SKILLS REQUIRED BY TECHNOLOGY GRADUATES IN ESTABLISHING AUTOMOBILE ENTERPRISES IN MINNA METROPOLIS OF NIGER STATE

BY

AKANBI MUKHTAR GBOLAHAN

2016/1/63764TI

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOOGY, MINNA

APRIL, 2023

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOOGY, MINNA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY DEGREE (B. TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION

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DECLARATION

I AKANBI MUKHTAR GBOLAHAN **Matric No**: 2016/1/63764TI an undergraduate student of the Department of Industrial and Technology Education certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

______________________ ______________________

AKANBI MUKHTAR GBOLAHAN Signature & Date

2016/1/63764TI

CERTIFICATION

This project has been read and approved as meeting the requirements for the award of B. Tech degree in Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna.

Dr. Kareem W.B
Project Supervisor

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Head of Department

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Sign & Date

Prof. Shehu I. Y.
External Examiner

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Sign & Date

DEDICATION

The researcher hereby dedicate this project work to his family, for their support and prayers.

ACKNOWLEDGEMENTS

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ABSTRACT

This study examined the technical skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state. Five research questions were developed to guide the study and five null hypotheses were tested at 0.05 level of significance. The employed a survey research design. The study used a four-point scale questionnaire, which contains a total of 60-items, as instrument. The total population of the study was 80 respondents comprising 20 automobile Lecturers and 60 automobile industry workers, there was no sampling because of the manageable size of the population. Mean, standard deviation was used to analyze the research questions while T-test was used to test the hypothesis. The findings of the study revealed the Connect the diagnostic device to the 16-pin on-board diagnostic connector, Removing and replacing electronics faulty injectors, Examine fluid level for leakage from the transmission vent, Check the operation of the braking system, adjust and repair according to the manufactures specification, Connect the vehicle on-board computer to a laptop using an interface and an on-board diagnostic software, Check and retrieve diagnostic trouble codes and freeze frame data stored in the electronic control module memory. The study recommended among other things, the curriculum for training auto-mechanic instructors should also be reviewed to include modern automobile technologies in order to prepare teachers and instructors who will be able to implement the curriculum with the new contents for the technical college programmes.

TABLE OF CONTENT

CHAPTER TWO

CHAPTER THREE

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

Technical Vocational Education and Training (TVET) is a type of education designed to equip individuals with competencies in an occupational trade for the technological and economic development of Nigeria. According to Federal Government of Nigeria (2014), TVET is described as a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the studyof technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. Part of the TVET programme is Technology Education.

Technology education allow students to go on different areas of trade which are Automobile Technology, BuildingTechnology, Electrical/Electronic Technology, Metalwork Technology, and Woodwork Technology. Automobile technology/trade is one of the vocational training offered in Technical institution in Nigeria. Classification of Automobile technology/trade in Technical institution according to NBTE (2011) include: Agricultural Implement Mechanics, Auto Electric Works, Vehicle Body Building and Motor Vehicle Mechanic’s Work. Motor Vehicle Mechanic’s Work is designed to produce competent automobile craftsmen for the technological and industrial development of Nigeria. Technology education graduate must possess revenant and adequate competencies in automobile technology.

Ernest et al. (2015) described competencies or skills as ability to do something well measured against a standard especially ability acquired through experience or training. To be skilled means having enough knowledge and attitude to do something to a satisfactory standard. Technology education graduate must possess skills in over hauling and maintenance of vehicles. Maintenance describes an action taken on anything to keep it working or to restore it to a good working condition. This ensures that a piece of equipment or item remains functional and serves us better. Technology education graduate must possess skills in maintenance of Ignition System, maintenance of fuel system, transmission system and braking system. This skills will enable them to be to effectively diagnoses any motor vehicle in the automobile enterprises

An enterprise is a venture or organized business activity which is specifically aimed at growth and profit making. In the opinion of Tambunan (2019), an enterprise is any business that is privately owned and operated, with a small number of employees and relatively low volume of sales. An enterprise may be owned and run by private individuals in which case it is called a private enterprise or may be owned by a government and so called a public enterprise. A business may also be owned and run by government and individuals in which case it becomes a joint enterprise. In the context of this study, enterprises refers to independent automobile maintenance workshops or garages undertaken by Technical College graduates of MVMW under private ownership for self-employment.

Consequently, many technology education graduate possess irrelevant and outdated skills as the Technical institutions through which they were trained, offer no mechanism for updating one's knowledge in tandem with the changing vehicle technology. There is no exception of this statement in Technical institutions in Nigeria as its MVMW graduates may have acquired little or no skills for the maintenance of modern vehicles. This underscores the background for which this study is undertaken to identify skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state.

1.2 Statement of the Problem

With advancement in technology, automobiles that are manufactured, imported or assembled in Nigeria are controlled primarily by computers, electronic components and controls that require a higher degree of sophistication for testing and servicing, as well as special diagnostic tools and instruments. Consequently, vehicle technology and maintenance processes have adversely affected transportation system in Nigeria and advanced the problems facing auto-mechanic graduates in the course of discharging their duties in the country (Adamu, 2017). Therefore, availability of adequately skilled graduates to service the ever-growing automobile population is seen as a critical area where there is a gap between the automobile industry requirements and the quality of training received by graduates of automobile technology in technical institutions.

This situation could be attributed to the deficiency of automobile technology curriculum and module specification as well as insufficient nature of college training on modern automobile technology skills which has equally restricted automobile technology graduates of technical institutions in skillfulness, efficiency, proficiency and productivity. Therefore, the study is undertaken to identify skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state.

1.3 Purpose of the Study

The purpose of this study was to identify skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state. Specifically the study will identify the following:

1. Skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprise.

2. Skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises.
3. Skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises.
4. Skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises.
5. Skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

1.4 Significance of the Study

The findings of this study would be of immense benefit to artisans, students MVMW graduates, technical teachers, National Board for Technical Education, Automobile Industries, Government and educational researchers.

Artisans (road side mechanics) who are products of the informal automobile sector or apprenticeship programme will benefit from the findings of this study by becoming more enlightened on the automobile emerging technologies and strive towards updating their knowledge and skills in line with the identified technology skills. This will enable them to keep pace with technological improvements for performing optimally and remain relevant in the modern automobile industry.

The automobile technology skills identified in this study when integrated into the curriculum could help the technical institution students of automobile technology to acquire new set of skills required for servicing and maintenance of modern vehicles. Students will also be exposed to new body of knowledge/content on modern cars so as to enhance their understanding of their working principles and how to handle complex fault in them.

The acquisition of skills identified in this study will enable automobile technology graduates to become self-reliant, self-employed and employers of labour. The findings will also enable automobile technology graduates to acquire new competencies for servicing and repair of modern vehicles in order to remain relevant in the automobile industry.

Automobile technology teachers will benefit from the findings of this study by identifying areas of automobile technology where students are deficient and on which they may need to update their technical competence for the production of enterprising graduates who will be productive in paid or self-employment. Teachers through the findings of this study will also identify out-dated technologies in curriculum content that should be given less emphasis while the emerging technologies will be given adequate recognition in the training of automobile technology students. Automobile technology teachers will equally use the findings of the study to master these new technology skills as a means of enhancement towards productivity and adaptability. Hence, updating their skills will remain paramount with constant advancement in frequent changes in automobile technology. This will be attainable when technical teachers attend planned retraining and improvement programmes that takes practical and new skills in automobile technology into cognizance.

The National Board for Technical Education which is solely responsible for planning and reviewing the technical college curriculum will through the findings of this study become aware of emerging technology skills required by automobile technology graduates in the maintenance of modern vehicles. National Board for Technical Education could use these identified skills to update the pedagogy and components of the curriculum for automobile technology in technical institution. This could make the curriculum more activity centered thereby stimulating the interest and motivation of students towards the automobile trade.

Automobile servicing companies will equally find the result of this study very beneficial when incorporated into the curriculum content of automobile technology in technical institutions as it will produce a pool of highly skilled automobile graduates (craftsmen) who will be versatile and adaptable to the dynamic nature of modern vehicles, thereby enhancing the performance and productivity of the automobile industry towards the sustenance of Nigeria's economic and industrial growth.

The findings of this study will sensitize the government on the performance gap between technical skills acquired by graduates of automobile technology in technical colleges and the requirements of modern automobile industries. Hence, the government will be encouraged to organize retraining programmes and skill improvement workshops for instructors of automobile technology whose responsibility it is to impart technical skills on students for gainful employment upon graduation.

1.5 Scope of the Study

The study will be carried out to skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state. The study will specifically cover Skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises, Skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises, Skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises, Skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises, Skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

1.6 Research Questions

The following research questions will guide the study;

1. What are the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises.
2. What are the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises.
3. What are the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises.
4. What are the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises.
5. What are the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

1.7 Hypotheses

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

H01 There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises

H02 There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises

H03 There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises

H04 There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises

H05 There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.1 Conceptual Framework

2.1.1 Concept of Skill Acquisition

People working in the specialized fields required technical and knowledge in order to meet the requirements of continually changing environment of the various woodwork industries. The basic skills are needed to function effectively in the world of work. Technical competence or skills refers to both the theoretical knowledge and practical skills required by the students in the course of their education and training in the technical colleges. It also means to acquaint the graduates with all the basic knowledge and practices which they need to be able to function effectively in the world of work (Schaltegger & Burritt, 2017).

Technical competence is also referred to, as the technical skills or industry based skills embedded in the school curriculum (Pan & Seow, 2016). According to Osuala (1998), technical skills refer to the ability to do or perform an activity in relation to some meaningful work. He further stressed that it presents challenges to the learner by integrating practical work, theoretical knowledge, common sense, observation ability and encouragement in an occupation. Okorie (2000) asserted that technical skill involve application of mental and physical activities. He also described it as ability to handle objects in a skillful manner. According to him it also enables an individual to develop physical, social, intellectual, economic and emotional capabilities. Okorie further pointed out that an individual who wants to acquire technical skills must possess qualities such as interest, ability, aptitude, practice, personality characteristics and physical qualities.

The acquisition of psychomotor skills is central in vocational technical education. Teachers of technology are therefore expected not only to possess relevant production skills but are also required to know the process of developing psychomotor skills and to focus on them when they teach their own students. This will enable the teachers to set up appropriate training techniques that will guide them in teaching students most effectively and efficiently.

An understanding of the process by which psychomotor skills are acquired is a basic condition for effective vocational education training. This process has variously been described by several scientists (Gofwen, 2007). The studies of these authors in the theories of skills acquisition have culminated into what has been known today as the six levels of steps of psychomotor skills acquisition, namely: perceiving, motivating, performing, adapting and innovation.

Perceiving with respect to teaching psychomotor skills, in vocational education, Hammond and Lamar (1988) stressed that the teacher should develop in students a strong desire to possess the manipulative ability. He should be genuinely interested in their skillful performance. It may be desirable or even necessary to have the students see a product that has been produced by a skilled person or in some cases, see the skill performance while it is in progress. This may not only motivate the students, it could develop in them an ideal. The student must know why the skill is needed if they want to possess it and they must feel the need for that ability. Merely telling them (as it is often done in theory lessons) that one ought to know how to do this will not supply a vigorous motive. The authors then concluded that the teacher should see that the students have a clear and correct picture (or perception) of what is to be achieved for motivation; otherwise not much improvement can be achieved.

Motivation in describing psychomotor skills acquisition, Sentile (1972 as cited in Gofwen, 2007) indicated that setting goals and / or solving problem must be the first step in creating motivation in the learner or trainee. Motivation involves satisfaction, needs, rewards, and/or punishment. Initial arousal of an intention seems to be prerequisite which operates as a trigger for further action. There are indications that engaging in an activity and practicing are meaningful only when the learner shows an appropriate indication of motivation. To this, Padelford (1984) states that motivation or incentive seems to be the activator and sustainer of action or thought when acquiring a psychomotor skill. Goals are an essential part of the process of acquiring psychomotor skills. They may be externally directed by another person or internally directed or both. It looks like many psychomotor skills are attained because the learner wants to, or because it feels good to the learner. It was pointed out that various kind of external stimulation and positive internal feedback make possible a high level of achievement in psychomotor skills. In teaching and learning process both internal and external sources of motivation should be employed. Without effective motivation or incentive which may lead to imitation, psychomotor skills would not be acquired or may be poorly attained at best.

Imitation is the stage where the learner is involved in mental manipulation of the form, pattern, or sequence and or mimicking a series of patterns or procedures. In psychomotor skill acquisition, therefore, the learner receives the necessary cues, mentally manipulates the cues and organizes them into a series of set before attempting to perform a function.

As a practical ways of assisting students to imitate Gall (1981) advised that the teacher should ask the students to name the important steps in doing what they are now ready to learn to do. Furthermore, the teacher should demonstrate the procedure, if it is difficult for the students to understand. Usually in learning from a demonstration, the students watch being done, and then try their hands, at doing what was demonstrated. The teacher should show and explain how to perform each operation step by step. The students should be made to go through the process each trying his hand at it. Performing operation is necessary to acquiring the skill; knowledge and imitation alone cannot develop a manipulative skill.

Performing, by same authors point to the fact that practice is necessary pre-requisite for learning a task and learning process with an increase in the amount of practice. Students in vocational technical education need to be given enough opportunities to practice what they are being though in theory lessons. Usually, the students will need to develop considerable skill before using operation on a large scale or on a valuable piece of work. To develop this degree of skill, repeated practice exercise may be used which involves various operations and standard of workmanship, Olaitan, (1999) stated that work experience will be effective in proportion to the specific experience for training habits of doing and thinking through repetitive performance. When such is done students may be able to adopt well.

Adaption is the ability to perform expertly to the ultimate goal of most psychomotor skill training but ideally it should go beyond that. Padelford (1984) recommended that certain psychomotor skill should be adapted to new situations (a sort of transfer of learning). Adapting according to Padelford, involves diagnosing and problem solving and the added dimension of creativity. Automatic action may be easier to evaluate, but vocational technical teachers should equally emphasize adaptive learning. This stem from the fact that transfer of learning is often required in problem solving situation which is a typical characteristic of the productive or service world. Adoption may bring about innovation.

Innovation is the highest level of psychomotor skill acquisition, which emphasizes the ability to experiment and create new forms of the learned skill. Singer (1981) stressed that the opportunity to express feelings and to gain a feeling of self-actualization are inherent in the innovative act. Innovation presents a challenge and an opportunity for fulfillment and positive self-concept. Expressing and symbolizing need not be restricted to the other fields of Endeavour but equally applicable to the fields of industry. Indeed, in the words of Padelford (1984) "that uniqueness and variation from standard forms characterize creative activity.

Innovation requires all the domains of learning and creativity, and much feedback. The need to provide adequate exposure to students who are enrolled in vocational technical programmed in practical skill areas while in school has variously been emphasized by vocational and technical educators. Olaitan,(1999) for instance observed that vocational technical education is education for work, hence technical teachers should expose trainees to learning in job related models and in an environment that depicts real work situations.

2. 1.2 Skills in the Maintenance of Automobile Engine System

The engine is the power plant of a vehicle. Engine system provides the energy to propel (move) the vehicle and operate the other systems. Most engines consume gasoline or diesel fuel. The fuel burns in the engine to produce heat. This heat causes gas expansion, creating pressure inside the engine. The pressure moves internal engine parts to produce power. The engine is usually located in the front portion of the body. Placing the heavy engine in this position makes the vehicle safer in the event of a head-on collision. In a few vehicles, the engine is mounted in the rear to improve handling (Wilcox, 2013).

Automotive engines have gone through tremendous changes since the automobile was first introduced in the 1880s, but all combustion engines still have three requirements that must be met to do their job of providing power – air, fuel, and ignition. The mixture of air and fuel must be compressed inside the engine in order to make it highly combustible and get the most out of the energy contained in the fuel mixture. Since the mixture is ignited within the engine, automobile power plants are called internal combustion engines (Melior, 2007). Erjavec (2010) stated that while trying to produce more fuel-efficient vehicles, manufacturers replaced large eight-cylinder engines with four-cylinder and other small engines. Today’s engine control systems are On-Board Diagnostic (OBD II) second-generation systems. These systems were developed to ensure proper emission control system operation for the vehicle’s lifetime by monitoring emission-related components and systems for deterioration and malfunction. In addition, by the mid-1980s, all automobiles were equipped with some type of electronic control system; basic engine systems like carburetors and ignition breaker points were replaced by electronic fuel injection and electronic ignition systems. These systems monitor the engine's operation and provide increased power outputs while minimizing fuel consumption and emissions. According to Stephen et al (2011), computers and electronic devices are used to control the operation of an engine. Because of these controls, today's automobiles use less fuel, perform better, and run cleaner than those in the past. Computerized engine control systems control air and fuel delivery, ignition timing, emission systems operation, and a host of other related operations. The result is a clean-burning, fuel-efficient, and powerful engine (Erjavec, 2010).

Engine control system according to Alfredas (2007) uses an Electronic Control Unit (ECU) with a built-in microprocessor. Stored inside the ECU is the data for fuel injection duration, ignition timing, idle speed, etc., which are matched with the various engine conditions as well as programs for calculation. The ECU utilizes these data and signals from the various sensors in the vehicle and makes calculations with the stored programs to determine fuel injection duration, ignition timing, idle speed, etc., and outputs control signals to the respective actuators which control operation . This allows the car to adapt to environmental conditions such as air density in order to increase the combustion efficiently subsequently improving fuel economy. All decisions made by the ECU are based on the state of sensors that are placed at various places throughout the vehicle primarily around the engine bay. In other words, electronic sensors are used to monitor the engine and many other systems.

Vineet (2004) stated that due to the regulations demanding lower emissions, together with the need for better performance, fuel economy, continuous diagnosis electronic systems form an inevitable part of engine management. Electronic Engine Management according to Vineet

(2004) is the science of electronically equipping, controlling and calibrating an engine to maintain top performance and fuel economy while achieving cleanest possible exhaust stream, and continuously diagnosing system faults. Furthermore, Vineet stated that the engine management ECU would perform the following functions.

- Sense ignition on (input -pin18), then turn on the main relay (output -pin 4), acknowledgement received at (input -pin23).
- Turn on the pump relay (output -pin 16)
- Turn on the sensors (output -pin 12)
- Fire ignition at appropriate time (output -pin 13)
- Send supply voltage to Throttle sensor (output -pin9)
- Sense air flow meter voltage (input -pin 21)
- Sense throttle voltage (input -pin 22)
- Sense temperature sensor voltage (input -pin 10)
- Adjust idle speed by sending pulses to stepper motor of idle adjuster (output –pins 14, 2, 15, 3)
- Turn on fuel injectors at appropriate time (output - pin 1).

The Engine management ECU can be thought of as an electronic system comprising of

Electronic Ignition System and Electronic Fuel Injection (EFI) system (Vineet, 2004).

Electronic Ignition System

Wilcox (2013) stated that the ignition system is used on gasoline engines to start combustion. An ignition system is needed on gasoline engines to ignite the air-fuel mixture. It produces an extremely high voltage surge, which operates the spark plugs. A very hot electric arc jumps across the tip of each spark plug at the correct time. This causes the air-fuel mixture to burn, expand, and produce power. In the opinion of Vineet (2004), the fundamental purpose of ignition systems is to supply a spark inside the cylinder, near the end of the compression stroke to ignite the compressed charge of air- fuel vapour. Bonnick (2001) stated that without a good quality spark, in the right place at the right time, the engine performance will be affected, as will the operation of the emissions control system. A misfire can lead to unburnt fuel reaching the exhaust and this will quickly harm the catalyst, often irreparably. For this reason, modern systems monitor the performance of each cylinder, in relation to combustion. One method of doing this is to sense the angular acceleration of the engine flywheel; a firing cylinder will produce more acceleration than a misfiring one. In order to identify the cylinder that is misfiring, the electronic control module (ECM) requires a reference signal and this is often provided by the camshaft position sensor.

On modern systems, the ECM has the ability to detect misfires because the unburnt fuel that results can cause serious damage to the exhaust catalyst. The ECM achieves this diagnosis by reading the time interval between pulses from the crankshaft speed sensor. Persistent misfires will activate the MIL and a fault code (DTC) will be recorded. Urgent remedial work will then be required if serious catalyst damage is to be avoided (Bonnick, 2001). On most engines, the motion of the piston and the rotation of the crankshaft are monitored by a crankshaft position sensor. The sensor electronically tracks the position of the crankshaft and relays that information to an ignition control module. Based on input from the crankshaft position sensor, and, in some systems, the electronic engine control computer and the ignition control module then turns the battery current to the coil "on and off" at just the precise time so that the voltage surge arrives at the cylinder at the right time. The voltage surge from the coil must be distributed to the correct cylinder because only one cylinder is fired at a time. In earlier systems, this was the job of the distributor (Erjavec, 2010).

Today's ignition systems do not use a distributor. Instead, these systems have several ignition coils, one for each spark plug or pair of spark plugs. When a coil is activated by the electronic control module, high voltage is sent through a spark plug circuit. The electronic control module has total control of the timing and distribution of the spark-producing voltage to the various cylinders. A distributor is driven by a gear on the camshaft at one-half the crankshaft speed. It transfers the high-voltage surges from the coil to spark plug wires in the correct firing order. The spark plug wires then deliver the high voltage to the spark plugs, which are screwed into the cylinder head. The voltage jumps across a space between two electrodes on the end of each spark plug and causes a spark. This spark ignites the air-fuel mixture.

According to (Vineet, 2004), the electronic ignition system should provide the spark to ignite the air-fuel vapour with proper timing depending on speed, load, temperature etc. The spark plug must fire at the correct time during the compression stroke. A crankshaft position sensor or a distributor operates the ignition module. The module operates the ignition coil. The coil produces high voltage for the spark plugs. With the ignition switch on and the engine running, the system uses sensors to monitor engine speed and other operating variables. Sensor signals are fed to the control module. The control module then modifies and amplifies (increases) these signals into on-off current pulses that trigger the ignition coil. When triggered, the ignition coil produces a high voltage output to fire the spark plugs. When the ignition key is turned off, the coil stops functioning and the spark-ignition engine stops running.

2. 1.3 Skills Required in Maintenance of the Automobile Transmission System

A transmission basically transfers the power from a car’s engine to drive shaft and the wheels. The gears present inside the transmission change the drive wheel speed and torque in relation to the engine speed and torque (pulling power), Lower gear ratios helps the engine to build up enough of power so that the car can easily accelerate from a halt. The transmission is a device that is connected to the back of the engine and sends the power from the engine to the drive wheels. According to Mayur (2012), an automobile engine runs at its best at a certain RPM

(Revolutions per Minute) range and it is the transmission's job to make sure that the power is delivered to the wheels while keeping the engine within that range. Automotive transmission is a key element in the power train that connects the power source to the wheels of a vehicle. The purpose of the transmission or transaxle is to use gears of various sizes to give the engine a mechanical advantage over the driving wheels. During normal operating conditions, power from the engine is transferred through the engaged clutch to the input shaft of the transmission /transaxle. Gears in the transmission housing alter the torque and speed of this power input before passing it on to other components in the drive train. Without the mechanical advantage the gearing provides, an engine can generate only limited torque at low speeds. Without sufficient torque, moving a vehicle from a standing point would be impossible (Erjavec, 2010).The transmission uses various gear combinations, or ratios, to multiply engine speed and torque to accommodate driving conditions.

Low gear ratios allow the vehicle to accelerate quickly and high gear ratios permit lower engine speed, providing good gas mileage. The basic function of any type of automotive transmission is to transfer the engine torque to the vehicle with the desired ratio smoothly and efficiently. The most common control devices inside the transmission are clutches and hydraulic pistons. Such clutches could be hydraulic actuated, motor driven or actuated using other means. The clutch allows the driver to engage or disengage the engine and manual transmission or transaxle. When the clutch pedal is in the released position, the clutch locks the engine flywheel and the transmission input shaft together. This causes engine power to rotate the transmission gears and other parts of the drive train to propel the vehicle. When the driver presses the clutch pedal, the clutch disengages power flow and the engine no longer turns the transmission input shaft and gears. A manual transmission lets the driver change gear ratios to better accommodate driving conditions. Manual transmission uses gears and shafts to achieve various gear ratios. The speed of the output shaft compared to the speed of the input shaft varies in each gear position. This allows the driver to change the amount of torque going to the drive wheels. In lower gears, the car accelerates quickly. When in high gear, engine speed drops while vehicle speed stays high for good fuel economy

An automatic transmission, on the other hand, does not have to be shifted by the driver. It uses an internal hydraulic system and, in most cases, electronic controls to shift gears. An automatic transmission serves the same function as a manual transmission. However, it uses a hydraulic pressure system to shift gears. An automatic transmission does not need a clutch pedal and shifts through the forward gears without the control of the driver. Instead of a clutch, it uses a torque converter to transfer power from the engine's flywheel to the transmission input shaft. The torque converter allows for smooth transfer of power at all engine speeds. Shifting in an automatic transmission is controlled by a hydraulic and/or electronic control system.

In a hydraulic system, an intricate network of valves and other components use hydraulic pressure to control the operation of planetary gear sets. These gear sets provide the three or four forward speeds, neutral, park, and reverse gears normally found in automatic transmissions. Newer electronic shifting systems use electric solenoids to control shifting mechanisms. Electronic shifting is precise and can be varied to suit certain operating conditions. All automatic transmission-equipped vehicles with OBD II have electronic shifting.

The input shaft of an automatic transmission is connected to the engine crankshaft through a torque converter (fluid coupling) instead of a clutch. To improve fuel economy, reduce emission and enhance driving performance, many new technologies have been introduced in the transmission area in recent years. In the transmission area, Zongxuan and Kumar (2005) stated that emerging technologies such as continuously variable transmission (CVT), dual clutch transmission (DCT), automated manual transmission (AMT) and electrically variable transmission (EVT) have appeared in the market, which is traditionally dominated by step gear automatic transmission (AT) and manual transmission (MT).

2. 1.4 Skills in the Maintenance of Automobile Braking System

The brake system converts the momentum of the vehicle into heat by slowing and stopping the vehicle wheels. This is done by causing friction at the wheels. The application of the friction units is controlled by a hydraulic system (Erjavec, 2010). The brake system produces friction to slow or stop the vehicle. When the driver presses the brake pedal, fluid pressure actuates a brake mechanism at each wheel. These mechanisms force friction material (brake pads or shoes) against metal discs or drums to slow wheel rotation. When the brake pedal is pressed, pressure is placed on a confined fluid. The fluid pressure transfers through the system to operate the brakes. An emergency brake is a mechanical system that applies the rear wheel brake. To obtain the most effective braking and allow the driver to retain control of the vehicle, the wheels should not lock up under braking. In order to overcome wheel lock, antilock braking system (ABS) is introduced.

Antilock braking system (ABS) technology has been used in the automotive industry since the 1980's and is implemented in most modern cars today (Li, 2010). In the opinion of Bosch (2004), 76 percent of all new vehicles were equipped with ABS in 2007 and it has become standard equipment for passenger cars in the European Union (EU), United States of America (USA) and Japan. Modern antilock brake systems can be thought of as electronic/hydraulic pumping of the brakes for straight-line stopping under panic conditions (Erjavec, 2010). A typical antilock braking system consists of a conventional hydraulic brake system (the base system) plus a number of antilock components. The base brake system consists of a vacuum power booster, master cylinder, front disc brakes, rear drum or disc brakes, interconnecting hydraulic tubing and hoses, a low fluid sensor, and a red brake system warning light. Antilock components are added to this base system to provide antilock braking ability. When the driver quickly and firmly applies the brakes and holds the pedal down, the brakes of a vehicle not equipped with ABS will almost immediately lock the wheels. The vehicle slides rather than rolls to a stop. During this time, the driver also has a very difficult time keeping the vehicle straight and the vehicle will skid out of control. The skidding and lack of control was caused by the locking of the wheels. If the driver was able to release the brake pedal just before the wheels locked up then reapply the brakes, the skidding could be avoided. This release and application of the brake pedal is exactly what an antilock system does.

When the brake pedal is pumped or pulsed, pressure is quickly applied and released at the wheels. This is called pressure modulation (Erjavec, 2010). Pressure modulation works to prevent wheel locking. Antilock brake systems can modulate the pressure to the brakes as often as fifteen times per second. By modulating the pressure to the brakes, friction between the tires and the road is maintained and the vehicle is able to come to a controllable stop. ABS works primarily to ensure that the driver maintains steering control of the vehicle under heavy braking. This is achieved by preventing the tyres from locking during heavy braking (Lambourn, et al 2007). There are two reasons for installing an ABS system in a car. The first objective is to avoid wheel lock-up and preserve the tyre ability or produce a lateral force, and thus vehicle maneuver ability. Furthermore, the wheel slip is kept in a neighborhood of the point that maximizes the tyre force in order to minimize the vehicle’s braking distance (Li, 2010). During ABS operation the brake fluid returns to the master cylinder and the driver will feel pulsations at the brake pedal which help to indicate that ABS is in operation. When ABS operation stops the modulator pump continues to run for approximately 1 second(s) in order to ensure that the hydraulic accumulators are empty (Bonnick, 2001).

2. 1.5 Skills in the Maintenance of On- Board Diagnostic (OBD) System

In the early seventies, the United States Environmental Protection Agency (EPA) introduced a new policy which mandated the use of On-Board Diagnostics (OBD) for vehicles in the United States of America. Similar requirements were also introduced by the California Air Resources Board (CARB). This led to the development of new technologies that allowed automotive service technicians to monitor almost all aspects of the vehicle performance on instruments hooked up to data ports on cars (William, 2011). OBD 11 replaced OBD 1 in the mid-nineties with more sophisticated monitoring systems and OBD 111 is on the horizon (Don, 2008). According to Malone (2006), cars were equipped with first generation on-board diagnostic (OBD-1) systems from 1986-1995 and further equipped with second generation OBD2 systems from 1996 till date. In addition, sophisticated computer technology, advanced wiring, intricate circuitry and complex engineering are now in use. OBD is a set of self-testing and diagnostic instructions programmed into the vehicles on- board computer. The programs are specifically designed to detect failures in the sensors, actuators, switches and wiring of various vehicle emission-related systems. If the computer detects a failure in any of these components or systems, it illuminates an indicator on the dashboard to alert the driver. The indicator illuminates only when an emission-related problem is detected (Smith, 2006).

The objective of OBD II is to reduce the time between occurrence of a malfunction and its detection and repair (Burelle, 2004). Consequently, the illumination of a Malfunction Indicator Light (MIL) on a vehicle's dashboard is intended to alert both vehicle owners and repair technicians that there is something wrong with the vehicle and that troubleshooting, repair or servicing is required. When the OBD system determines that a problem exists, a corresponding "Diagnostic Trouble Code (DTC)" is stored in the computer's memory. The computer also illuminates a yellow dashboard light indicating "Check Engine" or "Service Engine Soon" or displays an engine symbol (William, 2011). This light informs the driver of the need for service, not of the need to stop the vehicle. A blinking or flashing dashboard lamp indicates a rather severe level of engine misfire. When this occurs, the driver should reduce engine speed and load and have the vehicle serviced as soon as possible. After the problem has been fixed, the dashboard lamp will be turned off. In addition, when a problem that could cause a substantial increase in air emissions is detected, the OBD II system turns on a dashboard warning light, the Malfunction Indicator Light (MIL), to alert the driver of the need to have the vehicle checked by a repair technician. A repair technician can then ascertain the status of various vehicle systems by connecting a scan tool to the standardized connector, the Diagnostic or Data Link Connector (DLC).

Modern vehicles are getting cleaner due to newer technology and emission control components, but the emissions are only low when all the systems are in proper working order (William, 2011). When an engine is not running as efficiently as possible, performance is lost, fuel is wasted, and air emissions increase. OBD can detect problems that may not be noticeable upon visual inspection. By detecting emission control component deterioration and/or failures, and alerting the driver to the need for potential repair, vehicles can be properly serviced before more serious and expensive problems develop. Early diagnosis followed by timely repair can often prevent more costly repairs to either electronic or mechanical components. For example, a poorly performing spark plug can cause the engine to misfire, a condition sometimes unnoticed by the driver. The engine misfire can, in turn, quickly degrade the performance of the catalytic converter. With early OBD detection of the engine misfire, the driver would be faced with a relatively inexpensive spark plug repair. Without OBD detection, over time the driver could be faced with an expensive catalytic converter repair in addition to the spark plug repair. There are also situations under which the vehicle's OBD system can turn off the dashboard light automatically if the conditions that caused a problem are no longer present. If the OBD system evaluates a component or system three consecutive times and no longer detects the initial problem, the dashboard light will turn off automatically.

A modern OBD II system is capable of monitoring a number of sensors to determine whether they are working as intended. It can detect a malfunction or deterioration of various sensors and actuators, usually well before the driver becomes aware of the problem. These sensors and actuators, along with the diagnostic software in the on-board computer comprise the On-Board Diagnostics (OBD) system (Burelle, 2004). Bonnick (2001) included on-board diagnostic tool in the system because the information in the software needs to be read by the tool to appreciate the utility of the system.

2.2 Theoretical framework

2.2.2 Theory of Skill Development

Theory of skill development was propounded by Cratty in 1973. The theory states that individuals have tendency of developing skills in an occupation as a result of continuous or repetitive practice. It is stated that practical skills are essential skills that could be acquired through repetitive means in all technical occupations or professions. It is on this premise that the major objective of all Technical Colleges' programmed should make provision for practical skills to its graduates for self-reliant. Therefore, the teaching of vocational education at technical college level should mostly focus on practical skills so as to enable the students acquire marketable skills. Technical Colleges programmed therefore cannot be said to have accomplished without practical skills manifestation.

It is also stressed that skills acquisition cannot be expressed in word but only through demonstration. Theory of skill development is related to the present study in that graduates of and maintenance work technology need to develop skills for effective performance in their various industries or workplaces. Development of relevant skills makes them fit into various sit or positions in relevant industries. Without skills being develop there will be unemployment among graduates of general installation and maintenance work engineering craft students.

Skill development is a key factor in the employability of workers and the sustainability of enterprises, it is one of the objectives of skills development system to ensure that the skills acquired match the skills valued in the work place. Skills development systems must also help workers and enterprises adjust to changes and handle new conditions by constantly improving their skills to meet up with the climatic change, globalization, demographic trends, technological innovation and/or financial crisis. This is in line with the theory of technical and vocational skill development (TTVSD) by (Nyapson, 2017). TTSD states that improvement needs in skill development under lie vocational choice development, employability, mobility and sustainability of socio-economy of energy progressive society. Hence this theory is relevant to this study because technological innovations and advancement in general installation and maintenance works is complex and each subsystem of the modern general equipment, machineries, and tools is indeed a challenge to industries in Nigeria if there is no workforce to man them for high productivity.

2.3 Related Empirical Studies

Audu (2014) carried out a study on retraining needed by Motor Vehicle Mechanics (MVM) teachers in technical colleges in Niger State and Federal Capital Territory (FCT) Abuja, Nigeria. Two research questions were used to guide in the conduct of the study. The teachers of MVM program in the technical colleges in Niger State and FCT Abuja Nigeria constitute the respondents of the study. A 35 item questionnaire was used to collect data for the study. The data was analyzed using mean and standard deviation. The analysis of the data revealed that MVM teachers in the technical colleges need retraining in terms of pedagogical skills as well as practical skills areas in MVM. The competencies and skills that the teachers are supposed to acquire through retraining are expected to produce a positive impact on teaching/learning in the classroom and the schools workshops; leading to the production of graduates who can be productive and become gainfully employed or become self-reliant; thereby contributing to the development of the society and the nation at large. The similarities between the study and the present study is that they both based on training needs of MVM teachers and also adopted survey research design.

Muhammad (2014) carried out a research on by technical college automotive graduates in Auto-Electrical system maintenance and the factors influencing the level of technical skills possessed in auto electrical maintenance. A total of 56 auto-mechanics technical college graduates that are working in Bauchi and Gombe states and their 42 supervisors served as the respondents of the research. AutoElectrical task cluster from the National Board for Technical Education (NBTE) modular curriculum was used in developing the instrument for data collection (questionnaire). A test-re-test was used in determining the reliability of the instrument and Pearson product moment correlation coefficient was used to compute the reliability coefficient. The instrument had a reliability index of 0.72. Mean was used to answer the research questions and t-test statistics were used to test the hypotheses at 0.05 significant levels. The findings of the study revealed that: technical college auto mechanic graduates exhibited low level of technical skills in auto-electrical maintenance. The use of outdated teaching and learning facilities, teacher's competency, mismatch between curriculum content and needs of industry are the major factors affecting the acquisition of technical skills in auto-electrical system maintenance among auto-mechanics students. It was recommended that real or prototype of modern automobile and up to date equipment and learning facilities should be made available for teaching students in technical colleges, refresher courses be organized for auto mechanic teachers regularly in the auto mobile industry to update their technical skills, Curriculum of auto-mechanics trade should be reviewed on regular basis to reflect the need of the industries and the school learning environment should be a replica of working environment. The similarity between the two studies is that they adopt the same research design.

Michael (2019) conduct a research on competency needs of technical teachers for effective teaching of Basic Technology in Cross River State. Eight research questions guided the study while eight null hypotheses were formulated and tested at 0.05 level of significance. The study adopted descriptive survey research design. The population for the study was 82 technical teachers who were teaching Basic Technology. There was no sampling because of the manageable size of the population. The instrument used for data collection was structured questionnaire. Three experts validated the instrument. Cronbach's alpha reliability method was used to determine the internal consistency of the instrument in which 0.79 reliability coefficient was obtained for the entire instrument. Weighted Mean and Improvement Need Index (INI) were employed to analyze data for answering research questions while z-test statistic was used to test the hypotheses at 0.05 level of significance. The study found that 10 out of the 12 pedagogical competencies were needed by technical teachers for effective teaching of Basic Technology while 2 were not needed. In classroom management competency, 7 out of the 10 competencies were needed and 3 were not needed. In information and communication technology (ICT) competency, all the 12 items were needed by the technical teachers. As regards intrapersonal competency, 8 out of the 10 competencies were needed. On interpersonal competency, 9 out of the 12 items were needed. In terms of laboratory management competency, 9 out of the 12 competencies were needed. In the area of affective work competency, 4 out of the 12 competencies were needed. For instructional materials development and utilisation competency, 4 out of the 10 competencies were needed by the technical teachers for effective teaching of Basic Technology. The hypotheses tested revealed that there was no significant difference in the mean responses of male and female technical teachers in the areas of pedagogical, classroom management, information and communication technology, intrapersonal, laboratory management, affective work and instructional materials development and utilization competencies for effective teaching of Basic Technology. However, there was a significant difference in the mean responses of both male and female technical teachers as regards their interpersonal competency needs. It was recommended among others that Cross River State Ministry of Education and Secondary Education Board should organize regular retraining programme for technical teachers in the state on those areas where they are found in this study to be deficient particularly on the use of information and communication resources. The differences between the study and the present study is that the study base on basic technology will the present study base on MVM.

Ibeneme (2021) carried out a research on practical skills needs of technical college graduates of MVMW for employment in Anambra and Enugu States. Four research questions guided the study and four null hypotheses were tested. The study adopted descriptive survey research design. The population for the study consisted of 150 respondents (120 automobile industrial workers and 30 motor vehicle mechanic work teachers) in the two States. There was no sampling because of the manageable size of the population. The instrument for data collection was a structured questionnaire titled Practical skill Needs of Technical College graduates of Motor Vehicle Mechanics' Work Questionnaire (PSNTCGMVMWQ), validated by three experts; two in Department of Technology and Vocational Education and one from Measurement and Evaluation units of Department of Educational Foundation in the Faculty of Education, Nnamdi Azikiwe University Awka. Cronbach alpha reliability method was employed to determine the internal consistency of the instrument, which yielded coefficient values of 0.92, 0.87, 0.89 and 0.83 with an overall reliability coefficient of 0.88. Data were analyzed with mean and standard deviation to answer the research questions and determine the homogeneity of the respondents while T-test was used to test the hypotheses at 0.05 level of significance using the Statistical Package for Social Sciences (SPSS) version 9.2. The data analysis revealed that all the stipulated practical skills are very high needed by technical college graduates of MVMW for employment in Anambra and Enugu States. Based on the findings, it was concluded that the infusion of these skills into the curriculum is paramount, because it will enhance the preparation of the graduates for success in employment. It was recommended among others that curriculum designers for MVMW programme should periodically review the curriculum to reflect technological innovations. The differences between the study and the current study is that the study is carried out in Enugu state while the current study is carried out in Niger state.

2.4 Summary of Literature Reviewed

The literature reviewed is discussed under the following heading: Skills in the Maintenance of Automobile Engine System, Skills Required in Maintenance of the Automobile Transmission System, Skills in the Maintenance of Automobile Braking System, and Skills in the Maintenance of On- Board Diagnostic (OBD) System. Adequate and relevant studies were reviewed in the study. The study also reviewed Model of Skill development, which states that formal system of education is a gradual process that involves being embodied in different ways and developing skills that would make it possible for people to deal with the world; Dynamic Skill Theory by Kurt Fischer, which is of the view that skill within domains may promote or suppress other skills as they first develop resulting in spurts of growth in one skill concurrently with regression in another and the Psychological Theories of the Refugee and Schumpter Effects by Schumpter stated that the ability to make a good judgement about the future leads an individual to become a successful entrepreneur. Postulations from these theories guided this study in finding out entrepreneurial expectations and aspirations of entrepreneurs in starting-up enterprises.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Design of the Study

The study adopt the descriptive survey research design used to d identify skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state. Survey design according Nworgu (1991) is aimed at collecting data on and describing in a systematic manner, the characteristics features or facts about a given population. Osuala (2005) said that it is a design which studies the characteristics of people, the vital facts about people and their beliefs, opinions, attitude, motivation and behavior.

3.2 Area of the study

The study will be carried out in technical institutions in Minna metropolis, Niger state. Niger state falls on the land mass area of about 76,363km2 and with the population of about 3,950,349 (NPC, 2006).

3.3 Population for the Study

The population for the study consists of 80 respondents comprising 20 automobile Lecturers and 60 automobile industry workers

3.4 Sample and Sampling Technique

There will be no sampling since the population was small and manageable.

3.5 Instrument for Data Collection

The researcher designed a structured questionnaire as an instrument that was used in collecting data for the study. The questionnaire was made up of four sections (A, B, C, D, E and F). Section 'A' contains items on personal information of the respondents. Section 'B' seeks skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises. Section ‘C’ find out skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises. Section ‘D’ find out skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises. Section ‘E’ skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises. While section F will seek skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises. The questionnaire items were based on four points scale types. Items for section ‘B’, ‘C’ and ‘D’ contain four responses category each. The response categories for section ‘B’, ‘C’ and ‘D’ are strongly Agree (SA), Agree (A), and Disagree (D) and strongly disagree (SD). These response categories will be assign numerical values of 4, 3, 2 and 1 respectively. Respondents were require checking (√) against the response category that best satisfies their opinion.

3.6 Validation of instrument

The instrument will be validated by three lecturers in the department of Industrial and Technology Education, Federal University of Technology, Minna and contributions on the appropriateness of the instrument will be considered in the production of the final copy of the research instrument.

3.7 Reliability of instrument

In order to determine the reliability of the research instrument, a pilot test will be conducted using fifteen in other locations. During the test, the questionnaires were distributed by the researcher. The questionnaire was filled by the respondents and then returned to the researcher. The data collected will be analyzed using Crombach Alpha

3.8 Administration of instrument

The instrument that will be used for the data collection was administered to the respondents by the researcher and three research assistant in the study area

3.9 Method of data analysis

Data collected will be analyzed using mean and standard deviation for the research questions while t-test was used to test the hypothesis at the 0.05 level of significant. A four (4) point rating scale was to analyze the data as shown below.

Strongly Agree	(SA)	=	4points (3.5 – 4.0)
Agree	(A)	=	3points (2.5 - 3.49)
Disagree	(D)	=	2points (1.5 – 2.49)
Strongly Disagree	(SD)	=	1point (1.0 – 1.49)

Therefore, the mean value of the 4 point scale is:

= = 2.5

3.10 Decision Rule

The cutoff point of the mean score of 2.50 will be chosen as the agreed or disagreed point. This will be interpreted relatively according to the rating point scale adopt for this study. Therefore, an item with response below 2.49 and below was regard or consider as disagreed while an item with response at 2.5 and above was regarded or considered as agreed.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.1 Research Question 1

What are the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises?

Table 4.1: mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises.

N_1= 20 **N_2=60**

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Identify the on-board diagnostic port in modern vehicles.	3.14	.882	Agreed
2	Connect the diagnostic device to the 16-pin on-board diagnostic connector.	3.36	.783	Agreed
3	Retrieve transmission Diagnostic Trouble Codes (DTC's).	3.21	.774	Agreed
4	Record and print transmission diagnostic trouble codes.	2.96	.863	Agreed
5	Interpret ignition Diagnostic Trouble Codes (DTC's).	3.79	.544	Agreed
6	Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage.	2.97	1.018	Agreed
7	Record ignition timing using digital multimeter.	3.58	.671	Agreed
8	Carry out throttle cable inspection and adjustment.	3.64	.601	Agreed
9	Check the crank sensor using diagnostic tool.	3.70	.644	Agreed
10	Perform magnetic sensor testing.	3.67	.671	Agreed
11	Inspect, adjust or replace faulty crank position sensor.	3.74	.545	Agreed
12	Test and diagnose defective reluctor sensor.	3.65	.597	Agreed

N=80

$\bar{X}$ mean of the respondents

N_1 = No. of automobile lecturers

N_2= No. of automobile industry workers

SD = standard deviation of the respondents

Table 4.1 showed that both the automobile industry workers and automobile lecturers agreed on all items from 1 to 12. This is because none of the mean response was below 2.50 which was the beach mark of agreed on the 4-points response options. The standard deviation score ranged between 0.544 and 1.018. This showed that the responses of the automobile industry workers and automobile lecturers on the items were not divergent.

4.2 Research Question 2

What are the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises?

Table 4.2: mean response of the automobile industry workers and automobile lecturers towards the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises.

N_1= 20 N_2=60

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Ability to remove fuel injection fuel rail.	3.27	.675	Agreed
2	Ability to remove pressure regulator.	3.59	.758	Agreed
3	Removing and replacing electronics faulty injectors.	3.31	.587	Agreed
4	Replacing new O-ring onto new injector.	3.30	.624	Agreed
5	Undertaking visual inspection of the air mass sensor.	3.38	.537	Agreed
6	Checking for leakages in induction and exhaust system.	2.96	.863	Agreed
7	Using multimeter to check for oxygen sensor.	3.79	.544	Agreed
8	Checking the oxygen sensor for possible damage.	3.28	.954	Agreed
9	Ability to check malfunction indicator or lamp.	3.59	.669	Agreed
10	Competency in checking fuel injector using multimeter.	3.65	.597	Agreed
11	Competency in checking fuel pump and its circuits.	3.71	.640	Agreed
12	Checking pressure sensor and power control module.	3.56	.499	Agreed

N=80

$\bar{X}$ mean of the respondents

N_1 = No. of automobile lecturers

N_2= No. of automobile industry workers

SD = standard deviation of the respondents

Table 4.2 showed that both the automobile industry workers and automobile lecturers agreed on all items. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.499 and 0.945. This showed that the responses of the automobile industry workers and automobile lecturers on the items were not divergent.

4.3 Research Question 3

What are the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises?

Table 4.3: mean responses of the automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises.

N_1= 20 N_2=60

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Conduct thorough visual inspection on transmission linkage adjustments	3.72	.615	Agreed
2	Inspect and adjust the shift cable	3.95	.213	Agreed
3	Examine fluid level for leakage from the transmission vent	2.98	1.192	Agreed
4	Check transmission fluid and filters for oxidation or contamination	2.95	.213	Agreed
5	Check drive train for looseness or leaks	3.47	.706	Agreed
6	Remove and reinstall new gasket to correct fluid leakage	3.86	.468	Agreed
7	Check torque converter for leaks	3.59	.563	Agreed
8	Replace leaking or damaged torque converter	3.77	.685	Agreed
9	Check transmission vent for blockage	3.62	.721	Agreed
10	Replacement of O-ring and gears	3.91	.294	Agreed
11	Inspect entire transmission wiring harness for tears and other damages	3.62	.721	Agreed

12	Replace damaged fluid lines and fittings	3.82	.501	Agreed

N=80

$\bar{x}$ mean of the respondents

N_1 = No. of automobile lecturers

N_2= No. of automobile industry workers

SD = standard deviation of the respondents

Table 4.3 showed that both the automobile industry workers and automobile lecturers agreed on all items from 1 to 12. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.213 and 1.192. This showed that the responses of the automobile industry workers and automobile lecturers on the items were not divergent.

4.4 Research Question 4

What are the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises?

Table 4.4: mean responses of the automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises.

N_1= 20 **N_2=60**

S/N	ITEMS	$\bar{x}$	SD	Remark
1	Perform visual inspection of wheel speed sensor and cables	3.65	.553	Agreed
2	Identify defective wheel speed sensor	2.70	1.400	Agreed
3	Check wheel speed sensor and the pulse ring	2.96	.863	Agreed
4	Carry out speed sensor signal testing	3.79	.544	Agreed
5	Check power supply of the wheel speed sensor	2.97	1.018	Agreed
6	Recognize a defective Anti-lock Braking System (ABS) warning light	3.58	.671	Agreed
7	Test repaired braking system for functionality	3.18	1.065	Agreed

8	Carry out all kinds of mechanical tests on the braking system	3.70	.644	Agreed
9	Check the operation of the braking system, adjust and repair according to the manufactures specification	3.04	.818	Agreed
10	Replace faulty or bad braking system with new one	3.79	.544	Agreed
11	Select appropriate tools and equipment for the maintenance of automotive braking system	2.97	1.018	Agreed
12	Service automatic braking system correctly	3.51	.746	Agreed

N=80

$\bar{X}$ mean of the respondents

N_1 = No. of automobile lecturers

N_2= No. of automobile industry workers

SD = standard deviation of the respondents

Table 4.4 showed that both the automobile industry workers and automobile lecturers agreed on all items from 1 to 12. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.544 and 1.400. This showed that the responses of the automobile industry workers and automobile lecturers on the items were not divergent.

4.5 Research Question 5

What are the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises?

Table 4.5: mean responses of the automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

N_1= 20 **N_2=60**

S/N	ITEMS	$\bar{X}$	SD	Remark
1	Identify the on-board diagnostic port in modern vehicles	3.77	.529	Agreed
2	Locate the diagnostic link connector	3.68	.530	Agreed

3	Connect the vehicle on-board computer to a laptop using an interface and an on-board diagnostic software	3.06	1.229	Agreed
4	Connect the on-board diagnostic scan tool or handheld tester to data link connector	3.18	.809	Agreed
5	Check and retrieve diagnostic trouble codes and freeze frame data stored in the electronic control module memory	3.77	.548	Agreed
6	Record and print diagnostic trouble codes and freeze frame data	3.14	.985	Agreed
7	Interpret diagnostic trouble codes and freeze frame data	3.51	.745	Agreed
8	Carryout a careful visual inspection	3.50	.659	Agreed
9	Set the check mode diagnosis	3.61	.723	Agreed
10	Perform problem symptom confirmation	3.48	.674	Agreed
11	Carryout parts inspection using problem symptom table	3.72	.552	Agreed
12	Use on-board diagnostic tools to amend the automobile computer operating programme	3.74	.441	Agreed

N=80

$\bar{X}$ mean of the respondents

N_1 = No. of automobile lecturers

N_2= No. of automobile industry workers

SD = standard deviation of the respondents

Table 4.5 showed that both the automobile industry workers and automobile lecturers agreed on all items from 1 to 12. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.441 and 1.229. This showed that the responses of the automobile industry workers and automobile lecturers on the items were not divergent.

4.6 Hypothesis 1

There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises

Table 4.6 T-test skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises.

$N_1 = 20$ AND $N_2 = 60$

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Automobile Lecturers	20	3.57	.851	78	2.178	0.001	NS
Automobile Industry Workers	60	3.75	.444				

N=80

$\bar{X}_1$= mean of automobile lecturers

$\bar{X}_2$= mean of automobile industry workers

N_1 = automobile lecturers

N_2= automobile industry workers

SD_1 = standard deviation of automobile lecturers

SD_2 = standard deviation of automobile industry workers

NS=Not Significant

Table 4.6 showed that there was no significant difference in the responses of automobile industry workers and automobile lecturer on all the items as skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.7 Hypothesis 2

There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises.

Table 4.7 T-test on the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises.

N_1 = 20 AND N_2 = 60

Respondents	N	X	SD	Df	Tcal	P-value	Remark

Automobile Lecturers	20	3.67	.540	78	0.754	0.08	NS
Automobile Industry Workers	60	3.80	.422				

N=80

$\bar{X}_1$= mean of automobile lecturers

$\bar{X}_2$= mean of automobile industry workers

N_1 = automobile lecturers

N_2= automobile industry workers

SD_1 = standard deviation of automobile lecturers

SD_2 = standard deviation of automobile industry workers

NS=Not Significant

Table 4.7 showed that there was no significant difference in the responses of automobile industry workers and automobile lecturers on all the items skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.8 Hypothesis 3

There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises.

Table 4.8 T-test on the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises.

$N_1 = 20$ AND $N_2 = 60$

Respondents	N	X	SD	Df	Tcal	P-value	Remark

Automobile Lecturers	20	3.71	.566	78	1.072	0.009	NS
Automobile Industry Workers	60	3.80	.422				

N=80

$\bar{X}_1$= mean of automobile lecturers

$\bar{X}_2$= mean of automobile industry workers

N_1 = automobile lecturers

N_2= automobile industry workers

SD_1 = standard deviation of automobile lecturers

SD_2 = standard deviation of automobile industry workers

NS=Not Significant

Table 4.8 showed that there was no significant difference in the responses of automobile industry workers and automobile lecturers on all the items skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance.

4.9 Hypothesis 4

There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises.

Table 4.9 T-test on the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises**.**

N_1 = 20 AND N_2 = 60

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Automobile Lecturers	20	3.73	.445	78	0.452	1.012	NS
Automobile Industry Workers	60	3.80	.422				

N=80

$\bar{X}_1$= mean of automobile lecturers

$\bar{X}_2$= mean of automobile industry workers

N_1 = automobile lecturers

N_2= automobile industry workers

SD_1 = standard deviation of automobile lecturers

SD_2 = standard deviation of automobile industry workers

NS=Not Significant

Table 4.8 showed that there was no significant difference in the responses of automobile industry workers and automobile lecturers on all the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises; therefore the null hypothesis of no significant difference was upheld at 0.05 level of significance

4.10 Hypothesis 5

There is no significant difference in the mean responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

Table 4.8 T-test on the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

N_1 = 20 AND N_2 = 60

Respondents	N	X	SD	Df	Tcal	P-value	Remark
Automobile Lecturers	20	3.70	.571	78	0.829	0.001	NS
Automobile Industry Workers	60	3.82	.537				

N=80

$\bar{X}_1$= mean of automobile lecturers

$\bar{X}_2$= mean of automobile industry workers

N_1 = automobile lecturers

N_2= automobile industry workers

SD_1 = standard deviation of automobile lecturers

SD_2 = standard deviation of automobile industry workers

NS=Not Significant

Table 4.10 showed that there was no significant difference in the responses of automobile industry workers and automobile lecturers on all the items skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises; therefore the null hypothesis of no significant difference was upheld at 0.5 level of significance

4.11 Findings of the study

The following are the main findings of the study; they are prepared based on the research questions and hypothesis tested.

What are the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises

- Identify the on-board diagnostic port in modern vehicles.
- Connect the diagnostic device to the 16-pin on-board diagnostic connector.

- Retrieve transmission Diagnostic Trouble Codes (DTC's).
- Record and print transmission diagnostic trouble codes.
- Interpret ignition Diagnostic Trouble Codes (DTC's).
- Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage.
- Record ignition timing using digital multimeter.
- Carry out throttle cable inspection and adjustment.
- Check the crank sensor using diagnostic tool.
- Perform magnetic sensor testing.
- Inspect, adjust or replace faulty crank position sensor.
- Test and diagnose defective reluctor sensor.

What are the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises

- Ability to remove fuel injection fuel rail.
- Ability to remove pressure regulator.
- Removing and replacing electronics faulty injectors.
- Replacing new O-ring onto new injector.
- Undertaking visual inspection of the air mass sensor.
- Checking for leakages in induction and exhaust system.
- Using multimeter to check for oxygen sensor.
- Checking the oxygen sensor for possible damage.
- Ability to check malfunction indicator or lamp.
- Competency in checking fuel injector using multimeter.
- Competency in checking fuel pump and its circuits.
- Checking pressure sensor and power control module.

What are the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises

- Conduct thorough visual inspection on transmission linkage adjustments
- Inspect and adjust the shift cable
- Examine fluid level for leakage from the transmission vent
- Check transmission fluid and filters for oxidation or contamination
- Check drive train for looseness or leaks
- Remove and reinstall new gasket to correct fluid leakage
- Check torque converter for leaks
- Replace leaking or damaged torque converter
- Check transmission vent for blockage
- Replacement of O-ring and gears
- Inspect entire transmission wiring harness for tears and other damages
- Replace damaged fluid lines and fittings

What are the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises

- Perform visual inspection of wheel speed sensor and cables
- Identify defective wheel speed sensor
- Check wheel speed sensor and the pulse ring
- Carry out speed sensor signal testing
- Check power supply of the wheel speed sensor
- Recognize a defective Anti-lock Braking System (ABS) warning light
- Test repaired braking system for functionality
- Carry out all kinds of mechanical tests on the braking system

- Check the operation of the braking system, adjust and repair according to the manufactures specification
- Replace faulty or bad braking system with new one
- Select appropriate tools and equipment for the maintenance of automotive braking system
- Service automatic braking system correctly

What are the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises

- Identify the on-board diagnostic port in modern vehicles
- Locate the diagnostic link connector
- Connect the vehicle on-board computer to a laptop using an interface and an on-board diagnostic software
- Connect the on-board diagnostic scan tool or handheld tester to data link connector
- Check and retrieve diagnostic trouble codes and freeze frame data stored in the electronic control module memory
- Record and print diagnostic trouble codes and freeze frame data
- Interpret diagnostic trouble codes and freeze frame data
- Carryout a careful visual inspection
- Set the check mode diagnosis
- Perform problem symptom confirmation
- Carryout parts inspection using problem symptom table
- Use on-board diagnostic tools to amend the automobile computer operating programme

4.12 Discussion of findings.

The result from table 4.1 shows the findings on the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises. The findings of the study revealed Identify the on-board diagnostic port in modern vehicles, Connect the diagnostic device to the 16-pin on-board diagnostic connector, Retrieve transmission Diagnostic Trouble Codes (DTC's), Record and print transmission diagnostic trouble codes, Interpret ignition Diagnostic Trouble Codes (DTC's), Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage, Record ignition timing using digital multimeter, Carry out throttle cable inspection and adjustment, Check the crank sensor using diagnostic tool, Perform magnetic sensor testing, Inspect, adjust or replace faulty crank position sensor, Test and diagnose defective reluctor sensor. The findings of the study is inline with Akinola and Adeyinka (2022) that the designs of vehicles have advanced to a very sophisticated level, and unlike the old mechanically operated vehicle systems, the modern vehicles are being operated and controlled by computerised electronic sensors. For example, latest vehicles' ignition systems are electrically controlled without employing the old use of manually reset contact breaker.

The result of the hypothesis on skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises shows that there was no significant difference in the responses automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises.

Table 4.2 shows the result of the findings on the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises. The findings of the study revealed the Ability to remove fuel injection fuel rail, Ability to remove pressure regulator, Removing and replacing electronics faulty injectors, Replacing new O-ring onto new injector, Undertaking visual inspection of the air mass sensor, Checking for leakages in induction and exhaust system, Using multimeter to check for oxygen sensor, Checking the oxygen sensor for possible damage, Ability to check malfunction indicator or lamp, Competency in checking fuel injector using multimeter, Competency in checking fuel pump and its circuits, Checking pressure sensor and power control module. The findings of the study is inline with Maina (2022) who identified the areas of difficulty for the final year students of NTC motor vehicle mechanics work programmes to include the engine, particularly the ignition, fuel, cooling and lubricating systems; the transmission system comprising the clutch, gearbox and final drive assembly as well as the suspension, steering and braking systems among others.

The result of the hypothesis on skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises shows that there was no significant difference in the responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises.

The result from table 4.3 reveal the findings on skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises. The findings of the study revealed the Conduct thorough visual inspection on transmission linkage adjustments, Inspect and adjust the shift cable, Examine fluid level for leakage from the transmission vent, Check transmission fluid and filters for oxidation or contamination, Check drive train for looseness or leaks, Remove and reinstall new gasket to correct fluid leakage, Check torque converter for leaks, Replace leaking or damaged torque converter, Check transmission vent for blockage, Replacement of O-ring and gears, Inspect entire transmission wiring harness for tears and other damages, Replace damaged fluid lines and fittings. The findings of the study is inline with Taratorkin *et al.* (2022) that in the transmission system, emerging technologies such as continuously variable transmission (CVT), dual clutch transmission (DCT), automated manual transmission (AMT) and electrically variable transmission (EVT) have appeared in the market, which is traditionally dominated by step gear automatic transmission (AT) and manual transmission (MT)

The result of the hypothesis on the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises shows that there was no significant difference in the responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises.

The result from table 4.4 reveal the findings on skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises, the findings of the study shows Perform visual inspection of wheel speed sensor and cables, Identify defective wheel speed sensor, Check wheel speed sensor and the pulse ring, Carry out speed sensor signal testing, Check power supply of the wheel speed sensor, Recognize a defective Anti-lock Braking System (ABS) warning light, Test repaired braking system for functionality, Carry out all kinds of mechanical tests on the braking system, Check the operation of the braking system, adjust and repair according to the manufactures specification, Replace faulty or bad braking system with new one, Select appropriate tools and equipment for the maintenance of automotive braking system, Service automatic braking system correctly. The findings of the study is inline with Jayne and Ward (2016) that modern automobile technicians should troubleshoot problems in vehicles by checking components and systems; this can be done by using a diagnostic computer, test drives or digital tools to diagnose problems in vehicles, as well as how to repair the computerized systems present in many automobiles, such as steering, braking and global positioning systems.

The result of the hypothesis on the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises shows that there was no significant difference in the responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises.

The result from table 4.5 reveal the findings on skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises. The findings of the study revealed that Identify the on-board diagnostic port in modern vehicles, Locate the diagnostic link connector, Connect the vehicle on-board computer to a laptop using an interface and an on-board diagnostic software, Connect the on-board diagnostic scan tool or handheld tester to data link connector, Check and retrieve diagnostic trouble codes and freeze frame data stored in the electronic control module memory, Record and print diagnostic trouble codes and freeze frame data, Interpret diagnostic trouble codes and freeze frame data, Carryout a careful visual inspection, Set the check mode diagnosis, Perform problem symptom confirmation, Carryout parts inspection using problem symptom table, Use on-board diagnostic tools to amend the automobile computer operating programme. . The modern trend of mechanical services therefore requires the use of more complex and highly technological and special diagnostic equipment to analyze vehicle faults for repair and service. To ensure this for efficiency, safety, comfort and style, competent professional hands are required

The result of the hypothesis on the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises shows that there was no significant difference in the responses of automobile industry workers and automobile lecturers on the skills required by Technology education graduates in the maintenance of On-Board Diagnostic system for establishing automobile enterprises.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Study

The main focus of this research study was to find out the technical skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state.

Chapter 1 of the study discussed the background of the study, the statement of problem, purpose, significance, scope and the research questions were all stated and discussed for the conduct of this research.

The review of related literature looked into Concept of Skill Acquisition, Skills in the Maintenance of Automobile Engine System, Skills Required in Maintenance of the Automobile Transmission System, Skills in the Maintenance of Automobile Braking System, Skills in the Maintenance of On- Board Diagnostic (OBD) System. Various views of different authors concerning the topic were harmonized in a comprehensive literature review and empirical studies.

A survey approach was used to developed instrument for the study; the respondents identified as the population of the study were the automobile industry workers and automobile lecturers. The entire respondents were used. A number of 80 questionnaires were administered. The instrument used was analysed using frequency count, and mean scores. The research questions were discussed base on the findings from the responses and results of the instrument used.

Implication of the study and conclusions were also drawn from the findings discussed. Recommendations and suggestions for further study were formulated and stated according to the findings of the study.

5.2 Implication of the Study

The findings of the study had implications for government, technology education students and automobile lecturers Unless technologies in modern automobile systems such as engine, ignition, fuel, transmission, brake and on-board diagnostic (OBD) systems and new set of maintenance/repair skills are identified and integrated into the national curriculum content of technical colleges MVMW programmes, technical craftsmen will continue to remain irrelevant and useless in the automobile industry and as such find it difficult to gain employment or even establish self-owned automobile enterprises. This situation will not only increase crime, hunger and poverty amongst products of technical colleges and their families but will also affect the entire transportation system of the country thereby preventing the economic and industrial growth of the nation.

5.3 contribution to Knowledge

This study was able to establish the fact that the skills required by technology education graduate in establishing automobile enterprises in Minna, Niger State is important. The study further reiterate that the skills required by technology education graduate in establishing Automobile Enterprises in Minna Niger state will improve the quality of the maintainers and ignition of the vehicle in general.

5.4 Conclusion

Based on the findings of the study, the following conclusions were drawn: The general purpose of the study was to determine technical skills required by technology education graduates in establishing automobile enterprises in Minna metropolis of Niger state. Data were collected, analyzed and interpreted. Based on the findings of this study, it was concluded that techncial and new set of skills for the repair and maintenance of modern automobile systems are greatly required in almost all the systems of today’s vehicle more especially in the engine, ignition, fuel, transmission, braking and on-board diagnostic (OBD) systems.

5.5 Recommendations

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

- The identified skills of modern automobile systems should be integrated into the national curriculum of MVMW programme in technical colleges for the training of students who will be productive, enterprising, self-reliant and useful to the Nigerian automobile industry for economic and industrial development.

- The curriculum for training auto-mechanic instructors should also be reviewed to include modern automobile technologies in order to prepare teachers and instructors who will be able to implement the curriculum with the new contents for the technical college programmes.
- Federal Government of Nigeria, Automobile manufacturers and industries should collaborate with educational institutions to organize skill improvement training programmes for technical teachers on the identified knowledge and emerging technology skills.

5.6 Suggestion for Further Study

The following are suggested for further studies:

1. Strategies for skill improvement training of technical teachers on emerging technologies for effective teaching and learning of MVMW in technical colleges.
2. Assessment of the competency of technical college teachers in the utilization of emerging technologies for teaching MVMW programme in technical colleges.

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QUESTIONNAIRE

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

A QUESTIONNAIRE ON SKILLS REQUIRED BY TECHNOLOGY EDUCATION GRADUATES IN ESTABLISHING AUTOMOBILE ENTERPRISES IN MINNA METROPOLIS OF NIGER STATE

INTRODUCTION: Please kindly complete this questionnaire by ticking the column that best present your perception about the topic. The questionnaire is for research purpose and your view will be confidentially and strictly treated in response to the purpose of the research work.

SECTION A

PERSONAL DATA

Automobile Industry Workers: ☐

Automobile Lecturers: ☐

Note: A four (4) point scale is used to indicate your opinion, tick the options which best describe your agreement as shown below:

Strongly Agree	(SA)	=	4points
Agree	(A)	=	3points
Disagree	(D)	=	2points
Strongly Disagree	(SD)	=	1points

Section B: What are the skills required by Technology education graduates in the maintenance of Ignition System for establishing automobile enterprises?

S/N	Items	Scales			
		SA	A	D	SD
1	Identify the on-board diagnostic port in modern vehicles.				
2	Connect the diagnostic device to the 16-pin on-board diagnostic connector.				
3	Retrieve transmission Diagnostic Trouble Codes (DTC's).				
4	Record and print transmission diagnostic trouble codes.				
5	Interpret ignition Diagnostic Trouble Codes (DTC's).				
6	Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage.				
7	Record ignition timing using digital multimeter.				
8	Carry out throttle cable inspection and adjustment.				
9	Check the crank sensor using diagnostic tool.				
10	Perform magnetic sensor testing.				
11	Inspect, adjust or replace faulty crank position sensor.				
12	Test and diagnose defective reluctor sensor.				

Section C: What are the skills required by Technology education graduates in the maintenance of fuel system for establishing automobile enterprises?

S/N	Items	Scales			
		SA	A	D	SD
1	Ability to remove fuel injection fuel rail.				
2	Ability to remove pressure regulator.				
3	Removing and replacing electronics faulty injectors.				
4	Replacing new O-ring onto new injector.				

5	Undertaking visual inspection of the air mass sensor.				
6	Checking for leakages in induction and exhaust system.				
7	Using multimeter to check for oxygen sensor.				
8	Checking the oxygen sensor for possible damage.				
9	Ability to check malfunction indicator or lamp.				
10	Competency in checking fuel injector using multimeter.				
11	Competency in checking fuel pump and its circuits.				
12	Checking pressure sensor and power control module.				

Section D: What are the skills required by Technology education graduates in the maintenance of transmission system for establishing automobile enterprises?

S/N	**Skill Items**	**Scale**			
		SA	**A**	**D**	**SD**
1	Conduct thorough visual inspection on transmission linkage adjustments				
2	Inspect and adjust the shift cable				
3	Examine fluid level for leakage from the transmission vent				
4	Check transmission fluid and filters for oxidation or contamination				
5	Check drive train for looseness or leaks				
6	Remove and reinstall new gasket to correct fluid leakage				
7	Check torque converter for leaks				
8	Replace leaking or damaged torque converter				
9	Check transmission vent for blockage				
10	Replacement of O-ring and gears				
11	Inspect entire transmission wiring harness for tears and other damages				

12	Replace damaged fluid lines and fittings				

Section E: What are the skills required by Technology education graduates in the maintenance of braking system for establishing automobile enterprises?

S/N	**Skill Items**	**Scale**			
		SA	**A**	**D**	**SD**
1	Perform visual inspection of wheel speed sensor and cables				
2	Identify defective wheel speed sensor				
3	Check wheel speed sensor and the pulse ring				
4	Carry out speed sensor signal testing				
5	Check power supply of the wheel speed sensor				
6	Recognize a defective Anti-lock Braking System (ABS) warning light				
7	Test repaired braking system for functionality				
8	Carry out all kinds of mechanical tests on the braking system				
9	Check the operation of the braking system, adjust and repair according to the manufactures specification				
10	Replace faulty or bad braking system with new one				
11	Select appropriate tools and equipment for the maintenance of automotive braking system				
12	Service automatic braking system correctly				

Section F: What are the skills required by Technology education graduates in the maintenance of

On-Board Diagnostic system for establishing automobile enterprises?

S/N	**Skill Items**	**Scale**			
		SA	**A**	**D**	**SD**
1	Identify the on-board diagnostic port in modern vehicles				
2	Locate the diagnostic link connector				

3	Connect the vehicle on-board computer to a laptop using an interface and an on-board diagnostic software				
4	Connect the on-board diagnostic scan tool or handheld tester to data link connector				
5	Check and retrieve diagnostic trouble codes and freeze frame data stored in the electronic control module memory				
6	Record and print diagnostic trouble codes and freeze frame data				
7	Interpret diagnostic trouble codes and freeze frame data				
8	Carryout a careful visual inspection				
9	Set the check mode diagnosis				
10	Perform problem symptom confirmation				
11	Carryout parts inspection using problem symptom table				
12	Use on-board diagnostic tools to amend the automobile computer operating programme				