r - \overline{X}_p$	Remarks
1.	Determine the needed repairs	3.73	3.31	0.42	IN
2.	Choose the right tools needed for the expected repairs	3.64	2.76	0.88	IN
3.	Use precision measuring devices for modern automobile repair work	3.54	2.90	0.64	IN
4.	Read, understand and follow sequentially assembly blue prints, repair manuals and specifications	3.46	2.95	0.51	IN
5.	Remove the engine for overhaul	3.05	3.11	-0.06	INN
6.	Disassemble and re-assemble the engine in correct sequence	3.49	2.65	0.84	IN
7.	Remove and replace cylinder head using correct torque	2.77	3.25	-0.48	INN
8.	Test assembled engine	3.02	3.53	-0.51	INN
9.	Verify and certify performance	3.56	2.86	0.70	IN
10.	Repair and replace damaged components/parts in engine and systems	3.51	3.04	0.47	IN
11.	Diagnose and carry out needed repairs on the		2.95	0.70	IN

	emission system	3.34			
12.	Carry out modification (technological design to generate or adopt equipment and technology to serve user need)	3.44	2.99	0.44	IN

Data in Table 3 revealed that nine out of 12 items had performance gap values ranged from 0.42 to 1.42 and were positive indicating that the automobile technicians need improvement in nine skills for repairing faults on modern automobile engine and its support systems. Three out of 12 items have negative performance gap of -0.06, -0.48 and -0.51 indicating that improvement is not needed by automobile technicians in the three items. Generally, automobile technicians need improvement in all the 12 skills in repairing faults on modern automobile engine and its support systems but less emphasizes on the three items with negative performance gap values.

Testing of Hypotheses

Hypothesis 1

There will be no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for servicing

the modern automobile engine and its support systems. Data for testing this hypothesis are provided in Table 4.

Table 4
The t-test Analysis of the Mean Responses of Lecturers/Instructors and practicing automobile technicians on the Skills Improvement Needs of Automobile Technicians for Servicing the Modern Automobile Engine and its Support Systems

S/N	Skill Items	$\overline{X}_1$	S^2_1	$\overline{X}_2$	S^2_2	t- cal	Remarks
1	Understand how the engine system works	3.60	0.75	3.84	0.40	0.21	NS
2	Understand circuit boards	3.30	0.80	3.22	0.87	0.50	NS
3	Understand processor chips	3.05	0.75	2.91	0.97	0.02	NS
4	Understand computer application	3.10	1.02	3.23	0.97	0.30	NS
5	Identify engineering materials	3.30	0.65	3.40	0.83	0.35	NS
6	Read charts and service manuals	3.30	0.57	3.44	0.72	0.21	NS
7	understand charts and service manuals	3.05	0.88	3.33	0.68	0.32	NS
8	Interpret charts and service manuals	3.15	0.67	3.27	0.82	0.12	NS
9	Carry out checklist service on the engine	3.25	0.93	3.15	0.88	0.30	NS
10	Inspect electronic ignition system components	3.40	0.50	3.23	0.79	0.29	NS
11	Use oscilloscope to set ignition timing	2.95	0.82	2.91	0.79	0.33	NS
12	Carry out engine tune-ups	3.10	0.96	3.11	0.81	0.40	NS
13	Carry out inspection for wear on the engine components	3.35	0.81	3.40	0.74	0.28	NS
14	Test and identify extent of wear on the engine components	3.40	0.75	3.32	0.77	0.52	NS
15	Use pressure gauges and to determine cylinder pressure	3.20	0.89	3.13	0.79	0.47	NS
16	Understand pressure gauges and to determine cylinder pressure	3.30	0.86	3.03	0.74	0.24	NS
17	Interpret pressure gauges and to determine cylinder pressure	3.00	0.72	2.98	0.81	0.22	NS
18	Inspect drive belts	3.25	0.85	3.06	0.88	0.41	NS
19	Adjust drive belts	3.00	0.79	2.79	1.03	0.24	NS
20	Replace drive belts	3.10	0.78	3.01	0.86	0.52	NS
21	Inspect cooling system components (radiator, thermostat and hoses)	3.45	0.68	3.37	0.74	0.31	NS
22	Inspect coolant in the cooling system	3.25	0.71	3.34	0.80	0.52	NS
23	Drain, flush and refill cooling system with recommended coolant	3.45	0.68	3.03	0.80	0.18	NS
24	Perform oil and lubrication services on the engine	3.75	0.44	3.57	0.62	0.42	NS
25	Inspect and adjust cylinder valves	3.35	0.81	3.35	0.73	0.59	NS
26	Use dial gauges	2.85	0.87	3.16	0.72	0.23	NS
27	Interpret engine analyser tests	2.74	1.11	3.32	0.72	0.26	NS
28	Identify and isolate abnormal sounds	3.50	0.87	3.33	0.84	0.18	NS
29	Remove and reinstall engine cylinder head using correct torque specification	3.45	0.82	3.37	0.78	0.43	NS
30	Use modern/digital measuring instrument and tools	3.05	0.88	3.42	0.77	0.02	NS
31	Work within stipulated time	2.85	0.87	3.01	0.90	0.22	NS
32	Identify genuine spare parts	3.45	0.99	3.47	0.75	0.32	NS
33	Read journals of automobile technology and innovations	3.20	0.83	3.44	0.70	0.06	NS
34	Surf the internet for relevant contemporary technological knowledge	3.10	1.02	3.42	0.67	0.43	NS

Key: S_1^2 = Variance of lecturers/instructors of automobile Technology
S_2^2 = Variance of practicing automobile technicians

$\overline{X}_1$ = Mean of lecturers/instructors of automobile Technology
$\overline{X}_2$ = Mean of practicing automobile technicians
Df = 77
P = 0.05
t-tab =1.68
S = Significant
NS = Not Significant

Data presented in Table 4 revealed that each of 34 competency items had their calculated t-values ranged from 0.02 to 0.52 which were less than t-table value of 1.68 at 0.05 level of significance and at 77 degree of freedom (df). This indicated that there was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems. Therefore, the null hypothesis of no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems was not rejected.

Hypothesis 2

There will be no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau

state on skills improvement needs of automobile technicians for diagnosing faults in modern automobile engine and its support systems. Data for testing this hypothesis are provided in Table 5.

Table 5
The t-test Analysis of the Mean Responses of Instructors/Lecturers and Practicing Automobile Technicians on the Skills Improvement Needs of Automobile Technicians for Diagnosing Faults in Modern Automobile Engine and its Support Systems

S/N	Skill Items	$\overline{X}_1$	S^2_1	$\overline{X}_2$	S^2_2	t- cal	Remarks
1	Understand journals to update knowledge on latest technological development in automobile	3.20	1.00	3.50	0.79	0.61	NS
2	Read and understand blue prints/technical drawings, and charts	3.40	0.82	3.33	0.86	0.50	NS
3	Think critically and to possess investigative attitude	3.15	0.58	3.45	0.72	0.02	NS
4	Handle well, modern diagnostic equipment (i. e. perform On-Board- Diagnoses (OBD))	3.30	0.65	3.33	0.82	0.30	NS
5	Critically analyse and interpret faults from diagnosis results	3.30	0.47	3.22	0.76	0.35	NS
6	Understand computer controls on the engine	3.25	0.85	3.23	0.81	0.21	NS
7	Understand how the engine and other systems work	3.70	0.47	3.40	0.89	0.32	NS
8	Conduct engine testing, inspection and examination	3.60	0.68	3.47	0.72	0.12	NS
9	Inspect lubrication system and components,	3.50	0.68	3.45	0.79	0.30	NS
10	Inspect ignition system and components,	3.35	0.48	3.28	0.76	0.29	NS
11	Inspect fuel system and components,	3.45	0.60	3.16	0.96	0.63	NS
12	Inspect cooling system and components	3.25	0.63	3.25	0.84	0.74	NS
13	Inspect starter circuit and components	3.50	0.68	3.44	0.70	0.28	NS
14	conduct engine performance test using engine analyser	3.65	0.58	3.33	0.84	0.54	NS
15	Distinguish abnormal sounds in the engine	3.35	0.74	3.27	0.84	0.47	NS
16	localise such sounds to specific components or systems	3.45	0.68	3.16	0.81	0.24	NS
17	Confidently determine needed repairs on components and systems being diagnosed	3.50	0.60	3.40	0.81	0.22	NS

Data presented in Table 5 revealed that each of seventeen competency items had their calculated t-values ranged from 0.02 to 0.74 which were less than t-table value of 1.68 at 0.05 level of significance and

at 77 degree of freedom (df). This indicated that there was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for diagnosing faults in modern automobile engine and its support systems. Therefore, the null hypothesis of no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for diagnosing faults in modern automobile engine and its support systems was not rejected.

Hypothesis 3

There will be no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau State on skills improvement needs of automobile technicians for repairing faults on modern automobile engine and its support systems. Data for testing this hypothesis are provided in Table 6.

Table 6
The t-test Analysis of the Mean Responses of Lecturers/Instructors and Practicing Automobile Technicians on the Skills Improvement Needs of Automobile Technicians for Repairing Faults on Modern Automobile Engine and its Support Systems

S/N	Skill Items	$\overline{X}_1$	S^2_1	$\overline{X}_2$	S^2_2	t- cal	Remarks
1	Determine the needed repairs	3.70	0.57	3.74	0.57	0.61	NS
2	Choose the right tools needed for the expected repairs	3.50	0.51	3.69	0.56	0.50	NS
3	Use precision measuring devices for modern automobile repair work	3.35	0.58	3.61	0.52	0.04	NS
4	Read, understand and follow sequentially assembly blue prints, repair manuals and specifications	3.40	0.59	3.49	0.56	0.30	NS
5	Remove the engine for overhaul	2.95	0.94	3.08	0.72	0.35	NS
6	Disassemble and re-assemble the engine in correct sequence	3.45	0.60	3.50	0.62	0.21	NS
7	Remove and replace cylinder head using correct torque	3.35	0.67	3.22	0.72	0.32	NS
8	Test assembled engine	3.45	0.60	3.55	0.65	0.12	NS
9	Verify and certify performance	3.60	0.59	3.60	0.67	0.30	NS
10	Repair and replace damaged components/parts in engine and systems	3.50	0.60	3.50	0.62	0.29	NS
11	Diagnose and carry out needed repairs on the emission system	3.40	0.59	3.40	0.70	0.63	NS
12	Carry out modification (technological design to generate or adopt equipment and technology to serve user need)	3.45	0.60	3.45	0.70	0.74	NS

Data presented in Table 6 revealed that each of twelve competency items had their calculated t-values ranged from 0.04 to 0.74 which were less than t-table value of 1.68 at 0.05 level of significance and at 77 degree of freedom (df). This indicated that there was no significant difference between the mean responses of Lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau State on skills improvement needs of automobile technicians for repairing faults on modern automobile engine and its support systems. Therefore, the null hypothesis of no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau

State on skills improvement needs of automobile technicians for repairing faults on modern automobile engine and its support systems was not rejected.

Findings of the study

The following findings emerged from the study based on the research questions and hypotheses

A. Automobile Technicians Need Improvement in the following Skills for Servicing the Modern Automobile Engine and its Support Systems:

1. Read charts and service manuals
2. Understand charts and service manuals
3. Interpret charts and service manuals
4. Carry out checklist service on the engine
5. Use oscilloscope to set ignition timing
6. Inspect electronic ignition system components
7. Carry out engine tune-ups
8. Carry out inspection for wear on the engine components
9. Test and identify extent of wear on the engine components
10. Use pressure gauges and to determine cylinder pressure
11. Understand pressure gauges and to determine cylinder pressure
12. Interpret pressure gauges and to determine cylinder pressure

13. Adjust drive belts
14. Replace drive belts
15. Inspect electronic ignition system components
16. Inspect cooling system components (radiator, thermostat and hoses)
17. Inspect coolant in the cooling system
18. Drain, flush and refill cooling system with recommended coolant
19. Perform oil and lubrication services on the engine
20. Inspect and adjust cylinder valves
21. Use dial gauges
22. Interpret engine analyser tests
23. Remove and reinstall engine cylinder head using correct torque specification
24. Use modern/digital measuring instrument and tools
25. Work within stipulated time
26. Identify genuine spare parts
27. Surf the internet for relevant contemporary technological knowledge

B. Automobile Technicians Need Improvement in the following Skills for Diagnosing Faults in Modern Automobile Engine and its Support Systems:

1. Read and understand blue prints/technical drawings, and charts
2. Think critically and to possess investigative attitude
3. Handle well, modern diagnostic equipment (i. e. perform On-Board-Diagnoses (OBD))
4. Critically analyse and interpret faults from diagnosis results
5. Understand computer controls on the engine
6. Understand how the engine and other systems work
7. Conduct engine testing, inspection and examination
8. Inspect lubrication system and components,
9. Inspect ignition system and components,
10. Inspect fuel system and components,
11. Confidently determine needed repairs on components and systems being diagnosed
12. localise such sounds to specific components or systems
13. conduct engine performance test using engine analyser

C. Automobile Technicians Need Improvement in the Following Skills for Repairing Faults on Modern Automobile Engine and its Support Systems:

1. Determine the needed repairs

2. Choose the right tools needed for the expected repairs
3. Use precision measuring devices for modern automobile repair work
4. Read, understand and follow sequentially assembly blue prints, repair manuals and specifications
5. Disassemble and re-assemble the engine in correct sequence
6. Verify and certify performance
7. Repair and replace damaged components/parts in engine and systems
8. Diagnose and carry out needed repairs on the emission system
9. Carry out modification (technological design to generate or adopt equipment and technology to serve user need)

1. There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems.
2. There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs

of the automobile technician for diagnosing faults in modern automobile engine and its support systems.

3. There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs of the automobile technicians for repairing faults on modern automobile engine and its support systems.

Discussion of findings

The findings of this study reveal that automobile technicians need improvement in twenty seven skills for servicing the modern automobile engine and its support systems. These skills include read charts and service manuals, understand charts and service manuals, interpret charts and service manuals, carry out checklist service on the engine, use oscilloscope to set ignition timing, inspect electronic ignition system components, carry out engine tune-ups, carry out inspection for wear on the engine components, test and identify extent of wear on the engine components, use pressure gauges and to determine cylinder pressure, understand pressure gauges and to determine cylinder pressure, interpret pressure gauges and to determine cylinder pressure, adjust drive belts, replace drive belts, inspect cooling system components (radiator,

thermostat and hoses) and inspect coolant in the cooling system. These findings are in agreement with the opinion of Stasz (2001) that automobile technicians need to acquire servicing skills such as abilities to carry out engine tune-ups, adjust and replace drive belts in order to effectively service modern automobiles.

The findings of this study revealed that automobile technicians need improvement in thirteen skills for Diagnosing Faults in Modern Automobile Engine and its Support Systems. These skills include read and understand blue prints/technical drawings, and charts, think critically and to possess investigative attitude, handle well, modern diagnostic equipment, understand computer controls on the engine, understand how the engine and other systems work, conduct engine testing, inspection and examination and inspect lubrication system and components. These findings are in line with the opinion of Sagar (2006) that diagnosing skills include such skills as ability to identify various faults with relevant modern instruments and to understand computer controls on the engine as well as be able to interpret readings from such instruments.

The findings of this study revealed that automobile technicians need improvement in twenty seven skills for Repairing Faults on Modern Automobile Engine and its Support Systems. These skills include determine the needed repairs, choose the right tools needed for the expected repairs,

use precision measuring devices for modern automobile repair work, read, understand and follow sequentially assembly blue prints, repair manuals and specifications, disassemble and re-assemble the engine in correct sequence and verify and certify performance. The findings are in consonance with the finding of Giri (2010) that ability to determine the needed repairs, choose the right tools needed for the expected repairs, and disassemble and re-assemble the engine in correct sequence are needed for effective repair of faults in modern automobile.

There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems. The implication of the findings is that automobile technicians truly need improvement in their skills for servicing the modern automobile engine and its support systems

There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs of the automobile technician for diagnosing faults in modern automobile engine and its support systems. The implication of the findings is that automobile technicians truly need

improvement in their skills for diagnosing faults in modern automobile engine and its support systems.

There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs of the automobile technicians for repairing faults on modern automobile engine and its support systems. The implication of the findings is that automobile technicians truly need improvement in their skills for repairing faults on modern automobile engine and its support systems.

CHAPTER IV
SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter contains the re-statement of the problem, summary of procedure used, the principal findings of the study, implications of the study, conclusion, recommendations and the suggestions for further study.

Re-statement of the Problem

The modern automobile maintenance industry is already becoming more than what the roadside mechanic can handle. The industry is daily

becoming more technologically oriented with many computerised systems, thus making it more sophisticated. In addition to sophistication is the ceaseless influx of modern cars into the country. Abah (2010) stated that almost on a daily basis quite a number of new and fairly used vehicles (including the modern vehicles) are imported into the country.

The tasks expected of the automobile technician are to satisfactorily service the automobile engine and its support systems, to exhaustively diagnose any faults, and to completely repair or fix any problem on the motor vehicle. The efficiency of the automobile technician will depend on the skills, knowledge, and understanding he possesses of the modern automobile and its technological innovations. Erjavec (2004) and Bellis (2010) have noted that the majority of the roadside mechanics lack the knowledge and are deficient in skills needed to fix anything right on the modern automobile. In fact, the modern automobile use highly computerised technological compl 80 stems, which enhance and monitor the performance of the vehicle; hov 77 e technicians seem to lack the corresponding knowledge and skills to carry out the maintenance tasks required of them.

Due to deficiency of maintenance skills, some technicians have caused more damages to their clients' vehicles than repairs; some clients' vehicles have overstayed at the maintenance shop for several months and

in some cases, they are almost abandoned with no solution to the problem. This causes a lot of inconveniences, economic loses and regrets on the side of the clients. Inability of some of these technicians to precisely fix most of these problems, have also caused accidents and vehicle breakdown on the highways leading to injuries which may either result to incapacitation or even fatality. The problem of this study therefore is that automobile technicians in Plateau state have deficiency in the skills needed for effective maintenance of modern vehicles and thus the need for improvement arises. The purpose of the study was to investigate the skills improvement needs of automobile technicians for effective maintenance of modern automobile in Plateau State. Specifically, the study sought to determine the skills improvement needs of automobile technicians for:

1. Servicing modern automobile engine and its support systems
2. Diagnosing faults in modern automobile engine and its support systems
3. Repairing faults on modern automobile engine and its support systems.

Summary of Procedures Used

The study adopted survey research design. The population for the study was 79 respondents made up of 65 practising automobile technicians from registered automobile maintenance workshops and 14 lecturers/instructors from Federal College of Education (FCE) Pankshin and Plateau State Polytechnic (PSP) Barakin Ladi The entire population was used for the study because of its manageable size. A structured questionnaire was developed and used for data collection. The questionnaire was face validated by three experts, two from the Peugeot Assembly of Nigeria (PAN) Kaduna and one from a Polytechnic in the Federal Capital Territory (FCT) Abuja. They were asked to correct ambiguous statements and unclear worded items. They were required to check the appropriateness of the instrument, clarity of items and suitability of the purposes and hypotheses. Their inputs were used to develop the final version of the instrument. Cronbach Alpha Coefficient Method was used to determine the internal Consistency of the instrument. Seventy nine copies of questionnaire were distributed and retrieved back. The duly filled questionnaires were collected immediately to ensure 100% return rate. The data collected were analyzed using INI for answering the four research questions while t-test statistic was used to test all the null hypotheses at 0.05 level of significance.

Major Findings

Based on the data analyzed, the following major findings emerged:

1. Automobile technicians need improvement in twenty seven skills for servicing modern automobile engine and its support systems
2. Automobile technicians need improvement in thirteen skills for diagnosing faults in modern automobile engine and its support systems
3. Automobile technicians need improvement in nine skills for repairing faults on modern automobile engine and its support systems.
4. There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical) and practicing automobile technicians in Plateau state on skills improvement needs of automobile technicians for servicing the modern automobile engine and its support systems.
5. There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in Plateau state on skills improvement needs

of the automobile technician for diagnosing faults in modern automobile engine and its support systems.

6. There was no significant difference between the mean responses of lecturers/instructors of automobile technology in Polytechnics/Colleges of Education (Technical), and practicing automobile technicians in

Plateau state on skills improvement needs of the automobile technicians for repairing faults on modern automobile engine and its support systems.

Implication of the study

The findings of this study have implication for teachers, lecturers, and instructors of automobile technology in colleges of technology, monotechnics, polytechnics, and colleges of education (technical). The findings also have implication for stakeholders in the automobile industry in Nigeria most especially the automobile maintenance sector whose lifeline is the practicing automobile technicians, curriculum planners and developers/regulating bodies of the technical and vocational education programmes and government.

Teachers, lecturers, and instructors of automobile technology in colleges of technology, monotechnics, polytechnics and colleges of education (technical) will have to seek to improve their knowledge and skills based on the areas of skills that need improvement in line with globally accepted standard practices which emerge with the technological innovations in modern automobile and the challenges raised by its maintenance. Since the product of these vocational and technical institutions i. e. the automobile maintenance technicians cannot be above their producers i.e. teachers, lecturers and instructors, therefore,

government which is a major employer of these stakeholders, should give them all and every motivation and support needed in order to attain to the improvement needs raised by this study. This could be achieved through grants for research, organizing of seminars, workshops and conferences.

This will therefore raise the need for deliberate plans for the development of technical and vocational teachers, lecturers, and instructors in automobile trades and technology through industrial training programmes in line with the skill items that need improvement. The automobile industry in Nigeria should accept the findings of this study and seek ways of retraining practicing automobile technicians particularly those in the maintenance sector to enhance skill improvement in areas of deficiency which have been pointed out in the findings of this study. This will enable the technicians to satisfactorily service the modern automobile engine and its support system, exhaustively diagnose faults and to satisfactorily and completely repair or fix the diagnosed faults on the modern automobile engine and its support systems. This is the globally accepted standard for effective maintenance of modern automobile. Developed countries like the USA and European countries achieve such standards through associations which work together with government under appropriate legislature to update and certify technicians for accepted standard practices.

Curriculum planners in the technical and vocational education programmes can consider areas of skills improvement needs pointed out by this study to improve and develop their curriculum. Proper regulatory legislature is necessary to ensure review of such curriculum on a regular basis

to reflect technological innovations, most especially in the automobile industry. The impact of automobile on the society is great coupled with the fleet of automobiles being imported into the country on a daily basis, it is therefore very vital that the automobile maintenance technicians need to improve their skills in line with the areas of improvement needs raised by this study to effectively carry out the required maintenance.

Conclusion

The tasks expected of the automobile technicians are to satisfactorily service the automobile engine and its support systems, to exhaustively diagnose any faults, and to completely repair or fix any problem on the modern automobile. But observation revealed that the majority of the technicians have deficiency in the skills needed to carry out the aforementioned tasks which are the indices for effective maintenance on the modern automobile. This study was therefore carried out to determine the improvement needs of automobile technicians for effective maintenance of modern automobile in plateau state of Nigeria.

Based on the findings of this study, practicing automobile technicians in Plateau State were found to be deficient in 49 skill items needed to carry out effective maintenance on modern automobile (27 items for servicing, 13 for diagnosing, and 9 for repairs). This deficiency could be traced to lack of knowledge of technological innovations in the

automobile technology and industry and inability to embrace retraining and research. It may also be as a result of professional skill deficiency on the part of trainers, lecturers and instructors of automobile technology in the institutions concerned.

It therefore means that concerted effort should be made by all stakeholders to improve this trend, which has left the automobile maintenance sector at a rudimentary level with obsolete skills possessed by the maintenance technicians. Efforts would have to be made to enhance the machinery of training and retraining of teachers, lecturers and instructors as well as the practicing automobile technicians.

Recommendations

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

1. The identified 49 skill items which need improvement by practicing automobile maintenance technicians should be utilised for retraining of the technicians for effective maintenance of modern automobiles.
2. These identified areas of deficiency should be considered and incorporated into the curriculum by curriculum planners and vocational/technical institutions for improving their training programmes to meet up with globally accepted modern practices in

line with the trend of technological innovations in automobile technology and industry.

3. There should be progressive training and retraining of teachers, lecturers and instructors in line with the areas of skill deficiency to equip them with professional and technical skills for meeting the training needs of their trainees and potential technicians
4. Government, automobile industries and professional vocational associations should organize seminars and workshops for automobile technicians in order to build their capacity on how to effectively maintain modern vehicles in the society. Evening programmes should be established as vocational improvement centres under the entrepreneurial programmes of monotechnics, polytechnics, and colleges of education (technical).
5. All the skills acquisition centres in the study area should be equipped with necessary tools and machines for training automobile technicians.
6. Government and members of society should equip all the training institutions with modern tools, machines and equipment and qualified personnel for effective teaching and learning

Suggestion for further Study

The following are suggested for further studies:

1. Capacity building needs of lecturers for effective teaching of automobile technology to students in colleges of education or universities in Nigeria.
2. Competency improvement needs of automobile technology teachers for effective teaching in technical colleges in Nigeria
3. Work skills improvement need of graduates of automobile technology for employment in contemporary society
4. Evaluation of automobile technology programme of technical colleges in Plateau State of Nigeria.

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APPENDICES

APPENDIX 'A'

Department of Vocational Teacher Education
(Industrial Technical Education)
University of Nigeria, Nsukka
DATE:

Dear Sir/Madam,

REQUEST FOR VALIDATION OF RESEARCH INSTRUMENT

I am a post graduate student of Industrial Technical Education (Mechanical Technology) in the department of Vocational Teacher Education, University of Nigeria, Nsukka, currently undertaking a research project aimed at identifying **skills improvement needs of automobile technicians for effective maintenance of modern automobile in plateau state.**

Attached is the purpose of the study, research questions, hypotheses and a draft copy of the questionnaire for the study. You are please requested to vet the items for clarity, relevance and total coverage for use in collecting data for the study. You may also put down your comments and suggestions to improve the quality of the instrument.

Thank you
Yours faithfully,

MACHIEF, P.E.
PG/M.ED/08/49570

Validate's
Name ----------

Department ----------

Institution --

Sign/Date ---

APPENDIX 'B'

Department of Vocational Teacher Education

(Industrial Technical Education)

University of Nigeria, Nsukka

DATE:

Dear Respondents,

REQUEST TO FILL QUESTIONNAIRE

I am a post graduate student in the above Department and University currently undertaking a research project titled: **skills improvement needs of automobile technicians for effective maintenance of modern automobile in plateau state.**

The attached questionnaire schedule is to elicit the necessary information. You are please requested to respond to the items as objectively as possible. All information supplied will be treated confidentially and will be used strictly for this research.

Thank you

Yours faithfully,

MACHIEF, P.E.

PG/M.ED/08/49570

Researcher

APPENDIX 'C'

QUESTIONNAIRE FOR LECTURERS/INSTRUCTORS OF AUTOMOBILE TECHNOLOGY, AND PRACTICING AUTOMOBILE TECHNICIANS FOR IDENTIFYING SKILLS IMPROVEMENT NEEDS OF AUTOMOBILE TECHNICIANS FOR EFFECTIVE MAINTENANCE OF MODERN AUTOMOBILE IN PLATEAU STATE

SECTION A: Personal Data

Please carefully read the following statements and write down your responses in the space provided or check (√) against the response that best applies to you. All information will be kept confidential and used only for the purpose of this research work.

What is your status?

1. Lecturer/Instructor ( )
2. Practicing Automobile Technician ( )

Name & Address of Employment/Employer ----------

INSTRUCTIONS FOR PARTS I AND II SECTIONS B_I, C_I, D_I and **B_{II}, C_{II}, D_{II}:** Please indicate the level of requirement and performance respectively for the following skills items by checking (√) against the options that best suits your view points. The response options and their corresponding points are:

Part I: Required Category

Highly Required (HR) = 4

Required (R) = 3

Averagely Required (AR) = 2

Not Required (NR) = 1

Part II: Performance Category

High Performance (HP) = 4

Average Performance (AP) = 3

Low Performance (LP) = 2

No Performance (NP) = 1

PART I: REQUIRED CATEGORY

SECTION B_I: Skills required by automobile technicians for servicing of the modern automobile engine and its support systems

S/No	ITEMS STATEMENT **Ability to:**	RESPONSE			
		HR4	R3	AR2	NR1
1.	Understand how the engine system works				
2.	Understand circuit boards				
3.	Understand processor chips				
4.	Understand computer application				
5.	Identify engineering materials				
6.	Read charts and service manuals				
7.	understand charts and service manuals				
8.	Interpret charts and service manuals				
9.	Carry out checklist service on the engine				
10.	Inspect electronic ignition system components				
11.	Use oscilloscope to set ignition timing				
12.	Carry out engine tune-ups				
13.	Carry out inspection for wear on the engine components				
14.	Test and identify extent of wear on the engine components				
15.	Use pressure gauges and to determine cylinder pressure				
16.	Understand pressure gauges and to determine cylinder pressure				
17.	Interpret pressure gauges and to determine cylinder pressure				
18.	Inspect drive belts				
19.	Adjust drive belts				
20.	Replace drive belts				
21.	Inspect cooling system components (radiator, thermostat and hoses)				
22.	Inspect coolant in the cooling system				

23.	Drain, flush and refill cooling system with recommended coolant				
24.	Perform oil and lubrication services on the engine				
25.	Inspect and adjust cylinder valves				
26.	Use dial gauges				
27.	Interpret engine analyser tests				
28.	Identify and isolate abnormal sounds				
29.	Remove and reinstall engine cylinder head using correct torque specification				
30.	Use modern/digital measuring instrument and tools				
31.	Work within stipulated time				
32.	Identify genuine spare parts				
33.	Read journals of automobile technology and innovations				
34.	Surf the internet for relevant contemporary technological knowledge				

SECTION C_I: Skills required by the automobile technicians for diagnosing of faults in modern automobile engine and its support systems

S/NO	ITEMS STATEMENTS **Ability to:**	RESPONSES			
		HR 4	R 3	AR 2	NR 1
35	Understand journals to update knowledge on latest technological development in automobile				
36	Read and understand blue prints/technical drawings, and charts				
37	Think critically and to possess investigative attitude				
38	Handle well, modern diagnostic equipment (i. e. perform On-Board- Diagnoses (OBD))				
39	Critically analyse and interpret faults from diagnosis results				
40	Understand computer controls on the engine				
41	Understand how the engine and other systems work				
42	Conduct engine testing, inspection and examination				
43	Inspect lubrication system and components,				
44	Inspect ignition system and components,				
45	Inspect fuel system and components,				
46	Inspect cooling system and components				
47	Inspect starter circuit and components				
48	conduct engine performance test using engine analyser				
49	distinguish abnormal sounds in the engine				
50	localise such sounds to specific components or systems				
51	Confidently determine needed repairs on components and systems being diagnosed				

SECTION D_I: Skills required by automobile technicians for repairs or fixing of faults on modern automobile engine and its support systems

S/NO	ITEMS STATEMENT **Ability to:**	RESPONSES			
		HR 4	R 3	AR 2	NR 1
52	Determine the needed repairs				
53	Choose the right tools needed for the expected repairs				
54	Use precision measuring devices for modern automobile repair work				
55	Read, understand and follow sequentially assembly blue prints, repair manuals and specifications				
56	Remove the engine for overhaul				
57	Disassemble and re-assemble the engine in correct sequence				
58	Remove and replace cylinder head using correct torque				
59	Test assembled engine				
60	Verify and certify performance				
61	Repair and replace damaged components/parts in engine and systems				
62	Diagnose and carry out needed repairs on the emission system				
63	Carry out modification (technological design to generate or adopt equipment and technology to serve user need)				

PART II: PERFORMANCE CATIGORY

SECTION B_{II}: Skills performance by automobile technicians for servicing of the modern automobile engine and its support systems

S/No	ITEMS STATEMENT **Ability to:**	RESPONSE			
		HP4	AP3	LP2	NP1
1.	Understand how the engine system works				
2.	Understand circuit boards				
3.	Understand processor chips				
4.	Understand computer application				
5.	Identify engineering materials				
6.	Read charts and service manuals				
7.	understand charts and service manuals				
8.	Interpret charts and service manuals				
9.	Carry out checklist service on the engine				
10.	Inspect electronic ignition system components				
11.	Use oscilloscope to set ignition timing				
12.	Carry out engine tune-ups				
13.	Carry out inspection for wear on the engine components				
14.	Test and identify extent of wear on the engine components				
15.	Use pressure gauges and to determine cylinder pressure				
16.	Understand pressure gauges and to determine cylinder pressure				
17.	Interpret pressure gauges and to determine cylinder pressure				
18.	Inspect drive belts				
19.	Adjust drive belts				
20.	Replace drive belts				
21.	Inspect cooling system components (radiator, thermostat and hoses)				
22.	Inspect coolant in the cooling system				

23.	Drain, flush and refill cooling system with recommended coolant				
24.	Perform oil and lubrication services on the engine				
25.	Inspect and adjust cylinder valves				
26.	Use dial gauges				
27.	Interpret engine analyser tests				
28.	Identify and isolate abnormal sounds				
29.	Remove and reinstall engine cylinder head using correct torque specification				
30.	Use modern/digital measuring instrument and tools				
31.	Work within stipulated time				
32.	Identify genuine spare parts				
33.	Read journals of automobile technology and innovations				
34.	Surf the internet for relevant contemporary technological knowledge				

SECTION C_{II}: Skills performance by the automobile technicians for diagnosing of faults in modern automobile engine and its support systems

S/NO	ITEMS STATEMENTS **Ability to:**	RESPONSES			
		HP 4	AP 3	LP 2	NP 1
36	Read and understand blue prints/technical drawings, and charts				
37	Think critically and to possess investigative attitude				
38	Handle well, modern diagnostic equipment (i. e. perform On-Board- Diagnoses (OBD))				
39	Critically analyse and interpret faults from diagnosis results				
40	Understand computer controls on the engine				
41	Understand how the engine and other systems work				
42	Conduct engine testing, inspection and examination				
43	Inspect lubrication system and components,				
44	Inspect ignition system and components,				
45	Inspect fuel system and components,				
46	Inspect cooling system and components				
47	Inspect starter circuit and components				
48	conduct engine performance test using engine analyser				
49	distinguish abnormal sounds in the engine				
50	localise such sounds to specific components or systems				
51	Confidently determine needed repairs on components and systems being diagnosed				

SECTION D_{II}: Skills performance by automobile technicians for repairs or fixing of faults on modern automobile engine and its support systems

S/NO	ITEMS STATEMENT **Ability to:**	RESPONSES			
		HP 4	AP 3	LP 2	NP 1
52	Determine the needed repairs				
53	Choose the right tools needed for the expected repairs				
54	Use precision measuring devices for modern automobile repair work				
55	Read, understand and follow sequentially assembly blue prints, repair manuals and specifications				
56	Remove the engine for overhaul				
57	Disassemble and re-assemble the engine in correct sequence				
58	Remove and replace cylinder head using correct torque				
59	Test assembled engine				
60	Verify and certify performance				
61	Repair and replace damaged components/parts in engine and systems				
62	Diagnose and carry out needed repairs on the emission system				
63	Carry out modification (technological design to generate or adopt equipment and technology to serve user need)				

APPENDIX 'D'
DISTRIBUTION OF TARGET POPULATION

Table 1
Distribution of Target Population According Practicing Automobile Technicians

S/No.	Senatorial Zone	Population
1	Northern Zone	23
2	Central Zone	36
3	Southern Zone	6
Total		65

Source: Plateau State Ministry of Commerce Industries and Tourism (2007)

Table 2
Distribution of Target Population According to Institutions

Institution	FCE Pankshin	PSP Barakin Ladi	TOTAL
Lecturers/Instructors	5	9	14

Source: Institutions Concern

APPENDIX 'E'
RESULT OF THE ANALYSIS USING SPSS

RQ 1

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ITEMB1	79	1.00	4.00	3.7848	.52308
ITEMB2	79	1.00	4.00	3.2405	.85057
ITEMB3	79	1.00	4.00	2.9494	.91845
ITEMB4	79	1.00	4.00	3.2025	.97901
ITEMB5	79	1.00	4.00	3.3797	.78941
ITEMB6	79	1.00	4.00	3.4051	.68909
ITEMB7	79	1.00	4.00	3.2658	.74608
ITEMB8	79	1.00	4.00	3.2405	.78797
ITEMB9	79	1.00	4.00	3.1519	.89283
ITEMB10	79	1.00	4.00	3.2785	.73269
ITEMB11	79	1.00	4.00	2.9241	.79698
ITEMB12	79	1.00	4.00	3.1139	.84713
ITEMB13	79	1.00	4.00	3.3924	.75816
ITEMB14	79	1.00	4.00	3.3418	.76604
ITEMB15	79	1.00	4.00	3.1519	.81789
ITEMB16	79	1.00	4.00	3.1013	.77782
ITEMB17	79	1.00	4.00	2.9873	.79249
ITEMB18	79	1.00	4.00	3.1139	.87687
ITEMB19	79	1.00	4.00	2.8481	.97519
ITEMB20	79	1.00	4.00	3.0380	.83885
ITEMB21	79	1.00	4.00	3.3924	.72355
ITEMB22	78	1.00	4.00	3.3205	.78117
ITEMB23	79	1.00	4.00	3.1392	.79637
ITEMB24	79	2.00	4.00	3.6203	.58406
ITEMB25	79	1.00	4.00	3.3544	.75172
ITEMB26	79	1.00	4.00	3.0886	.77111
ITEMB27	79	1.00	4.00	3.1772	.87354
ITEMB28	79	1.00	4.00	3.3797	.83672
ITEMB29	79	1.00	4.00	3.3924	.79126
ITEMB30	79	1.00	4.00	3.3291	.81211
ITEMB31	79	1.00	4.00	2.9747	.89119
ITEMB32	79	1.00	4.00	3.4684	.81391
ITEMB33	79	1.00	4.00	3.3797	.73909
ITEMB34	79	1.00	4.00	3.3418	.78260
Valid N (listwise)	78				

RQ2

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ITEMC35	79	1.00	4.00	3.4304	.85760
ITEMC36	79	1.00	4.00	3.3544	.84789
ITEMC37	79	1.00	4.00	3.3797	.70354
ITEMC38	79	1.00	4.00	3.3291	.77990
ITEMC39	79	1.00	4.00	3.2405	.70192
ITEMC40	79	1.00	4.00	3.2405	.81987
ITEMC41	79	1.00	4.00	3.4810	.81431
ITEMC42	79	1.00	4.00	3.5063	.71385
ITEMC43	79	1.00	4.00	3.4684	.76520
ITEMC44	79	1.00	4.00	3.3038	.70446
ITEMC45	79	1.00	4.00	3.2405	.89464
ITEMC46	79	1.00	4.00	3.2532	.79208
ITEMC47	79	1.00	4.00	3.4557	.69425
ITEMC48	79	1.00	4.00	3.4177	.79433
ITEMC49	79	1.00	4.00	3.2911	.81888
ITEMC50	79	1.00	4.00	3.2405	.78797
ITEMC51	79	1.00	4.00	3.4304	.76265
Valid N (listwise)	79				

RQ3

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ITEMD52	79	1.00	4.00	3.7342	.57085
ITEMD53	79	2.00	4.00	3.6456	.55558
ITEMD54	79	2.00	4.00	3.5443	.55000
ITEMD55	79	2.00	4.00	3.4684	.57368
ITEMD56	79	1.00	4.00	3.0506	.78281
ITEMD57	79	2.00	4.00	3.4937	.61755
ITEMD58	79	1.00	4.00	3.2532	.70653
ITEMD59	79	2.00	4.00	3.5316	.63721
ITEMD60	79	2.00	4.00	3.5696	.65405
ITEMD61	79	2.00	4.00	3.5190	.61729
ITEMD62	79	2.00	4.00	3.3418	.67721
ITEMD63	79	1.00	4.00	3.4430	.67457
Valid N (listwise)	79				

H01

Group Statistics

	STATUS	N	Mean	Std. Deviation	Std. Error Mean
ITEMB1	lecturers	20	3.6000	.75394	.16859
	Autotechnicians	59	3.8475	.40741	.05304
ITEMB2	lecturers	20	3.3000	.80131	.17918
	Autotechnicians	59	3.2203	.87233	.11357
ITEMB3	lecturers	20	3.0500	.75915	.16975
	Autotechnicians	59	2.9153	.97004	.12629
ITEMB4	lecturers	20	3.1000	1.02084	.22827
	Autotechnicians	59	3.2373	.97094	.12641
ITEMB5	lecturers	20	3.3000	.65695	.14690
	Autotechnicians	59	3.4068	.83291	.10844
ITEMB6	lecturers	20	3.3000	.57124	.12773
	Autotechnicians	59	3.4407	.72567	.09447
ITEMB7	lecturers	20	3.0500	.88704	.19835
	Autotechnicians	59	3.3390	.68507	.08919
ITEMB8	lecturers	20	3.1500	.67082	.15000
	Autotechnicians	59	3.2712	.82693	.10766
ITEMB9	lecturers	20	3.1500	.93330	.20869
	Autotechnicians	59	3.1525	.88695	.11547
ITEMB10	lecturers	20	3.4000	.50262	.11239
	Autotechnicians	59	3.2373	.79522	.10353
ITEMB11	lecturers	20	2.9500	.82558	.18460
	Autotechnicians	59	2.9153	.79412	.10339
ITEMB12	lecturers	20	3.1000	.96791	.21643
	Autotechnicians	59	3.1186	.81123	.10561
ITEMB13	lecturers	20	3.3500	.81273	.18173
	Autotechnicians	59	3.4068	.74553	.09706
ITEMB14	lecturers	20	3.4000	.75394	.16859
	Autotechnicians	59	3.3220	.77550	.10096
ITEMB15	lecturers	20	3.2000	.89443	.20000
	Autotechnicians	59	3.1356	.79779	.10386
ITEMB16	lecturers	20	3.3000	.86450	.19331
	Autotechnicians	59	3.0339	.74199	.09660
ITEMB17	lecturers	20	3.0000	.72548	.16222
	Autotechnicians	59	2.9831	.81983	.10673
ITEMB18	lecturers	20	3.2500	.85070	.19022
	Autotechnicians	59	3.0678	.88793	.11560
ITEMB19	lecturers	20	3.0000	.79472	.17770
	Autotechnicians	59	2.7966	1.03023	.13412
ITEMB20	lecturers	20	3.1000	.78807	.17622
	Autotechnicians	59	3.0169	.86086	.11207
ITEMB21	lecturers	20	3.4500	.68633	.15347

	Autotechnicians	59	3.3729	.74042	.09639
ITEMB22	lecturers	20	3.2500	.71635	.16018
	Autotechnicians	58	3.3448	.80681	.10594
ITEMB23	lecturers	20	3.4500	.68633	.15347
	Autotechnicians	59	3.0339	.80870	.10528
ITEMB24	lecturers	20	3.7500	.44426	.09934
	Autotechnicians	59	3.5763	.62155	.08092
ITEMB25	lecturers	20	3.3500	.81273	.18173
	Autotechnicians	59	3.3559	.73725	.09598
ITEMB26	lecturers	20	2.8500	.87509	.19568
	Autotechnicians	59	3.1695	.72284	.09411
ITEMB27	lecturers	20	2.7500	1.11803	.25000
	Autotechnicians	59	3.3220	.72968	.09500
ITEMB28	lecturers	20	3.5000	.82717	.18496
	Autotechnicians	59	3.3390	.84303	.10975
ITEMB29	lecturers	20	3.4500	.82558	.18460
	Autotechnicians	59	3.3729	.78561	.10228
ITEMB30	lecturers	20	3.0500	.88704	.19835
	Autotechnicians	59	3.4237	.77021	.10027
ITEMB31	lecturers	20	2.8500	.87509	.19568
	Autotechnicians	59	3.0169	.90003	.11717
ITEMB32	lecturers	20	3.4500	.99868	.22331
	Autotechnicians	59	3.4746	.75100	.09777
ITEMB33	lecturers	20	3.2000	.83351	.18638
	Autotechnicians	59	3.4407	.70151	.09133
ITEMB34	lecturers	20	3.1000	1.02084	.22827
	Autotechnicians	59	3.4237	.67475	.08785

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence nterval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ITEMB1	Equal variances assumed	10.044	.002	-1.857	77	.067	-.24746	.13327	-.51283	.01792
	Equal variances not assumed			-1.400	22.874	.175	-.24746	.17673	-.61317	.11825
ITEMB2	Equal variances assumed	.183	.670	.360	77	.720	.07966	.22132	-.36104	.52036
	Equal variances not assumed			.376	35.457	.710	.07966	.21214	-.35081	.51013
ITEMB3	Equal variances assumed	3.535	.064	.565	77	.574	.13475	.23869	-.34055	.61004
	Equal variances not assumed			.637	41.670	.528	.13475	.21158	-.29233	.56182
ITEMB4	Equal variances assumed	.017	.898	-.540	77	.591	-.13729	.25447	-.64401	.36943
	Equal variances not assumed			-.526	31.470	.602	-.13729	.26093	-.66913	.39456

ITEMB5	Equal variances assumed	.763	.385	-.520	77	.604	-.10678	.20522	-.51542	.30186
	Equal variances not assumed			-.585	41.328	.562	-.10678	.18259	-.47543	.26187
ITEMB6	Equal variances assumed	2.394	.126	-.787	77	.434	-.14068	.17874	-.49659	.21523
	Equal variances not assumed			-.885	41.413	.381	-.14068	.15887	-.46143	.18008
ITEMB7	Equal variances assumed	.353	.554	-1.509	77	.135	-.28898	.19148	-.67027	.09231
	Equal variances not assumed			-1.329	27.097	.195	-.28898	.21748	-.73514	.15717
ITEMB8	Equal variances assumed	6.826	.011	-.592	77	.556	-.12119	.20474	-.52887	.28650
	Equal variances not assumed			-.656	40.128	.515	-.12119	.18463	-.49431	.25194
ITEMB9	Equal variances assumed	.293	.590	-.011	77	.991	-.00254	.23251	-.46553	.46045
	Equal variances not assumed			-.011	31.449	.992	-.00254	.23851	-.48870	.48362
ITEMB10	Equal variances assumed	4.163	.045	.857	77	.394	.16271	.18990	-.21544	.54086
	Equal variances not assumed			1.065	52.534	.292	.16271	.15281	-.14384	.46927
ITEMB11	Equal variances assumed	.283	.596	.167	77	.867	.03475	.20751	-.37847	.44796
	Equal variances not assumed			.164	31.764	.871	.03475	.21158	-.39636	.46585
ITEMB12	Equal variances assumed	1.954	.166	-.085	77	.933	-.01864	.22060	-.45791	.42062
	Equal variances not assumed			-.077	28.595	.939	-.01864	.24082	-.51149	.47420
ITEMB13	Equal variances assumed	.004	.949	-.288	77	.774	-.05678	.19734	-.44972	.33616
	Equal variances not assumed			-.276	30.570	.785	-.05678	.20603	-.47721	.36365
ITEMB14	Equal variances assumed	.004	.947	.391	77	.697	.07797	.19930	-.31888	.47481
	Equal variances not assumed			.397	33.655	.694	.07797	.19651	-.32153	.47746
ITEMB15	Equal variances assumed	.379	.540	.303	77	.763	.06441	.21287	-.35947	.48828
	Equal variances not assumed			.286	29.917	.777	.06441	.22536	-.39590	.52471
ITEMB16	Equal variances assumed	1.770	.187	1.329	77	.188	.26610	.20028	-.13270	.66490
	Equal variances not assumed			1.231	29.080	.228	.26610	.21610	-.17582	.70803
ITEMB17	Equal variances assumed	1.014	.317	.082	77	.935	.01695	.20637	-.39399	.42789
	Equal variances not assumed			.087	36.754	.931	.01695	.19418	-.37660	.41049
ITEMB18	Equal variances assumed	.386	.536	.801	77	.425	.18220	.22741	-.27063	.63503
	Equal variances not assumed			.819	34.102	.419	.18220	.22259	-.27011	.63452
ITEMB19	Equal variances assumed	2.855	.095	.804	77	.424	.20339	.25290	-.30020	.70697
	Equal variances not assumed			.914	42.315	.366	.20339	.22264	-.24582	.65260
ITEMB20	Equal variances assumed	.000	.982	.381	77	.705	.08305	.21825	-.35154	.51764
	Equal variances not assumed			.398	35.573	.693	.08305	.20884	-.34067	.50677
ITEMB21	Equal variances assumed	.131	.719	.410	77	.683	.07712	.18822	-.29768	.45192
	Equal variances not assumed			.426	35.156	.673	.07712	.18123	-.29074	.44498
ITEMB22	Equal variances assumed	1.016	.317	-.466	76	.643	-.09483	.20360	-.50034	.31068
	Equal variances not assumed			-.494	36.903	.624	-.09483	.19204	-.48398	.29433
ITEMB23	Equal variances assumed	.126	.724	2.061	77	.043	.41610	.20190	.01407	.81813
	Equal variances not assumed			2.236	38.313	.031	.41610	.18611	.03944	.79276
ITEMB24	Equal variances assumed	5.819	.018	1.152	77	.253	.17373	.15081	-.12656	.47402
	Equal variances not assumed			1.356	45.951	.182	.17373	.12813	-.08418	.43164

ITEMB25	Equal variances assumed	.027	.869	-.030	77	.976	-.00593	.19576	-.39574	.38388
	Equal variances not assumed			-.029	30.306	.977	-.00593	.20552	-.42548	.41362
ITEMB26	Equal variances assumed	.241	.625	-1.618	77	.110	-.31949	.19748	-.71273	.07375
	Equal variances not assumed			-1.471	28.309	.152	-.31949	.21713	-.76404	.12506
ITEMB27	Equal variances assumed	6.964	.010	-2.625	77	.010	-.57203	.21795	-1.00602	-.13805
	Equal variances not assumed			-2.139	24.714	.043	-.57203	.26744	-1.12316	-.02091
ITEMB28	Equal variances assumed	.335	.565	.742	77	.461	.16102	.21712	-.27133	.59337
	Equal variances not assumed			.749	33.380	.459	.16102	.21507	-.27636	.59840
ITEMB29	Equal variances assumed	.000	.993	.375	77	.709	.07712	.20587	-.33283	.48706
	Equal variances not assumed			.365	31.483	.717	.07712	.21104	-.35304	.50728
ITEMB30	Equal variances assumed	.030	.863	-1.804	77	.075	-.37373	.20716	-.78623	.03877
	Equal variances not assumed			-1.682	29.325	.103	-.37373	.22225	-.82807	.08061
ITEMB31	Equal variances assumed	.022	.881	-.722	77	.473	-.16695	.23130	-.62753	.29363
	Equal variances not assumed			-.732	33.651	.469	-.16695	.22808	-.63063	.29674
ITEMB32	Equal variances assumed	.999	.321	-.116	77	.908	-.02458	.21194	-.44660	.39745
	Equal variances not assumed			-.101	26.661	.920	-.02458	.24378	-.52506	.47591
ITEMB33	Equal variances assumed	.023	.881	-1.263	77	.210	-.24068	.19051	-.62003	.13867
	Equal variances not assumed			-1.160	28.678	.256	-.24068	.20755	-.66538	.18402
ITEMB34	Equal variances assumed	4.198	.044	-1.615	77	.110	-.32373	.20044	-.72285	.07539
	Equal variances not assumed			-1.324	24.866	.198	-.32373	.24459	-.82760	.18014

H02

Group Statistics

	STATUS	N	Mean	Std. Deviation	Std. Error Mean
ITEMC35	lecturers	20	3.2000	1.00525	.22478
	Autotechnicians	59	3.5085	.79596	.10362
ITEMC36	lecturers	20	3.4000	.82078	.18353
	Autotechnicians	59	3.3390	.86324	.11238
ITEMC37	lecturers	20	3.1500	.58714	.13129
	Autotechnicians	59	3.4576	.72687	.09463
ITEMC38	lecturers	20	3.3000	.65695	.14690
	Autotechnicians	59	3.3390	.82232	.10706
ITEMC39	lecturers	20	3.3000	.47016	.10513
	Autotechnicians	59	3.2203	.76717	.09988
ITEMC40	lecturers	20	3.2500	.85070	.19022
	Autotechnicians	59	3.2373	.81662	.10631
ITEMC41	lecturers	20	3.7000	.47016	.10513
	Autotechnicians	59	3.4068	.89286	.11624
ITEMC42	lecturers	20	3.6000	.68056	.15218
	Autotechnicians	59	3.4746	.72768	.09474
ITEMC43	lecturers	20	3.5000	.68825	.15390

	Autotechnicians	59	3.4576	.79485	.10348
ITEMC44	lecturers	20	3.3500	.48936	.10942
	Autotechnicians	59	3.2881	.76679	.09983
ITEMC45	lecturers	20	3.4500	.60481	.13524
	Autotechnicians	59	3.1695	.96762	.12597
ITEMC46	lecturers	20	3.2500	.63867	.14281
	Autotechnicians	59	3.2542	.84268	.10971
ITEMC47	lecturers	20	3.5000	.68825	.15390
	Autotechnicians	59	3.4407	.70151	.09133
ITEMC48	lecturers	20	3.6500	.58714	.13129
	Autotechnicians	59	3.3390	.84303	.10975
ITEMC49	lecturers	20	3.3500	.74516	.16662
	Autotechnicians	59	3.2712	.84752	.11034
ITEMC50	lecturers	20	3.4500	.68633	.15347
	Autotechnicians	59	3.1695	.81267	.10580
ITEMC51	lecturers	20	3.5000	.60698	.13572
	Autotechnicians	59	3.4068	.81195	.10571

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ITEMC35	Equal variances assumed	1.423	.237	-1.399	77	.166	-.30847	.22055	-.74765	.13070
	Equal variances not assumed			-1.246	27.527	.223	-.30847	.24752	-.81588	.19893
ITEMC36	Equal variances assumed	.220	.640	.276	77	.783	.06102	.22070	-.37845	.50048
	Equal variances not assumed			.284	34.338	.778	.06102	.21521	-.37618	.49821
ITEMC37	Equal variances assumed	3.202	.077	-1.711	77	.091	-.30763	.17983	-.66572	.05046
	Equal variances not assumed			-1.901	40.306	.064	-.30763	.16184	-.63464	.01938
ITEMC38	Equal variances assumed	1.644	.204	-.192	77	.848	-.03898	.20305	-.44331	.36535
	Equal variances not assumed			-.214	40.775	.831	-.03898	.18177	-.40614	.32817
ITEMC39	Equal variances assumed	3.121	.081	.436	77	.664	.07966	.18257	-.28388	.44320
	Equal variances not assumed			.549	54.287	.585	.07966	.14501	-.21103	.37035
ITEMC40	Equal variances assumed	.479	.491	.060	77	.953	.01271	.21351	-.41243	.43786
	Equal variances not assumed			.058	31.710	.954	.01271	.21792	-.43133	.45675
ITEMC41	Equal variances assumed	6.645	.012	1.400	77	.165	.29322	.20941	-.12377	.71021
	Equal variances not assumed			1.871	63.005	.066	.29322	.15673	-.01998	.60642
ITEMC42	Equal variances assumed	.206	.651	.677	77	.501	.12542	.18535	-.24365	.49450

	Equal variances not assumed			.700	34.865	.489	.12542	.17926	-.23854	.48938
ITEMC43	Equal variances assumed	.350	.556	.213	77	.832	.04237	.19921	-.35431	.43906
	Equal variances not assumed			.228	37.550	.821	.04237	.18545	-.33320	.41795
ITEMC44	Equal variances assumed	3.029	.086	.337	77	.737	.06186	.18332	-.30317	.42690
	Equal variances not assumed			.418	51.990	.678	.06186	.14812	-.23536	.35909
ITEMC45	Equal variances assumed	3.522	.064	1.215	77	.228	.28051	.23078	-.17903	.74005
	Equal variances not assumed			1.518	53.164	.135	.28051	.18482	-.09017	.65119
ITEMC46	Equal variances assumed	1.792	.185	-.021	77	.984	-.00424	.20627	-.41498	.40651
	Equal variances not assumed			-.024	43.123	.981	-.00424	.18008	-.36738	.35891
ITEMC47	Equal variances assumed	.017	.896	.328	77	.744	.05932	.18067	-.30044	.41908
	Equal variances not assumed			.331	33.383	.742	.05932	.17896	-.30461	.42325
ITEMC48	Equal variances assumed	3.321	.072	1.526	77	.131	.31102	.20380	-.09480	.71684
	Equal variances not assumed			1.818	47.272	.075	.31102	.17112	-.03318	.65522
ITEMC49	Equal variances assumed	.129	.720	.370	77	.712	.07881	.21306	-.34545	.50308
	Equal variances not assumed			.394	36.987	.696	.07881	.19984	-.32611	.48374
ITEMC50	Equal variances assumed	.011	.916	1.384	77	.170	.28051	.20270	-.12312	.68413
	Equal variances not assumed			1.505	38.503	.141	.28051	.18640	-.09668	.65770
ITEMC51	Equal variances assumed	1.772	.187	.470	77	.640	.09322	.19832	-.30169	.48813
	Equal variances not assumed			.542	43.766	.591	.09322	.17203	-.25354	.43998

H03

Group Statistics

	STATUS	N	Mean	Std. Deviation	Std. Error Mean
ITEMD52	lecturers	20	3.7000	.57124	.12773
	Autotechnicians	59	3.7458	.57515	.07488
ITEMD53	lecturers	20	3.5000	.51299	.11471
	Autotechnicians	59	3.6949	.56490	.07354
ITEMD54	lecturers	20	3.3500	.58714	.13129
	Autotechnicians	59	3.6102	.52578	.06845
ITEMD55	lecturers	20	3.4000	.59824	.13377
	Autotechnicians	59	3.4915	.56851	.07401
ITEMD56	lecturers	20	2.9500	.94451	.21120
	Autotechnicians	59	3.0847	.72607	.09453
ITEMD57	lecturers	20	3.4500	.60481	.13524
	Autotechnicians	59	3.5085	.62623	.08153
ITEMD58	lecturers	20	3.3500	.67082	.15000
	Autotechnicians	59	3.2203	.72082	.09384
ITEMD59	lecturers	20	3.4500	.60481	.13524
	Autotechnicians	59	3.5593	.65050	.08469
ITEMD60	lecturers	20	3.6000	.59824	.13377
	Autotechnicians	59	3.5593	.67648	.08807
ITEMD61	lecturers	20	3.5000	.60698	.13572
	Autotechnicians	59	3.5254	.62577	.08147
ITEMD62	lecturers	20	3.4000	.59824	.13377
	Autotechnicians	59	3.3220	.70566	.09187
ITEMD63	lecturers	20	3.4500	.60481	.13524
	Autotechnicians	59	3.4407	.70151	.09133

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ITEMD52	Equal variances assumed	.199	.657	-.308	77	.759	-.04576	.14857	-.34160	.25008
	Equal variances not assumed			-.309	33.025	.759	-.04576	.14806	-.34699	.25546
ITEMD53	Equal variances assumed	.369	.545	-1.363	77	.177	-.19492	.14297	-.47960	.08977
	Equal variances not assumed			-1.430	35.846	.161	-.19492	.13626	-.47130	.08147
ITEMD54	Equal variances assumed	.361	.550	-1.857	77	.067	-.26017	.14013	-.53920	.01886
	Equal variances not assumed			-1.757	30.007	.089	-.26017	.14806	-.56255	.04221
ITEMD55	Equal variances assumed	.013	.910	-.614	77	.541	-.09153	.14903	-.38829	.20524

	Equal variances not assumed			-.599	31.448	.554	-.09153	.15288	-.40315	.22010
ITEMD56	Equal variances assumed	1.138	.289	-.663	77	.509	-.13475	.20328	-.53953	.27004
	Equal variances not assumed			-.582	27.019	.565	-.13475	.23139	-.60950	.34001

ITEMD57	Equal variances assumed	.066	.797	-.364	77	.717	-.05847	.16068	-.37844	.26149
	Equal variances not assumed			-.370	33.855	.713	-.05847	.15791	-.37944	.26249
ITEMD58	Equal variances assumed	.001	.972	.707	77	.482	.12966	.18340	-.23554	.49486
	Equal variances not assumed			.733	35.026	.469	.12966	.17694	-.22953	.48885
ITEMD59	Equal variances assumed	.056	.814	-.661	77	.511	-.10932	.16547	-.43882	.22018
	Equal variances not assumed			-.685	35.057	.498	-.10932	.15957	-.43324	.21460
ITEMD60	Equal variances assumed	.570	.453	.239	77	.812	.04068	.17027	-.29836	.37972
	Equal variances not assumed			.254	36.777	.801	.04068	.16016	-.28390	.36526
ITEMD61	Equal variances assumed	.040	.843	-.158	77	.875	-.02542	.16073	-.34547	.29463
	Equal variances not assumed			-.161	33.724	.873	-.02542	.15830	-.34722	.29637
ITEMD62	Equal variances assumed	1.045	.310	.443	77	.659	.07797	.17614	-.27277	.42870
	Equal variances not assumed			.480	38.354	.634	.07797	.16228	-.25045	.40638
ITEMD63	Equal variances assumed	.479	.491	.053	77	.958	.00932	.17567	-.34048	.35912
	Equal variances not assumed			.057	37.712	.955	.00932	.16319	-.32112	.33976

APPENDIX 'F'

RESULT OF THE RELIABILITY OF THE INSTRUMENT

SECTION A

Case Processing Summary

Reliability Statistics

Cronbach Alpha[a]	N of Items
.801	34

		N	%
Cases	Valid	10	100.0
	Excluded[a]	0	.0
	Total	10	100.0

SECTION B

Case Processing Summary

Reliability Statistics

Cronbach Alpha	N of Items
.762	17

		N	%
Cases	Valid	10	100.0
	Excluded[a]	0	.0
	Total	10	100.0

SECTION C

Case Processing Summary

		N	%
Cases	Valid	10	100.0
	Excluded[a]	0	.0
	Total	10	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.747	12

OVERALL

Case Processing Summary

Reliability Statistics

Cronbach's Alpha	N of Items
.850	63

		N	%
Cases	Valid	10	100.0
	Excluded[a]	0	.0
	Total	10	100.0