ON BOARD DIAGNOSTIC SKILLS REQUIRED BY MOTOR VEHICLE MECHANICS IN THE SERVICING AND MAINTENANCE OF IGNITION SYSTEM IN ILORIN METROPOLIS

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

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DECLARATION

I, **AJAYI, Abdulhamid Fikunmi** with matric no. **2016/1/63765TI** an undergraduate student of 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.

………………………………….   …………………………..

Name & Matric No   Signature and Date

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.

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DEDICATION

This research is dedicated Almighty Allah, who gave me the knowledge, understanding, strength, and courage to carry out this work to its completion. I am grateful to my wonderful parent Mr, & Mrs. Ajayi for their love, encouragement, prayers, and support

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ABSTRACT

The study was designed to investigate the on board diagnostic skills required by Motor Vehicle Mechanics (MVMs) in the servicing and maintenance of ignition system in Ilorin metropolis. A descriptive survey was used for the study. Two research questions and two null hypotheses guided the study. 25 items structured questionnaire developed by the researcher and validated by 3 experts was used for data collection. A total of 120 respondents comprising of automobile workshop supervisors and master automobile electrician was used as a total population of the study. 109 out of 120 questionnaires distributed were properly filled and used for data analysis representing 90.83% return rate. Mean and standard deviation were used to answer the research questions and t-test was used to test the hypotheses at .05 level of significance at 107 degree of freedom. The findings revealed that all the items on onboard diagnostic skills and safety skills were highly required by Motor Vehicle Mechanics (MVMs) in servicing and maintaining the electronic ignition system in Ilorin metropolis. Based on the study, it was recommended that Kwara state government should provide financial support to various automobile workshops in Ilorin metropolis so as to purchase appropriate OBD scan tools and protective equipment needed for training. It was also recommended that MVMs should ensure to always be up-to-date on the best practices by attending in-service training.

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CHAPTER ONE

INTRODUCTION

1.1   Background of the study

In the present world of rapid technological advancement, motor vehicles have become a crucial means for the easy mobility of humans and goods. Motor vehicles are widely accepted and used by individuals, organizations, companies, and industries in Nigeria due to the countless benefits derived from their use. Technology products such as motor vehicle parts are associated with wear and tear causing faults and breakdowns to occur. Also, modern cars of today are known to be equipped with sophisticated embedded computers that monitor and record engine conditions. These computers exhibit Malfunctioning Indication Light (MIL) to notify motor vehicle users and Motor Vehicle Mechanics (MVMs) of any perceived fault in the motor vehicle systems. This means that together with manual and visual diagnostic abilities, MVMs also need to be skilled and well acquitted with modern trends as regards computerized diagnostics aid such as On-Board Diagnostics (OBD). Alabi et al. (2019), stated that MVMs require OBD skills to be capable of carrying out services and maintenance on a modern automobile with both mechanical and electrical diagnostic procedures.

According to Penn (2011), MVMs are skilled workers who have been trained in auto mechanics, which includes auto body repair and spray painting, auto electrical work, auto body mechanic work, auto body construction (panel beating), and car parts merchandise. Hiller and Coombes (2014) also defined MVMs as skilled individuals that are specialized in maintaining motor vehicles and repairing and sometimes modification of motor vehicles. It can also be said that MVMs are qualified and trained technicians

whose job is to service, maintain, repair, replace, adjust or alter faulty or damaged engine components and accessories, and other parts such as suspension system, braking system, cooling system, ignition system, etc.

MVMs acquire automobile servicing and maintenance skills through formal training in Technical Colleges, Polytechnics, and Universities while some are trained through apprenticeship under the instruction of a master technician. Maintenance in this context is the process aimed at ensuring that automobile engines and other systems operate continuously in good working conditions. Maintenance involves tests, measurements, replacements, adjustments, and repairs. The main task of MVMs is to diagnose problems accurately and quickly but they fall short when it comes to diagnosing electronic components (Baba et al., 2018). Therefore, motor vehicles cannot operate in good working condition when an electronic component such as the electronic ignition system is faulty and there is no doubt that service and maintenance as regards this aspect is highly aided by adequate OBD skills.

Skill is the required ability, capacity or technique learned through practice to excellently carry out a particular task. According to crammer (2014), skill is the ability and capacity gained through a systematic, deliberate, and sustained effort to smoothly and adaptively carry out complex tasks which may include cognitive skills, technical skills, and interpersonal skills. Therefore, it can be understood that skills are possessed by craftsmen who are enterprising, self-reliant, and sufficiently competent to meet the demands of the world of work (Ede & Olaitan, 2010). Sambo et al. (2012) showed that the level of skill acquisition can be influenced by time spent with master craftsmen. This is an indication that adequate practical skills, fault detection, and isolation techniques, problem-solving skills, and interpersonal skills are best integrated into an

individual through work experience. The main focus here is the OBD skills required by MVMs in the servicing and maintenance of the ignition system.

The ignition system is an integral part of a motor vehicle and is responsible for producing the adequate spark required to effectively ignite an air-fuel mixture (fresh charge) in an Internal Combustion Engine (ICE). Okwelle et al. (2017) claimed that to efficiently and effectively repair and maintain motor vehicles, the working principle of all systems present in the motor vehicle needs to be understood by MVMs. This claim is understood to mean that comprehending the principle of operations of the ignition system is of great importance since it is one of the systems present in a motor vehicle. The mechanical ignition system is an old technology that uses a coil to multiply the voltage provided by a battery into thousands of voltages required to create a spark necessary to ignite the air-fuel mixture (fresh charge). It is characterized by a mechanical distributor used to control spark timing. As technology advanced, it was replaced by the electronic ignition system which is controlled by onboard computers known as the Power train Control Module (PCM). According to Charles (2019), the major difference between the modern electronic ignition system and the mechanical ignition system is that more than one coil activated by computer controls known as the Power train Control Module (PCM) is present in an electronic ignition system in contrast to the mechanical ignition system which has a single coil and a distributor. Laukkowen (2013) stated that since the Ignition system consists of different parts, there are different potential failure points which means that diagnosing an Ignition system failure calls for a methodological approach to eliminate one potentially failed component after another until the culprit is ultimately located.

Electronic ignition system faults such as faulty ignition coil, spark plug, spark plug wires, crank position sensor failure, and cam position sensor failure can cause a misfire

and trigger the Malfunction Indication Light (MIL) in an OBD-II motor vehicle (Michealklyde 2020). Magnus (2021) also claimed that misfires can occur due to fuel-related issues such as a faulty fuel injector or bad fuel pump and low engine compression. This indicates that some other engine parts in a motor vehicle have similar symptoms of failure as the ignition system. It also indicates that diagnosing these faults is not straightforward and it requires a skilled MVM to successfully amend as quickly and accurately as possible. Alabi et al. (2019) believe that troubleshooting and maintenance of modern automobiles are best carried out using the OBD scan tool since most of these systems now are primarily electronically operated. They mentioned further that this approach is not just an upgrade of the primitive trial-by-error or solely manual technique, it is one of the major ways an MVMs can remain relevant in the 21st-century automobile world. Despite years of active learning and training, MVMs only possess partial OBD skills to service, repair, and maintain modern automobiles. Technical college graduates of automobile technology are also not free from the criticism of having little emerging technology skills for ignition system maintenance (Udogu, 2015). This study is therefore aimed to identify onboard diagnostic skills required by motor vehicle mechanics in the servicing and maintenance of ignition system in the Ilorin metropolis.

On-Board Diagnostic (OBD) is the vehicle's computer system that provides self-diagnosis and reporting functions for easy detection of faults. OBD came into existence in the 1980s which was OBD-I. It was designed to alert motor vehicle users or mechanics of a particular fault without storing information. As a result of that, it was characterized by the limitation of not reporting the nature of motor vehicle faults to motor vehicle users or mechanics. OBD-II was introduced in the 1990s as an improvement on the OBD-I in such a way that it provides a series of diagnostic trouble

codes (DTCs) that are related to certain faults. The OBD-II can detect ignition failures due to its misfire monitoring ability controlled by PCM. The PCM of motor vehicles led to a significant reduction in engine emissions (Emmanuel et al., 2015). Therefore, engine misfire detection is an important element of OBD-II systems since engine misfires can induce an increasing level of exhaust emission and potentially damage the catalytic converter (Mohammed et al., 2011).

Modern motor vehicles have more embedded electronic components and controls that require a higher degree of complexity for testing and servicing which is aided by OBD-II scan tools. The OBD-II scan tool or scan reader is used to retrieve trouble codes from the OBD-II system and it requires a certain level of literacy and skill from MVMs. Ezeama (2017) noted that scan tools are accessible to MVMs today and that the ability to utilize and apply diagnostic skills is very essential if accurate and effective result is to be attained when using these tools.

1.2   Statement of the Problem

As a result of inadequate or partial training received, most MVMs are not skilled enough to successfully diagnose, service, and maintain ignition systems that are controlled by embedded OBD computers. The electronic ignition system are been diagnosed with an inappropriate diagnosing procedure when using the diagnostic tools by some MVMs. Therefore, the inability to adequately isolate and pinpoint the real source of a particular ignition system failure may result in damage to other related parts in a motor vehicle engine. This ends up leaving the vehicle in a worse condition in most cases. As a result, this study intends to identify the On-Board Diagnostic skills required by motor vehicle mechanics in the servicing and maintenance of ignition system in Ilorin metropolis.

1.3   Purpose of study

The main purpose of the study is to identify the On-Board Diagnostic skills required by Motor Vehicle Mechanics in the servicing and maintenance of ignition system in Ilorin metropolis. Specifically, the study sought to:

1. Identify the On-Board Diagnostic Skills Required by Motor Vehicle Mechanics to Service and Maintain the Electronic Ignition System.

2. Find out the safety skills required by MVMs when servicing and maintaining Electronic Ignition System.

1.4   Significance of the study

The findings of this study would benefit both informally trained roadside mechanics and apprenticeship programs by becoming more aware of on-board diagnostic skills and also making the required effort to improve and update their current knowledge and skills in accordance to the modern automobile diagnostic practices which are applied on the ignition system.

The integration of the identified onboard diagnostic skills in this study could enable motor vehicle mechanics to develop modern competencies required in servicing and maintaining the ignition system.

This study will provide relevant information enough to benefit motor vehicle mechanic trainers as the findings would point out specific components of the ignition system that require careful and critical diagnosis which needs to be improved upon in their training process to produce competent motor vehicle mechanics.

1.5   Scope of the Study

This study covered the On-Board Diagnostics skills required by Motor Vehicle Mechanics in the servicing and maintenance of ignition system in Ilorin Metropolis.

The study is limited to Spark Ignition Engine (SIE) and will not include Compression Ignition Engines (CIE) due to differences in ignition components used.

1.6 Research Questions

The following research questions guided the study:

1. What are the On-Board Diagnostic skills required by Motor Vehicle Mechanics to service and maintain the Electronic Ignition System?

2. What are the safety skills required by Motor Vehicle Mechanics when servicing and maintaining Electronic Ignition System?

1.7 Hypotheses

The following null hypotheses were formulated to guide the study and were tested at .05 level of significance.

1. $H_0 1$: There is no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the On-Board Diagnostic skills required by Motor Vehicle Mechanics to service and maintain the electronic ignition system in Ilorin metropolis.

2. $H_0 2$: There is no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the safety skills required by MVMs when servicing and maintaining Electronic Ignition System.

CHAPTER TWO

LITERATURE REVIEW

The literature review of this study is organized under the following subheadings:

2.1   Conceptual Framework

2.1.1   On-Board Diagnostic (OBD)

2.1.2   On-Board Diagnostic Tools

2.1.3   The Ignition System

2.1.4   Electronic Ignition System (Distributor Ignition)

2.1.5   Electronic Ignition System (Distributor-less System)

2.1.6   Role of Motor Vehicle Mechanics and their Importance in the Automobile Industry

2.1.7   OBD Skills in the Servicing and Maintenance of the Ignition System

2.1.8   Current Practices in the use of the OBD System in Servicing and Maintaining the Ignition System

2.1.9   Challenges Associated with OBD Skills for Servicing and Maintaining the Ignition System

2.2   Review of Empirical Studies

2.3   Summary of Literature Review

2.1 Conceptual Framework

2.1.1 On-Board Diagnostic (OBD)

When the automobile engine can self-diagnose and report system faults, it is generally known as the On-Board Diagnostic (OBD). Motor vehicle mechanics and automobile owners are shown information related to different automobile systems with the help of the OBD. Since the inception of OBD in the 1980s, there have been differences in the amount of diagnostic information it provides. When faults were detected by the old versions of the OBD, it only activated the malfunction indicator light (MIL) without showing the potential cause of the detected fault. But motor vehicle mechanics are now able to recognize and correct detected faults with the aid of recent OBD systems that provide a standardized series of diagnostic trouble codes (DTCs) that can be accessed when a diagnostic scan tool is plugged into the standardized digital communications port of the modern system.

When systems such as the fuel system, ignition system, Exhaust Gas Recirculation (EGR) system, and all main engine sensors are faulty, they tend to increase unhealthy exhaust emissions into the environment, but the OBD system was developed to monitor and control the emissions. The working condition of the emission controls is judged by the information obtained from the system's sensors, but emissions are only indirectly measured by these sensors. The check engine light, or MIL, is the driver information interface and a vital part of the system. It illuminates to alert the driver to any engine faults that are detected. The light disappears if the engine is restored to working condition, but the fault is stored in ECU memory to enhance diagnostics. Information about the faulty component is also stored. Then the stored information can be accessed through scanning tools. In a device known as the Engine Control Unit, modern engines are electrically controlled by real-time software.

Malfunction Indicator Light (MIL)

Udogu (2015) claimed that while engine check lights have been a part of cars for a while, the Malfunction Indicator Light (MIL) on the OBD-II system has a new standard use and significance. One of the main goals of OBD-II is to warn the driver or a repair specialist when one or more of the vehicle's systems are malfunctioning. The Malfunction Indicator Light (MIL) provides the first level of alert. Although MIL is the most typical abbreviation, this indicator has also been known as the Check Engine Light and the Service Engine Light. The MIL on the dashboard of the car could be lit up when the OBD computer notices a problem. Until the required repairs are made or the problem is resolved, this light cannot be turned off. To find out what's wrong, car owners need to consult a MVM and arrange for a service visit if the MIL illuminates steadily. After only a brief period of illumination, the indicator light may occasionally turn off. This might occur, for instance, if you tighten the gas cap after it was previously loose.

The dashboard light may blink in certain situations and this may be a sign of a significant problem. If this happens, the driver of the vehicle should immediately come to a stop and consult the owner's manual to determine whether the vehicle may be driven or if it needs to be towed to a service facility. The United states, Europe and Asia among other countries legislations require that MIL are only illuminated for emission-related malfunctions but recent development now allow On-Board computers to monitor non-emission related components (Tom, 2017).

2.1.2 On-Board Diagnostic Tools

On-Board Diagnostic tools are computer-based read-out devices created to communicate with a vehicle's on-board computer in order to read and display diagnostic trouble codes (DTCs). Udogu (2015) stated that direct communication between the scan

tool and the vehicle data stream occurs and that the ability of a scan tool to interface with any OBD-II compliant car was one of the main improvements that OBD-II offered to automotive repair. All cars must communicate with these universal scan tools in a precise manner as specified by OBD-II legislation.

2.1.3   The Ignition System

Tom (2017) stated that the ignition system's primary function is to deliver a spark to the compressed charge of fuel and air inside the cylinder when the compression stroke is almost completed. He also claimed that a voltage of 2-3 kV is needed for a spark to cross an air gap of 0.6 mm at standard atmospheric pressure (1 bar), a voltage of around 8 kV is needed for a spark to jump over an identical gap in an engine cylinder with an 8:1 compression ratio, and a voltage of up to 20 kV could be required for combinations with weaker mixtures and greater compression ratios.

2.1.4   Electronic Ignition System (Distributor Ignition)

The older mechanical ignition system present in automobiles has been replaced with electronic ignition system. Instead of depending on the mechanical movement of parts, it uses electrical components to start the spark that ignites the gasoline in the engine. The improved accuracy and reliability of an electronic ignition system are its significant benefits. It is less prone to wear and tear and can be regulated more precisely since it incorporates electrical components. This can lead to improved engine performance such as easy starting, more stable idle, and improved fuel efficiency. The Electronic Control Module (ECM), the ignition coil, distributor, and the spark plugs, crankshaft, and camshaft sensors are a few of the parts that make up the electronic ignition system. The system's brain known as the ECM uses data from sensors to regulate the timing and power of the ignition. The ignition coil is in charge of elevating the battery's low voltage to the required high voltage for spark plug ignition. While the spark plugs are

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situated at the top of the engine, they are responsible for creating the spark for igniting the air-fuel mixture at the Top Dead Center (TDC) of the cylinder.

When the ignition switch is activated, the current from the battery passes through the ignition switch and is transmitted to the primary coil windings where a magnetic field is created and collapsed to form a high voltage in the secondary windings. The current flowing to the primary windings is also turned ON and OFF as the armature of the reluctor rotates past the sensor or pick-up coil. It is able to do this when the tooth of the armature comes in direct contact with the pick-up coil and voltage signal is sent to the ECM. As the ECM receives this voltage signal, it stops the flow of current into the primary windings but the ECM has a timing circuit that turns the circuit on when the magnetic field has collapsed to cause very voltage in the secondary windings.
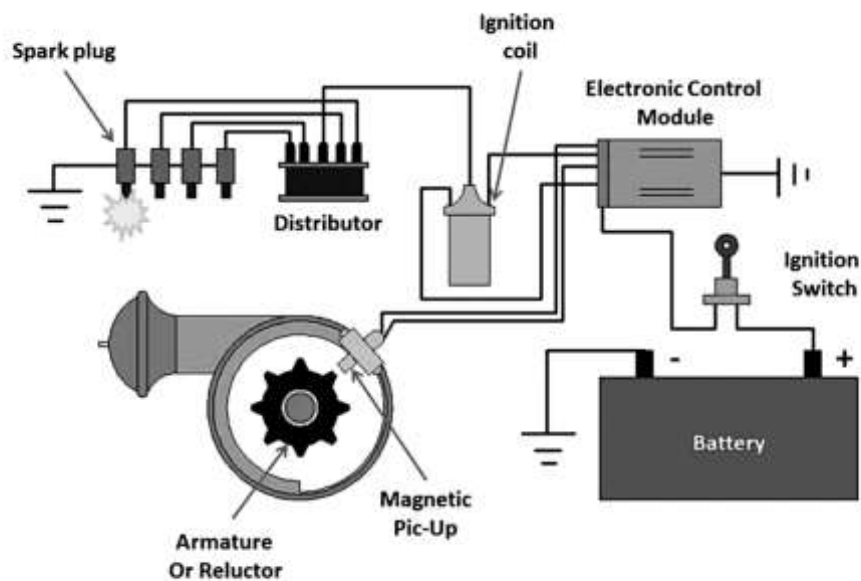
Figure 1: Early Electronic Distributor Ignition System

2.1.5   Electronic Ignition System (Distributor-less System)

To ensure that a spark was delivered to each cylinder at the appropriate moment, all gas engines up to 1984 employed a distributor that was powered by the camshaft. These systems were named Distributor Ignition (DI) systems. Electronic components have

been a part of distributor systems since the mid-1970s, and the term "electronic ignition" was formerly applied to them (Udugo, 2015).

The majority of engines made nowadays does not have distributors and perform this function using engine sensors and electrical components. Modern automobiles' four-cylinder engines employ the distributor-less ignition system (Tom, 2017). There are two ignition coils, one for the first and fourth cylinders and the other for the second and third. Every time a pair of cylinders approaches the firing point, which is close to the top dead center (TDC), a spark is generated. This indicates that a spark happens both during the power stroke and the exhaust stroke. Because of this, this kind of ignition system is also sometimes referred to as the "lost spark" system. The flywheel has two sensors, one of which measures engine speed and the other of which acts as an ignition switch. Both of them operate according to the variable resistance principle.
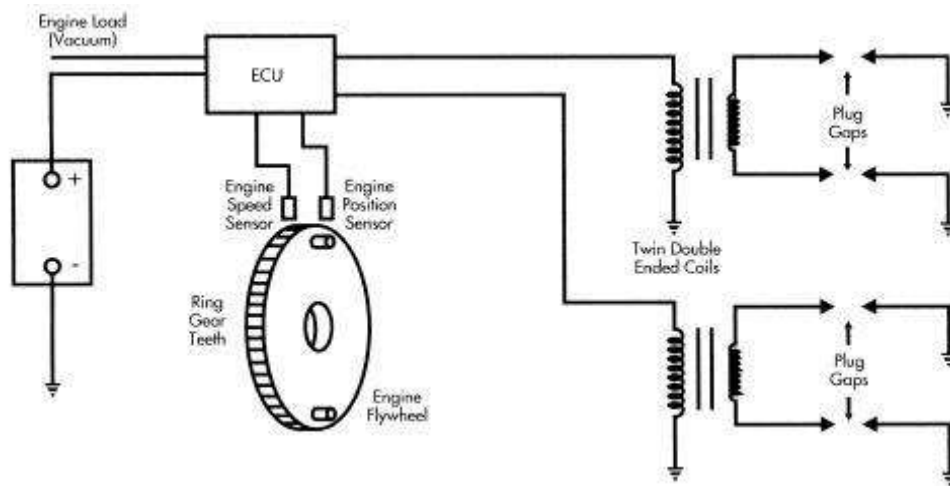
Figure 2: Distributor less Ignition System, adopted from Allan (2001)

2.1.6   Role of Motor Vehicle Mechanics and their Importance in the Automobile Industry

Motor vehicle mechanics, also known as auto mechanics or automobile technicians, play a vital role in the automotive industry in Nigeria. They are responsible for

diagnosing, repairing, and maintaining a wide range of vehicles, including cars, trucks, buses, and other types of transportation. MVM, according to Imobo (2018), check, maintain, and repair cars and light trucks that are powered by gasoline, ethanol, and other alternative fuels like electricity. Workers that can utilize computerized shop equipment and deal with electronic components while maintaining their proficiency with traditional hand tools are increasingly necessary due to the development of automobile technology. Imobo (2018) stated that autotronics technology is used by motor vehicle mechanics to carry out tasks including inspecting, detecting, servicing, maintaining, and repairing auto parts. While some technicians choose to specialize in one area, others learn the abilities necessary to work on all components of a vehicle. The typical duties of a motor vehicle technician include the following:

1. **Diagnosing problems:** Using diagnostic tools and equipment, mechanics identify and troubleshoot problems of vehicle's systems, including the engine, transmission, electrical systems, and braking system, and ignition system.

2. **Repairing and maintaining vehicles:** Mechanics repair and maintain vehicles by replacing or repairing faulty parts, such as spark plugs, belts, brakes, etc. They may also perform routine maintenance tasks, such as oil changes, brake pad replacement, battery maintenance, fluids check and refill, filter replacement, suspension and steering inspection etc.

3. **Testing and inspecting vehicles:** Mechanics test and inspect vehicles to ensure that they are safe and functioning properly. This may involve road-testing the vehicle and performing safety inspections.

4. **Communicating with customers:** Mechanics often work directly with customers, discussing their vehicles' problems and providing recommendations for repairs and maintenance.

The importance of motor vehicle mechanics in the automotive industry in Nigeria cannot be overstated. They play a crucial role in keeping vehicles on the road and ensuring that they are safe and reliable for drivers. They also help to maintain the overall efficiency and effectiveness of the transportation systems in the country.

2.1.7   OBD Skills in the Servicing and Maintenance of the Ignition System

OBD skills refer to the ability to use diagnostic tools and equipment to access and interpret real-time data from a vehicle's OBD system. OBD is a system that is built into modern vehicles to help mechanics diagnose and troubleshoot issues with the vehicle's various systems, including the ignition system. To properly service and maintain an ignition system, automobile mechanics need to be proficient in the use of OBD diagnostic tools and techniques. This may include the ability to connect a diagnostic scanner to the vehicle's OBD system, interpret diagnostic trouble codes (DTCs), and use this information to diagnose and fix issues with the ignition system. The OBD skill also involves using specialized software and diagnostic procedures to diagnose issues with the vehicle's engine, emissions, and other systems.

Tania et.al. (2008) stated that qualified MVMs with commendable diagnostic skills have become rare due to the increased complexity of modern automobile vehicles. He also claimed that due to the increased complexity, there is a high demand for good MVMs capable of performing diagnosis, maintenance, and repair on these complex automobile systems. Therefore, the OBD system is obviously among these complexities, and to develop OBD skills, mechanics and technicians typically undergo training or certification to learn how to use diagnostic tools and equipment and how to interpret the data provided by a vehicle's OBD system. Dwi (2012) also opined that modern advancements in automobiles are based on computer control systems, of which the ignition system is a crucial part, and MVM trainees are required to have mastery of

the computer-controlled system. Hence, foundational knowledge and understanding of the operation of the ignition system are necessary to troubleshoot ignition system failure. To overcome the complexities and gain basic knowledge, training may include hands-on experience using diagnostic tools and equipment, as well as theoretical instruction on diagnostic procedures and the interpretation of diagnostic codes. In addition to training and certification, developing OBD skills also requires a strong understanding of automotive systems (this study is focused on the ignition system) and how they work, as well as experience working with diagnostic tools and equipment. With the right training and experience, mechanics can use OBD diagnostic tools and techniques to quickly and accurately diagnose and fix issues with the ignition system, helping to keep vehicles running smoothly and reliably.

This can be gained through on-the-job experience as well as by staying up-to-date on the latest diagnostic technologies and techniques. Having OBD skills is essential for mechanics and technicians who work on modern vehicles, as most vehicles manufactured today are required by law to be equipped with an OBD system. In addition to their diagnostic skills, mechanics also need to be knowledgeable about the various components of the ignition system, including the spark plugs, ignition coil, distributor, and other related parts. They should be able to perform routine maintenance tasks such as replacing spark plugs and checking ignition timing, as well as more complex repairs such as replacing the ignition coil or distributor.

2.1.8 Current Practices in the use of the OBD System in Servicing and Maintaining the Ignition System

The current state of the art in OBD skills involves the use of advanced diagnostic technologies and tools to quickly and accurately diagnose and repair problems with a vehicle's ignition system and other systems. The most common type of OBD system is

OBD-II, which was introduced in the mid-1990s and is now the standard for diagnosing and repairing vehicles. OBD-II systems can diagnose a wide range of problems with a vehicle's engine, transmission, and Ignition system and are used by technicians around the world to troubleshoot and repair vehicles. To diagnose and repair ignition systems, MVMs typically use a variety of diagnostic tools and equipment, including:

1. **OBD-II scan tool:** An OBD-II scan tool is a device that can be plugged into a vehicle's on-board diagnostic (OBD-II) port to access information about the vehicle's systems, including the ignition system. It can be used to retrieve diagnostic trouble codes (DTCs) that can help pinpoint the source of any issues with the ignition system.

2. **Multimeter:** A multimeter is a device that can measure various electrical properties, such as voltage, current, and resistance. It can be used to test the electrical circuits and components in an ignition system to diagnose issues and determine if any components need to be replaced.

3. **Ignition testers:** These are specialized tools that can be used to test the condition and performance of a vehicle's ignition system, including the spark plugs, ignition coils, and other components. Ignition testers can help diagnose issues such as misfires, weak sparks, or no spark at all.

4. **Timing light:** Timing light is a tool that uses a strobe light to allow a mechanic to see the timing mark on the crankshaft pulley or flywheel. It can be used to check the ignition timing to make sure it is set correctly and diagnose any issues that may be causing the engine to run poorly.

5. **Compression gauge:** A compression gauge is a device that can be used to measure the amount of pressure inside the cylinders of an engine. It can be used

to test the compression of the engine to diagnose issues with the ignition system, such as a faulty spark plug or a problem with the ignition timing.

6. **Spark plug gapping tools:** These tools are used to measure the gap between the electrodes on a spark plug and to adjust the gap to the correct specification as needed. Incorrect spark plug gaps can cause issues with the ignition system, so it's important to ensure that the spark plugs are gapped properly.

7. **Oscilloscopes:** Oscilloscopes allow technicians to analyze the performance of electrical components and circuits and to diagnose problems with sensors, control modules, and other electronic components.

2.1.9   Challenges Associated with OBD Skills for Servicing and Maintaining the Ignition System

OBD can be a useful tool for mechanics to quickly identify problems and troubleshoot issues, but it is not without its challenges and limitations. Ezeora & Ehimen (2021) discovered in his experiment that MVMs are not familiar with the OBD system (OBDS). The revelation that they do not have relevant skills to manipulate the OBDS also indicated that they lack the necessary tools and equipment to maintain and repair modern automobiles. He went on to say that modern vehicles are outfitted with several digital sensors that can only be accurately diagnosed using the OBDS, and as a result, MVM are required to be competent enough to maintain and repair these types of vehicles, or else their performance will remain poor. This is also supported by a statement made by the National Policy on Education (NPE) that Technical and Vocational Education and Training (TVET) is facing many challenges, among which is inadequate equipment and training materials.

One of the main challenges with using OBD for servicing and maintaining ignition systems is the complexity of the system itself. Ignition systems in modern vehicles can

be quite complex, with many different components and subsystems working together to generate the spark needed to ignite the fuel and air mixture in the engine. The ignition system is made up of several different components, and a problem with one of these components can manifest in a variety of ways. For example, a faulty spark plug can cause the engine to misfire, but it can also cause the engine to run rough or fail to start altogether. As a result, diagnosing the root cause of the problem can be challenging and may require a thorough understanding of the ignition system and its components. Similarly, a wide range of vehicles may have different types of ignition systems with varying levels of complexity and different diagnostic codes and procedures. These complexities can make it difficult for mechanics to identify the root cause of an issue, especially if the problem is not related to the ignition system itself.

According to Akpakpavi (2014), one of the biggest challenges faced by MVM is the increasing ICT-driven entry barrier in the automobile industry, which causes small and medium automobile workshops to be unable to keep pace with advanced automobile technology. And as a result, the adoption of manually-based practices, e.g., trial and error, continues to be the prevailing practice. The challenge with OBD is also in the reliance on diagnostic codes and computerized systems. While OBD can provide valuable information about the health of a vehicle's ignition system, it can be difficult for mechanics to interpret and understand the meaning of these codes. In some cases, multiple codes may be present, and it can be challenging to determine which ones are relevant to the issue at hand. Additionally, OBD systems rely on computerized systems, which can be prone to errors or malfunctions. This can sometimes make it difficult for mechanics to accurately diagnose and fix problems, as they may be working with incorrect or misleading information.

Finally, OBD systems can be expensive to use. Mechanics may need to purchase specialized diagnostic equipment and software in order to access and interpret OBD data, which can be a significant investment. Therefore, OBD can be a valuable tool for servicing and maintaining ignition systems in motor vehicles, but it is not without its challenges and limitations. Mechanics may need to deal with complex ignition systems, reliance on diagnostic codes and computerized systems, and the cost required to use OBD effectively. Technicians need to be knowledgeable and experienced in using OBD to accurately diagnose and fix problems with the ignition system and other vehicle components.

2.2   Review of Empirical Studies

Alabi, James, and Idris (2019) conducted research on the core on-board diagnostic skills required by motor vehicle mechanics for troubleshooting engine performance and transmission systems of modern automobiles in Niger State. The study was conducted using a survey-research approach. Eight hundred and thirty-three (833) MVM master craftsmen and twenty-nine (29) automotive technology lecturers made up the study's population. The researcher created a standardized questionnaire for data collection. The tool was verified by three experts. At 0.05 levels of significance, two research questions and two null hypotheses were tested. Mean and standard deviation were used to respond to the research questions, and z-test statistics were used to test the null hypotheses at 0.05 levels of significance. The first research question was, "What are the on-board diagnostic skills required by motor vehicle mechanics for troubleshooting the engine performance of modern automotive?" The second research question was, "What are the on-board diagnostic skills required by motor vehicle mechanics for troubleshooting the transmission system of modern automotive?" According to the study, diagnosing the transmission system of a contemporary car requires twenty (20) skills, while

troubleshooting the engine performance of a modern car requires twenty (20) skills. Few of the suggested skills are related to the present study, which focuses on OBD skills for servicing and maintaining the ignition system.

Some of these skills include the ability to monitor camshaft timing using diagnostic tools, the ability to check the variable camshaft timing (VCT) position for misalignment using the scan tool, and the ability to inspect the variable camshaft timing (VCT) circuit to the PCM for high and low voltage.

The study focuses on the on-board diagnostic skills for troubleshooting the transmission system of modern automobiles. The current study, on the other hand, focuses on the on-board diagnostic skills needed for servicing and maintaining the ignition system. The present study has filled the identified gap.

Mbah, Chidozie, and Oluka (2021) carried out a study to determine the maintenance skill needs of auto-electrical craft graduates for self-employment in contemporary society in Anambra State. The research was carried out using a descriptive survey research design. The study was guided by two research questions and two null hypotheses. The study's participants were one hundred and fifty eight (158) car artisans and master craftsmen from Anambra State's seven largest cities who had graduated from technical colleges. Since the population could be controlled, there was no sampling. A thirty five (35)-item structured questionnaire created by the researcher served as the instrument for collecting data. The instrument was validated by three experts. To answer the study questions, the mean and standard deviation were used, and the t-test was used to test the hypotheses at the.05 levels of significance. The first research question was, "What are the automobile on-board diagnostic system skill needs of technical college Auto Electric Works graduates in contemporary society for self-employment in Anambra State?" The second research question was, "What are the

electronics ignition system skill needs of technical college Auto Electric Works graduates in contemporary society for self-employment in Anambra State?" Based on the first research question, the findings of the study showed that the skills needed include the ability to install a windmill software for reading on-board diagnostic data, identify the on-board diagnostic port in modern vehicles, locate the diagnostic link connector, connect an on-board diagnostic scan tool or handheld tester to the date connector, etc. The ability to interpret ignition diagnostic trouble codes (DTCs), record ignition timing using a digital multi-meter, inspect and adjust throttle cables, check the crank sensor using a diagnostic tool, perform magnetic sensor testing, inspect, adjust, or replace a faulty crank position sensor, and test and diagnose a deflection sensor were some of the identified skills in maintaining electronic ignition systems. While the study is related to the present study as it focuses on OBD skills as well as the electronic ignition system skills needed by Auto Electric Works graduates in Anambra State, the present study was carried out in the Ilorin metropolis.

Olaitan and Ujevbe (2020) conducted a study on thirty (30) master roadside mechanics and twenty (20) apprentice roadside mechanics in Nsukka, Enugu State, using a 4-point scale questionnaire that was validated by three experts. The study examined strategies for improving roadside motor vehicle mechanics' basic computer skills for effective manipulation of automotive digital diagnostic tools. Three research questions served as the study's direction. A descriptive survey research design was employed for the study. The data was examined using the mean and standard deviation. The study's conclusions included, among other things, that roadside motor vehicle mechanics lack the computer skills necessary for effectively using automotive digital diagnostic tools, which presents difficulties for the diagnosis, repair, and maintenance of contemporary automobiles. The study also showed that current maintenance practices fall below the international

best practices required for the effective manipulation of automotive digital diagnostic tools. As a result, roadside auto mechanics experience a daily decline in business from drivers of modern vehicles. The study recommended, among other things, that stakeholders continuously conduct appropriate training and retraining programs for up skilling roadside motor vehicle mechanics in Nsukka, an urban area of Enugu State, in partnership with leaders of roadside motor vehicle mechanics. Therefore, the study serves as a credible source and foundation for the present study due to its analysis of the strategies for improving the computer skills needed for handling digital diagnostic tools. The focus of the present study, the OBD skills needed to service and maintain the ignition system, is partly reliant on the computer skills needed for manipulating the digital diagnostic tools.

2.3 Summary of the Literature Review

The study's literature review examines relevant concepts regarding the on-board diagnostic skills required by MVM in servicing and maintaining the ignition system in Ilorin. Concepts such as the OBD, ignition system, and OBD skills in the servicing and maintenance of the ignition system were all explained. The current practices in the use of OBD systems in servicing and maintaining the ignition system, such as the use of OBD-II scan tools, oscilloscope, and other relevant tools, were also discussed.

The challenges and limitations faced by MVM in using OBD for servicing the ignition system were also explained. The following challenges were discussed: inadequate awareness (unfamiliarity) of MVM with OBD systems (OBDS), the complexity of the ignition system, an ICT-driven entry barrier in the automobile industry, and the expensive cost of diagnostic equipment. The roles and importance of MVM in the automobile industry were duly discussed too.

Finally, a review of related empirical studies was carried out on three related research works. The review enables the current researcher to have a full understanding of the concepts of topics, the choice of an appropriate research design, the method of data collection, and the data analysis method for the study. None of the research work was completely related to the OBD skills required by motor vehicle mechanics in the servicing and maintenance of ignition systems in the Ilorin metropolis. Therefore, the present study fills the gap.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1   Research Design

The study employed the descriptive survey research design. Idris et al. (2014) stated that descriptive survey design is considered suitable if the study sought information from sample that was drawn from a population using a questionnaire. Therefore, the essence of employing this research design was to enable the researcher conduct a field investigation by sampling the population of Motor Vehicle Mechanics in order to investigate the On-board diagnostic skills required by motor vehicle mechanics in the servicing and maintenance of ignition system in Ilorin metropolis.

3.2   Area of the Study

The study was conducted within Ilorin metropolis which consists of three Local Government Areas (LGA) namely; Ilorin East, Ilorin South, and Ilorin West. Ilorin is located in Kwara State, on latitude 8°24'N and 83°6'N and longitude 4°10'E and 4°36'E and It is situated at a strategic point between the densely populated south-western and the sparsely populated middle belt of Nigeria (Adedeji, Adesina, & Chikezie 2020). The neighboring States and borders by location are Niger State to the North, Kogi State to the East, Republic of Benin to the West, Oyo and Osun States to the South.

3.3   Population of the Study

The population for the study comprises 120 Automobile workshop supervisors and Master automobile electricians from the three LGAs (Ilorin East, Ilorin South, and Ilorin West) in Ilorin Metropolis.

3.4   Sample and sampling technique

The entire population was used for the study due to the manageable size, therefore no sampling was adopted.

3.5   Instrument for Data Collection

The instrument for data collection was a structured questionnaire developed by the researcher. The questionnaire consists of two sections A & B.

Section A contains personal data of the respondents (Automobile Workshop Supervisors and Master Automobile Electrician) which are necessary for the research only.

Section B contains the data collection which was carried out using 25-item structured questionnaire which will be grouped into 2 sub-sections.

Section B 1: What are the On-Board Diagnostic Skills Required by Motor Vehicle Mechanics to Service and Maintain the Electronic Ignition System?

Section B 2: What are the safety skills required by MVMs when servicing and maintaining Electronic Ignition System?

The instrument will be structured in four point response scales of;

Highly Required (HR) = 4 points

Required (R) = 3 points

Moderately Required (MR) = 2 points

Not Required (NR) = 1 point

3.6   Validation of the Instrument

The instrument was validated by three experts from the Department of Industrial and Technology Education (ITE). These experts made suggestion and corrections used in modifying the instrument, to ensure that the items are clearly stated and appropriate for the stated research questions and hypotheses. The validated questionnaire items by the validates was used for data collection and data analyses.

3.7   Method of Data Collection

Data collection was done by the researcher alone due to the manageable size of the population.

3.8   Method of Data Analysis

Data relating to the research questions was analyzed using mean and standard deviation while the t-test statistic was used for testing the null hypotheses at 0.05 level of significance. For calculating the mean and standard deviation for the items, the response modes will be assigned numerical value as follows: HR – Highly Required - 4 points, R – Required - 3 points, MR – Moderately Required - 2 points, NT – Not Required - 1 point. For answering the research question, any item with a mean response of 2.50 and above was considered as Required while those below 2.50 will be regarded as Moderately Required. This is because 2.50 is the lower true limit of Required. For testing the hypotheses, if the t-calculated value is equal or greater than the t-table value (t-critical), the null hypothesis was rejected at 0.05 level of significance otherwise was accepted.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Research Question 1

What are the On-Board Diagnostic skills required by Motor Vehicle Mechanics to service and maintain the electronic Ignition system?

Table 4.1: Mean Responses of Automobile Workshop Supervisors and Master Automobile Electricians

$N_1=62$ $N_2=47$

S/NO	Items	$\overline{X}_1$	$\overline{X}_2$	$\overline{X}_t$	Remarks
1.	Identify the on-board diagnostic port in modern vehicles	3.48	3.53	3.50	Required
2.	Connect the diagnostic device to the 16-pin on-board diagnostic connector	3.24	3.21	3.23	Required
3.	Retrieve ignition Diagnostic Trouble Codes (DTC's)	3.69	3.51	3.60	Required
4.	Record and print ignition diagnostic trouble codes	2.94	2.80	2.87	Required
5.	Interpret ignition Diagnostic Trouble Codes (DTC's)	3.60	3.49	3.55	Required
6.	Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage	3.45	3.38	3.42	Required
7.	Record ignition timing using digital oscilloscope	3.37	3.77	3.57	Required
8.	Carry out throttle cable inspection and	3.16	3.25	3.21	Required

		$\overline{X}_1$	$\overline{X}_2$		
	adjustment				
9.	Check the crank sensor using diagnostic tool	3.24	3.36	3.30	Required
10.	Perform magnetic sensor testing	2.97	3.17	3.07	Required
11.	Inspect, adjust or replace faulty crank position sensor	3.77	3.55	3.66	Required
12.	Test and diagnose defective reflector sensor	3.50	3.38	3.44	Required
13.	Check supply voltages and signals with multimeter and oscilloscope	3.55	3.15	3.35	Required
14.	Use plug wire or adapter to check for spark	3.39	3.21	3.30	Required

KEYS: N_1= Number of Automobile Workshop Supervisors

N_2= Number of Master Automobile Electricians

$\overline{X}_1$= Mean of Automobile Workshop Supervisors

$\overline{X}_2$= Mean of Master Automobile Electricians

The data presented in table 4.1 showed that the automobile workshop supervisors and master automobile electricians agreed that items 1-14 are On-Board Diagnostic skills required by Motor Vehicle Mechanics to service and maintain the electronic Ignition system. This is because their mean scores fall within the range of 2.87 – 3.66 which is above the 2.50 lower true limit of required.

4.2   Research Question 2

What are the safety skills required by motor vehicle mechanics when servicing and maintaining the electronic Ignition system?

Table 4.2: Mean Responses of Automobile Workshop Supervisors and Master Automobile Electricians.

$N_1=62$ $N_2=47$

S/NO	Items	$\overline{X}_1$	$\overline{X}_2$	$\overline{X}_t$	Remark
15.	Ability to identify and use appropriate tools	3.69	3.85	3.77	Required
16.	Ability to identify and use appropriate personal protective equipment	3.58	3.49	3.54	Required
17.	Ability to follow manufacturer's instructions and guidelines	3.53	3.40	3.47	Required
18.	Ability to use insulated tools to operate on high tension circuits when engine is running	3.55	3.47	3.51	Required
19.	Ability to disconnect/turn off the ignition system when replacing parts	3.24	3.49	3.37	Required
20.	Ability to correctly use first aid box in case of accident	3.63	3.55	3.59	Required
21.	Ability to disconnect power sources before handling high tension wires	3.48	3.62	3.55	Required
22.	Ability to be aware of the surroundings and potential hazards	3.35	3.43	3.39	Required
23.	Ability to seek out training to improve safety skills	3.27	3.59	3.43	Required
24.	Ability to regularly inspect and maintain tools	3.68	3.51	3.59	Required
25.	Ability to store tools and equipment properly	3.45	3.23	3.34	Required

The data presented in table 4.2 showed that the automobile workshop supervisors and master automobile electricians agreed that items 15-25 are the safety skills required by motor vehicle mechanics when servicing and maintaining the electronic Ignition system. This is because their mean scores fall within the range of 3.34 – 3.77 which is above the 2.50 lower true limit of required.

4.3 Null hypothesis 1

There is no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the On-Board diagnostic skills required by motor vehicle mechanics to service and maintain the Electronic Ignition system in Ilorin Metropolis.

Table 4.3: t-test analysis of mean scores and standard deviation of Automobile Workshop Supervisors and Master Automobile Electricians on the On-Board diagnostic skills required by motor vehicle mechanics to service and maintain the Electronic Ignition system in Ilorin Metropolis.

$N_1=62$ $N_2=47$

S/NO	Items	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	t-cal	Remarks
1.	Identify the on-board diagnostic port in modern vehicles	3.48	0.49	3.53	0.49	-0.53	NS
2.	Connect the diagnostic device to the 16-pin on-board diagnostic connector	3.24	0.43	3.21	0.41	0.37	NS
3.	Retrieve ignition Diagnostic Trouble Codes (DTC's)	3.69	0.46	3.51	0.49	1.97	NS

No.	Task						
4.	Record and print ignition diagnostic trouble codes	2.94	0.82	2.80	0.87	0.86	NS
5.	Interpret ignition Diagnostic Trouble Codes (DTC's)	3.60	0.63	3.49	0.74	0.84	NS
6.	Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage	3.45	0.69	3.38	0.73	0.51	NS
7.	Record ignition timing using digital oscilloscope	3.77	0.59	3.37	0.67	-3.22	S
8.	Carry out throttle cable inspection and adjustment	3.16	0.79	3.25	0.73	-0.61	NS
9.	Check the crank sensor using diagnostic tool	3.24	0.79	3.36	0.78	-0.79	NS
10.	Perform magnetic sensor testing	2.97	0.72	3.17	0.59	-1.55	NS
11.	Inspect, adjust or replace faulty crank position sensor	3.77	0.49	3.55	0.77	1.82	NS
12.	Test and diagnose defective reflector sensor	3.50	0.76	3.38	0.79	0.80	NS
13.	Check supply voltages and signals with multimeter and oscilloscope	3.55	0.61	3.15	0.82	2.92	S
14.	Use plug wire or adapter to check for spark	3.39	0.66	3.21	0.77	1.31	NS

KEYS:

N_1 = Number of Automobile Workshop Supervisors

N_2 = Number of Master Automobile Electricians

$\overline{X}_1$ = Mean of Automobile Workshop Supervisors

$\overline{X}_2$ = Mean of Master Automobile Electricians

SD_1 = Standard deviation of Automobile Workshop Supervisors

SD_2 = Standard deviation of Master Automobile Electricians

t-cal = t calculated value

S = significant

NS = not significant

df (degree of freedom) = $(N_1 + N_2) - 2 = (62 + 47) - 2 = 107$

The analysis in table 4.3 showed that the t-cal values of all items were below the t-critical value ($\pm$ 1.98) except for two items; 7 and 13. Therefore, the null hypothesis was rejected for each of the two items while it was accepted for the remaining 12 items. Hence, the responses of automobile workshop supervisors and master automobile electricians on the On-Board diagnostic skills required by motor vehicle mechanics to service and maintain the Electronic Ignition system in Ilorin Metropolis differed for two items, but did not differ on the remaining 12 items.

4.4 Null hypothesis 2

There is no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the safety skills

Required by Motor Vehicle Mechanics when servicing and maintaining the electronic Ignition system.

Table 4.4: t-test analysis of mean scores and standard deviation of automobile workshop supervisors and master automobile electricians on the safety skills required by motor vehicle mechanics when servicing and maintaining the electronic ignition system in Ilorin metropolis.

$N_1=62$ $N_2=47$

S/NO	Items	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	t-cal	Remark
15.	Ability to identify and use appropriate tools	3.69	0.53	3.85	0.36	-1.78	NS
16.	Ability to identify and use appropriate personal protective equipment	3.58	0.61	3.49	0.53	0.81	NS
17.	Ability to follow manufacturer's instructions and guidelines	3.53	0.56	3.40	0.70	1.07	NS
18.	Ability to use insulated tools to operate on high tension circuits when engine is running	3.55	0.61	3.47	0.77	0.61	NS
19.	Ability to disconnect/turn off the ignition system when replacing parts	3.24	0.59	3.49	0.58	-2.21	S
20.	Ability to correctly use first aid box in case of accident	3.63	0.47	3.55	0.49	0.86	NS

21.	Ability to disconnect power sources before handling high tension wires	3.48	0.49	3.62	0.49	-1.48	NS
22.	Ability to be aware of the surroundings and potential hazards	3.35	0.76	3.43	0.84	-0.52	NS
23.	Ability to seek out training to improve safety skills	3.27	0.63	3.59	0.49	-2.88	S
24.	Ability to regularly inspect and maintain tools	3.68	0.59	3.51	0.68	1.39	NS
25.	Ability to store tools and equipment properly	3.45	0.66	3.23	0.83	1.54	NS

The analysis in table 4.4 showed that the t-cal values of 2 items were greater than the t-critical value while 9 items were below the t-critical value ($\pm$ 1.98). As a result of this, the null hypothesis was rejected for each of the 2 items, while it was accepted for each of the remaining 11 items. This means that there is no significant difference for items accepted but there is significant difference for items rejected as regards the safety skills required by motor vehicle mechanics when servicing and maintaining the electronic ignition system in Ilorin metropolis.

4.5   Findings of the Study

1. The findings made in this study on research question one showed that all 14 items are the On-Board Diagnostic skills required by Motor Vehicle Mechanics to service and maintain the electronic Ignition system. Some of these skills

include the ability to identify OBD port, connect diagnostic device, retrieve, record, print, and interpret ignition Diagnostic Trouble Codes (DTCs), etc.

2. The findings of this study based on research question two showed that all 11 items are safety skills required by motor vehicle mechanics when servicing and maintaining the electronic Ignition system. Summarily, some of this skills required are ability to identify and use appropriate tools and personal protective equipment, ability to follow manufacturer's instructions and guidelines, etc.

3. The findings of this study on hypothesis one revealed that there is no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the On-Board diagnostic skills required by motor vehicle mechanics to service and maintain the Electronic Ignition system in Ilorin Metropolis.

4. The findings of this study on hypothesis two revealed that there is no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the safety skills required by Motor Vehicle Mechanics when servicing and maintaining the electronic Ignition system.

4.6   Discussion of the Findings

1. The data analysis based on the research question one as presented in table 4.1 revealed that the itemized OBD skills required by motor vehicle mechanics to service and maintain the electronic ignition system were rated to be highly required. These highly required skills are ability to; identify the on-board diagnostic port in modern vehicles, connect the diagnostic device to the 16-pin On-Board Diagnostic connector, retrieve ignition DTCs, record and print ignition DTCs, check the crankshaft position (CKP) and camshaft position

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(CMP) sensors and their wiring for damage, record ignition timing using digital oscilloscope, 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 reflector sensor, check supply voltages and signals with multimeter and oscilloscope, use plug wire or adapter to check for spark. The findings of this study are also supported by Mbah, Chidozie, and Oluka (2021) as their study showed that skills such as the ability to check the crank sensor using diagnostic tools, use plug wire or adapter to check for spark, check supply voltages and signals with the use of multimeter and oscilloscope are needed for servicing and maintaining the ignition system. It also in conformity with the findings of Udogu (2015), who stated that MVMs are expected to use their OBD skills to service and maintain the ignition system of modern technology automobiles. All the above listed skills which were considered to be highly required are very important when servicing and maintaining the electronic ignition system of modern vehicles with OBD abilities. Therefore, automobile workshop supervisors, master automobile electrician, and other MVMs who are highly experienced need to focus on training and developing young and inexperienced MVMs around these skills.

2. The data collected based on research question two as presented in table 4.2 showed that all 11 items regarding the safety skills required by MVMs when servicing and maintaining the electronic ignition system are highly required. These highly required safety skills are ability to; identify and use appropriate tools, identify and use appropriate personal protective equipment, follow manufacturer's instructions and guidelines, use insulated tools to operate on

high tension circuits when engine is running, disconnect the ignition system when replacing parts, correctly use first aid box in case of accident, disconnect power sources before handling high tension wires, be aware of the surroundings and potential hazards, seek out training to improve safety skills, regularly inspect and maintain tools, and store tools and equipment properly. Servicing and maintaining the electronic ignition system comes with the risk of getting electrocuted. This is because the electronic ignition system consists of battery, coils, and high tension wires which carry very high voltage. As a result of this, when applying the required OBD skills in servicing and maintaining the electronic ignition system, it is necessary that MVMs are highly skilled in ensuring the safety of themselves, safety of their workshop environment, and of the modern vehicle they are working on. Therefore, automobile workshop supervisors, master automobile electrician, and other MVMs who are highly experienced need to also focus on training and developing young and inexperienced MVMs around these safety skills.

3. Findings on hypothesis one as presented in table 4.3 showed that for 12 out of 14 OBD skills, there was no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the On-Board diagnostic skills required by motor vehicle mechanics to service and maintain the Electronic Ignition system but they significantly differed in 2 of the OBD skills. The mean responses on the two OBD skills showed that the Automobile Workshop Supervisors rated the 2 required OBD skills slightly higher which are closer to the upper limit of 4 point compared to the Master Automobile Electricians. And as a result of this, there was a significant difference in two items only. Therefore, this means that there is conformity

between the opinion of both respondents on all 14 itemized OBD skills but they differ slightly in the extent to which 2 out of 14 OBD skills are required.

4. The findings on hypothesis two as presented in table 4.4 revealed that for 9 out of 11 OBD skills, there was no significant difference between the mean responses of Automobile Workshop Supervisors and Master Automobile Electricians on the safety skills required by Motor Vehicle Mechanics when servicing and maintaining the electronic Ignition system except in two cases where the responses on 2 safety skills differed significantly. The two skills are; ability to disconnect the ignition system when replacing parts, and ability to seek out training to improve safety skills. Nevertheless, the two sets of respondents had similar opinion that both skills are required but the automobile workshop supervisors are of the opinion that they are highly required while the master automobile technicians are of the opinion that the two skills are required or moderately required. This been the reason for the significant difference.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1   Summary of the Study

The purpose of the study is to identify the on-Board diagnostic skills required by motor vehicle mechanics in the servicing and maintaining of the ignition system in Ilorin metropolis. As a result of inadequate or partial training received, most motor vehicle mechanics are not skilled enough to successfully diagnose, service, service, and, maintain ignition systems that are controlled by on-board computers. The electronic ignition system are been diagnosed with an inappropriate diagnosing procedure when using the diagnostic tools by some MVMs. Therefore, the inability to adequately isolate and pinpoint the real source of a particular ignition system failure may result in damage to other related parts in a motor vehicle engine. This may end up leaving the vehicle in a worse condition in most cases.

The study employed the descriptive survey research design. The population for the study comprises of 120 automobile workshop supervisors and master automobile electricians from the three LGAs (Ilorin East, Ilorin South, and Ilorin West) in Ilorin Metropolis. The entire population was used for the study due to the manageable size; therefore, no sampling was adopted. 109 out of 120 questionnaires were successfully returned. The instrument was validated by three experts from the Department of Industrial and Technology Education (ITE). These experts made suggestion and corrections which was used in modifying the instrument, to ensure that the items are clearly stated and appropriate for the sated research questions and hypotheses. The validated questionnaire items were eventually used for data collection and data

analyses. The data collected was analyzed using mean and standard deviation while t-test statistic was used to test the null hypothesis at 0.05 level of significance.

5.2   Implications of the Study

Experienced MVMs such as Automobile workshop supervisors and master automobile electricians need to improve all skills that revolve around the diagnosis of electronic ignition system i.e. both OBD skills and safety skills.

When these experienced MVMs are skilled and competent enough in this aspect of OBD skills and related safety skills, younger, upcoming, or inexperienced MVMs would consequently be equipped with these skills to service and maintain the electronic ignition system. And this is feasible since the inexperienced ones are normally trained by the experienced ones.

When experienced MVMs and their students or trainees implement the findings of this study, they would become adequately skilled in isolating and pinpointing the real source of a particular ignition system failure. as a result of this, damage to the ignition system, other related systems, and safety issues would be drastically reduced to its minimum since there would be a minimized reliance on trial an d error method of diagnosis.

5.3   Contribution to Knowledge

The study contributed to knowledge by establishing the required OBD skills that are required by MVMs in the servicing and maintaining of the ignition system. It also establishes the safety skills needed by MVMs when servicing and maintaining the electronic ignition system.

5.4 Conclusion

Motor vehicle mechanics in Ilorin metropolis need on-board diagnostic skills so that they are able to effectively service and maintain the ignition system of modern automobile used in the metropolis. Acquisition of these skills leads to the availability of motor vehicle mechanics that are relevant in the 21st century when it comes to effective and efficient service delivery ignition system. Based on that, this study has revealed the on-board diagnostic skills required my motor vehicle mechanics in the servicing and maintain of the ignition system in Ilorin metropolis.

5.5 Recommendations

1. Those in charge of training motor vehicle mechanics should ensure that all the skills identified in the study are incorporated into the training.

2. Both trainers and trainees are faced with financial challenges, therefore, Kwara state government should provide financial support to various automobile workshops in Ilorin metropolis so as to purchase appropriate OBD scan tools and protective equipment needed for the training.

3. Motor vehicle mechanics should ensure to always be up-to-date on best practices by attending in-service training. Therefore, professional bodies such as National Automotive Council (NAC) should make the process easy by periodically organizing training workshops.

5.6 Suggestion for Further Studies

By putting the findings and limitations of the study into consideration, the following are suggestions proposed for other researchers to explore;

1. A similar study on the on-board diagnostic skills required for servicing and maintaining the ignition system can be carried out in a larger scale i.e. the whole state or whole nation at large.

2. Replication of this study can be carried on other motor vehicle system such as braking, suspension, and fuel systems.

3. This study can also be replicated for compression ignition engine.

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REQUEST LETTER TO VALIDATORS

Industrial and Technology Education Department

Federal University of Technology,

P.M.B. 65.

Minna.

26th January, 2023

Dear Sir,

REQUEST FOR FACE VALIDATION OF INSTRUMENT FOR ON-BOARD DIAGNOSTIC SKILLS REQUIRED BY MOTOR VEHICLE MECHANICS IN SERVICING AND MAINTAINING THE IGNITION SYSTEM IN ILORIN METROPOLIS.

I am an undergraduate student of the above named address currently undertaking a study on the topic: ON-BOARD DIAGNOSTIC SKILLS REQUIRED BY MOTOR VEHICLE MECHANICS IN SERVICING AND MAINTAINING THE IGNITION SYSTEM IN ILORIN METROPOLIS.

Attached is the draft copy of the instrument. As an expert in this area, your assistance is hereby solicited to enable me accomplish this task. Kindly go through the item to verify their clarity, relevance and appropriateness in the use of language. In addition to this you can also make further suggestions that will improve the status and quality of the instrument. Your contribution to this work is highly appreciated.

Thanks

Yours faithfully,

Ajayi Abdulhamid

2016/1/63765TI

Industrial and Technology Education Department

Federal University of Technology,

P.M.B. 65.

Minna.

26th January, 2023

Dear Respondent,

REQUEST FOR RESPONSE TO QUESTIONNAIRE

I am a final year student of the above mentioned institution, undertaking a study titled: **"On-Board Diagnostic Skills Required by Motor Vehicle Mechanics in Servicing and Maintaining the Ignition System in Ilorin Metropolis ".** Your objective responses are highly needed in ascertaining the facts under investigation. Please feel free and open to share your mind objectively, for your responses have great impact on the findings. All collected responses will be used only for this research and treated confidentially.

Thank you

Yours faithfully,

Ajayi Abdulhamid
2016/1/63765TI

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

RESEARCH QUESTIONNAIRE

A QUESTIONNAIRE FOR AUTOMOBILE WORKSHOP SUPERVISORS AND MASTER AUTOMOBILE ELECTRICIANS

Research Topic: On-Board Diagnostic Skills Required by Motor Vehicle Mechanics in Servicing and Maintaining the Ignition System in Ilorin Metropolis.

Instruction: Please read the questions and respond appropriately by ticking your choice [√].

Response Option: Highly Required = HR = 4 points

Required =R = 3 points

Moderately Required = MR = 2 points

Not Required = NR = 1 points

SECTION A

NAME OF AUTOMOBILE WORKSHOP……………………..

……………………………………………………………………………………………….

LOCATION …………………………………………………………………………………...

……………………………………………………………………………………………….

AUTOMOBILE WORKSHOP SUPERVISOR

MASTER AUTOMOBILE ELECTRICIAN

Please tick appropriately.

SECTION B 1

What are the On-Board Diagnostic Skills Required by Motor Vehicle Mechanics to Service and Maintain the Electronic Ignition System?

S/NO	Items	HR 4	R 3	MR 2	NR 1
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 ignition Diagnostic Trouble Codes (DTC's)				
4.	Record and print ignition 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 oscilloscope				
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 reflector sensor				
13.	Check supply voltages and signals with multimeter and oscilloscope				
14.	Use plug wire or adapter to check for spark				

SECTION B 2

What are the safety skills required by Motor Vehicle Mechanics when servicing and maintaining Electronic Ignition System?

S/N0	Items	HR 4	R 3	MR 2	R 1
15.	Ability to identify and use appropriate tools				
16.	Ability to identify and use appropriate personal protective equipment				
17.	Ability to follow manufacturer's instructions and guidelines				
18.	Ability to use insulated tools to operate on high tension circuits when engine is running				
19.	Ability to disconnect/turn off the ignition system when replacing parts				
20.	Ability to correctly use first aid box in case of accident				
21.	Ability to disconnect power sources before handling high tension wires				
22.	Ability to be aware of the surroundings and potential hazards				
23.	Ability to seek out training to improve safety skills				
24.	Ability to regularly inspect and maintain tools				
25.	Ability to store tools and equipment properly				