

Identification of Competencies Required By Auto-Electricity/Electronics Graduates of Technical Colleges for Success in Automotive Servicing In Nigeria

Kanife ¹, Chukwuemeka Emmanuel ², Okanya Arinzechukwu Victor ³

Abstract

The study is on the Identification of Competencies Required By Auto-Electricity/Electronics Graduates of Technical Colleges for Success in Automotive Servicing In Nigeria. A descriptive survey research design was adopted for the study. Two research questions guided the study. The population of the study is 150 auto-electricians some of who are technical college graduates and who are also registered members of Automobile Electrician Association of Nigeria, Nsukka branch. Due to the manageable size of the population the entire population was used as the sample of the study. The instrument for data collection is the questionnaire. A 99 item questionnaire was developed from literature to obtain data for the study. The instrument was validated by three experts from the faculty of vocational and technical education, University of Nigeria, Nsukka. The frequency table was used to tally the responses in the different categories of each item. The mean was used to analyze the data collected. Decision Rule: real limit of number was applied in decision making thus: any item that have a mean of 3.50-4.00 will be termed Very highly required, 2.50-3.49 is regarded as Highly required, 1.50-2.49 will be termed Slightly required, 0.50-1.49 will be termed Not required. The findings revealed various competencies required by auto electrician graduates for success in auto motive servicing in accordance with the specific electrical system found in a vehicle, ranging from the starting motor to the computer/mechatronics systems. It was discovered that each competency is highly required for the proper maintenance of automobile with regards to auto electricians. Also, based on the findings of this study, it was recommended that Curriculum of Technical colleges should be reviewed on a regular basis to reflect workplace needs. The learning environment should be a replica of working environment. Within the competency list, Core competency items, which are essential for entry-level students, are required to be taught. Knowledge of these tasks is highly needed to integrate for increasing activity in automotive technology.

Keywords: Technical colleges, Automotive Servicing, Automotive systems, Auto electricians and Electricity/electronics technology.

Author Affiliation: ^{1,2,3} Department of Industrial Technical Education, Faculty of Vocational and Technical Education, University of Nigeria, Nsukka, Enugu, Nigeria.

Corresponding Author: Kanife. Department of Industrial Technical Education, Faculty of Vocational and Technical Education, University of Nigeria, Nsukka, Enugu, Nigeria.

Email: chukwuemekakanife994@gmail.com

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1. INTRODUCTION

IMPULSE BUYING

Technical college is an educational institution that prepares students for a career in a specific field. It is a college that trains individuals for jobs in technology and other skill oriented programmes. Technical colleges in Nigeria are established to produce craftsmen at the craft (secondary) level and master craftsmen at advance craft (post secondary) level Nigerian Policy on Education (NPE) (2013). Technical college according to Ruth and Raven,^[1] is a regional higher education institution offering certificates for professional technical subjects. Technical colleges are institutions in which the main feature of their curricula activities are structured in foundation and trade modules (NPE 2013). The curriculum programmes of technical colleges according to Nigerian Policy on Education (2013) are grouped into related trades which consist of four components namely: General education, theory and related courses, workshop practice, Industrial training/production work, Entrepreneurial training.^[2]

Furthermore, they train and produce technicians for industry, they impart vital technical skills in the youths,

and they help towards the goal of self employment and job creation towards technological advancement and skill acquisition.^[3] The objectives of technical colleges according to (NPE 2013) shall be to: Provide trained manpower in the applied sciences and business particularly at craft, advanced and technical levels, Provide technical knowledge and vocational skills necessary for agricultural, commercial and economic development and to give necessary training and impart skills to individuals who shall be self-reliant. For these objectives to be achieved programmes are offered in a technical colleges and one of it is automotive technology which is also known as motor vehicle mechanic work, designed to provide skills and training in automotive trades.

Automotive systems in automotive technology are organized into ten major areas namely: Computer systems monitor and control various vehicle systems, Fuel system provides a combustible air-fuel mixture to power the engine, Electrical system generates and/or distributes the power needed to operate the vehicle's electrical and electronic components, Cooling and lubrication systems

prevent engine damage and wear by regulating engine operating, temperature and reducing friction between internal engine parts.^[4] Exhaust and emission control systems quiet engine noise and reduce toxic substances emitted by the vehicle, Drive train systems transfer power from the engine to the drive wheels, Suspension, steering, and brake systems used to slow and stop a rotating wheel and thus a moving vehicle, Accessory and safety systems increase occupant comfort, safety, security, and convenience.^[5] These systems are maintained through a process called automotive servicing.

Automotive Servicing is a series of maintenance procedures carried out at a set time interval or after the vehicle has travelled a certain distance.^[6] The service intervals are specified by the vehicle manufacturer in a service schedule and some modern cars display the due date for the next service electronically on the instrument panel.^[7] Automotive servicing is an act of inspecting or testing the conditions of the vehicle subsystems such as computer systems: fuel system, electrical system, cooling and lubrication systems, exhaust and emission control systems, drive train systems, steering, and brake systems, accessory and safety systems.^[8] Procedures commonly carried out during a motor vehicle service include: change the engine oil, replace the oil filter, replace the air filter, replace the fuel filter, replace the spark plugs, tune the engine, check level and refill brake fluid, check level and refill power steering fluid, check level and refill automatic transmission fluid, grease and lubricate components, inspect and replace the timing belt if needed, check condition of the tires.^[9] However, automotive servicing is not limited to the above procedures but all those set of activities that can increase the longevity of a vehicle which include replacement of worn out parts, fixing faulty parts etc.^[10]

Electricity/electronics is a type of automotive specialty which deals with the operation, diagnosis, and service of the electrical, electronics and computer control systems found on today's automobiles. (Duffy, 2010). The electrical components such as battery, fuse, starter, Ignition coil, Capacitor, alternator, voltage regulator of the vehicles bring about the electrical energy needed to crank the engine for starting, recharge the battery after cranking, creating air fuel charges and power the headlamps, light bulbs and electrical accessories.^[11] Individuals in this field of automotive technology are called Auto electricians.

Auto electricians' graduate from a technical college are individual whose job is to diagnose, repair, and maintain the electrical components of cars, trucks, and a variety of other vehicles that are used for personal and the commercial use.^[12] An auto electrician according to Fischer^[13] should be able to perform the following task/competencies: work with computer-controlled engine management systems, service, identify and repair faults on electronically controlled vehicle systems such as electronic fuel injection, electronic ignition, anti-lock braking, cruise control, automatic transmission, airbags and air conditioning, install electrical equipment such as gauges, lighting, alternators and starter motors in vehicles, install electrically operated accessories such as radios, heating or demisting equipment, air conditioners, driving lamps and anti-theft systems, refer to circuit diagrams, and use meters and test instruments to find electrical faults, adjust engine control systems and timing to ensure vehicles are running at peak performance, test recondition and replace faulty

alternators, generators, starter motors and related items such as voltage regulators and batteries, repair or replace faulty ignition, electrical wiring, fuses, lamps and switches, use hand tools, specialized electrical tools, instruments and machines, including drills, grinders, presses and lathes, solder or weld when repairing electrical parts, sell and install electrical parts and accessories, install, repair and service air conditioning systems. Auto electricians install, maintain, identify faults and repair electrical wiring and computer-based equipment in motor vehicles and related equipment.^[8]

There are many other different tasks/competencies exhibited by an auto electrician/electronics towards automotive servicing. Most competencies are important for the diagnostic and repairs thereby denoting the reliability of the technician. Competence is the ability of an individual to do a job properly. A competency is a set of defined behaviors that provide a structured guide enabling the identification, evaluation and development of the behaviors in individual employees.^[14] Competencies are the measurable or observable knowledge, skills, abilities, and behaviors critical to successful job performance.

There are mainly two types of competency namely Technical and Core competencies. Technical competencies refer to a skill or area of knowledge used in the occupations of an industry.^[15] It is the ability to perform the activities within an occupation to a defined standard, consistently and over time. However there have been some recent technological innovations in automotive servicing in which an auto electrician requires competence.

2.Statement of the Problem

The quality of technical college graduates has been a major source of concern by most employers in Nigerian labor market. The expectation of the society and the graduates of this programme is that of gaining employment in automotive industries, establishing a repair/ Maintenance shop or going for further studies after graduation. It has been observed that auto electricians from technical colleges lack practical competencies and are not carrying out maintenance of automobiles to the satisfaction of their employers. Most of this mechanics end up on the road side where they are restricted to crude implements due to improper knowledge of tasks and skills needed for auto vehicle maintenance and repairs. The worry of this Paper is that graduates from technical colleges exhibit low technical skills in auto electricity/electronics in automotive servicing or maintenance, it now becomes obvious that the identification of appropriate competencies in autoelectricity/electronics will help graduates to be competent. However the essential functions of an auto electrician includes taking readings using a laptop or hand held device connected to an engine's electronic control unit(found in newer vehicles), checking, testing and wiring of parts in older vehicles using portable instruments, researching faults using manufacturers circuit diagrams and specification manuals.

Accurate explanation of these competencies will inform old mechanics of the currents trend of skills required as regards to automotive servicing.

3. Research Questions

The following research questions guided the study:

- 1 What are the competencies required by auto electrician graduate for success in automotive servicing?
- 2 What are the various sources for skill acquisition by auto electrician graduate for success in automotive servicing?

4. Methodology and Procedures

A descriptive survey research design was adopted for the study. It was conducted in, Nsukka Urban area of Enugu State. The population of the study is 150 auto-electricians some of who are technical college graduates and who are also registered members of Automobile Electrician Association of Nigeria, Nsukka branch. Due to the manageable size of the population the entire population was used as the sample of the study. The instrument for data collection is the questionnaire. The questionnaire is divided into two sections; Section A and Section B. Section A solicit information on the background information of the respondents such as Sex, Years of Experience etc. Section B is subdivided into Part I and Part II in line with the research questions as specified for the study. Part 1 sought for data information on the competencies required by auto electrician graduate for the success of automotive, Part II sought data information on the

sources of skill acquisition for auto electrician graduate for the success of automotive servicing. Each of the items is designed to elicit responses of the respondents to the researcher's questions. The questionnaire generated from literature consists of 99 items. Each of the items is supplied with four responses categories of; Very Highly Required, Highly Required, Slightly required, and Not Required, Very highly Possessed, Highly Possessed, Slightly Possessed and Not Possessed for part I, Strongly Agree, Agree, Disagree and Strongly disagree for part II. In relation to each item, the respondents are expected to choose the response categories, which best appeals to them.

The questionnaire was face validated by three experts from the faculty of vocational and technical education, University of Nigeria, Nsukka. Their suggestions and recommendation were integrated into the final copy of the questionnaire. The questionnaire was administered on 150 respondents. The researcher employed the services of two research assistants who helped in the administering and collection of the questionnaires. The frequency table was used to tally the responses in the different categories of each item. The mean was used to analyze the data collected. Decision Rule: real limit of number was applied in decision making thus: any item that have a mean of

TABLE 1: Mean ratings of the responses of respondents on the diagnose faults in starting system of vehicle.

S No	Items	Mean	Remark
1.	Carry out tests on the spark plug to determine faults.	3.14	HR
2.	Using proper testing tools	3.20	HR
3.	Adopt a method for diagnosing faults.	3.10	HR
4.	Identify faults and determine repair action.	3.26	HR
5.	Carry out tests according to guidelines.	3.12	HR
6.	Follow repair manual effectively for diagnosing.	3.10	HR
7.	Check the cranking.	3.12	HR

From table 1 above, the respondents agreed that item 1,2,3,4,5,6,7 are highly required in diagnosing faults in starting system of vehicle with mean range of 2.50-3.49. This implies that the items are highly required for diagnosing faults in starting system of vehicle.

TABLE 2: Mean ratings of the responses of respondents on how to repair starter motor of vehicle.

S/N	Items	Mean	Remark
8.	Repair faults in the starter motor.	3.03	HR
9.	Adopt a method for repairing starter.	3.33	HR
10.	Inspect and ensure that the fault is rectified.	3.09	HR
11.	Observe occupational health rules.	3.37	HR
12.	Follow Repair manual.	3.01	HR

From table 2, the respondents agreed that items 8,9,10,11,12 are highly required for repairing faults in the starter motor with the mean range of 2.50-3.49. This implies that the items are highly required for repairing starter motor of vehicle.

TABLE 3: Mean ratings of the responses of respondents on how to the install the starter motor in a vehicle.

S/N	Items	Mean	Remark
13.	Select relevant tools and method for installation.	3.12	HR
14.	Reconnect the wiring and connectors.	3.25	HR
15.	Tighten the bolts of the starter motor to specified toque	3.17	HR
16.	Ensure the faults is removed.	3.25	HR

From the above table 3, the respondents agreed that items 13,14,15,16 are highly required for installation of starter motor in the vehicle with mean range of 2.50-3.49. This implies that the items are highly required for installation of the starter motor in the vehicle.

TABLE 4: Mean ratings of the responses of respondents on how to diagnose faults in charging system.

S/N	Items	Mean	Remark
16.	Carry out test on battery and alternator.	3.18	HR
17.	Adopt a method of diagnoses.	3.35	HR
18.	Identify faults and repair them.	3.07	HR
19.	Carry out test according to guidelines	3.10	HR
20.	Follow repair manual	2.99	HR

From table 4 above, the respondents agreed that items 16,17,18,19,20 are highly required for diagnosing faults in charging system with mean range of 2.50-3.49. This implies that the items are highly required for diagnosing fault in charging system.

TABLE 5: Mean ratings of the responses of respondents on how to replace faulty components of alternator.

S/N	Items	Mean	Remark
21.	Select relevant tools.	3.24	HR
22.	Adopt a method for repairing indicator lighting	3.18	HR
23.	Follow repair manual	3.20	HR

From table 5 above, the respondents agreed that items 21,22,23 are highly required for replacing faulty components of alternator in charging system with mean range of 2.50-3.49. This implies that the items are highly required in replacing faulty components of alternator in charging system of vehicle.

TABLE 6: Mean ratings of the responses of respondents on how to replace light bulb of a vehicle.

S/N	Items	Mean	Remarks
24.	Select proper tools.	3.15	HR
25.	Follow instruction in repair manual.	3.09	HR
26.	Communicate to the client.	3.21	HR
27.	Implement instruction from manual.	3.03	HR
28.	Observe safety rules.	3.04	HR

From table 6 above, the respondents agreed that item 24,25,26,27,28 are highly required for the replacement of faulty light bulbs with mean range of 2.50-3.49. This implies that the items are highly required in replacing light bulbs of a charging system in a vehicle.

TABLE 7: Mean ratings of the responses of respondents on how to align the head light of a vehicle.

S/N	Items	Mean	Remark
29.	Select proper tools.	3.26	HR
30.	Use a method for adjusting head light.	3.03	HR
31.	Inspect and verify the focus of head light.	3.25	HR
32.	Observe occupational and machine safety	2.99	HR

From the table 7 above, the respondents agreed that the item 29,30,31,32 are highly required highly required in aligning the head light of a vehicle with mean range of 2.50-3.49. This implies that the items are highly required in replacing faulty light bulbs in a charging system of a vehicle.

TABLE 8: Mean ratings of the responses of respondents on how to inspect conventional ignition system components of a vehicle.

S/N	Items	Mean	Remarks
33.	Warnings are observed.	3.16	HR
34.	Inspection is performed.	3.50	VHR
35.	Inspection are recorded	2.95	HR
37.	Inspection reports is forwarded to supervisors	3.35	HR
38.	Test ignition system	3.14	HR
39.	Correct information is accessed	3.30	HR
40.	Test is carried out to determine faults.	3.09	HR
41.	Tests are completed	3.35	HR
42.	Faults are identified/repared	2.94	HR
43.	All tests are carried out.	3.19	HR

From table 8 above, the respondents agreed that the items 33,34,35,36,37,38,39,40,41,42,43 are highly required for inspecting conventional ignition system components with the mean range of 2.50-3.49. This implies that the items highly required in inspecting conventional ignition system components in ignition system of a vehicle.

TABLE 9: Mean ratings of the responses of respondents on how to service ignition system and components.

S/N	Items	Mean	Remarks
44.	Correct information is accessed	3.04	HR
45.	Service of conventional ignition	2.95	HR
46.	Adjustments are made.	3.01	HR
47.	Engine is run and tested for proper operation	3.02	HR

From table 9 above, the respondents agreed that all the items are highly required for service of conventional ignition system and its components with mean range of 2.50-3.49. This implies that the items highly required in servicing ignition system and components of ignition system of a vehicle.

TABLE 10: Mean ratings of the responses of respondents on how to repair conventional ignition system.

S/N	Items	Mean	Remarks
48.	Correct information is accessed.	3.09	HR
49.	Repairs are carried out with proper tools.	3.21	HR
50.	Ignition system is carried out without damage.	3.09	HR
51.	Ignition system is tested.	3.29	HR
52.	Repairs and tests are carried out according to requirement.	3.06	HR

From table 10, the respondents agreed that all the items are highly required for repairing conventional ignition system components of a vehicle with mean range of 2.50-3.49. This implies that the items are highly required in repairing conventional ignition system of a vehicle.

TABLE 11: Mean ratings of the responses of respondents on how to carry out heating, ventilation, engine cooling systems repair.

S/N	Items	Mean	Remarks
52.	Diagnose temperature control problems in heater.	3.30	HR
53.	Perform cooling recovery test	2.96	HR
54.	Inspect engine cooling and heater hoses.	3.29	HR
55.	Inspect test and replace thermostat	3.20	HR
56.	Flush system: refill with coolant	3.21	HR
57.	Inspect and test cooling fan, fan clutch etc	3.41	HR
58.	Inspect and test fan circuit, determine action.	3.14	HR
59.	Inspect and test heater control valve.	3.24	HR
60.	Remove and reinstall heater core.	3.19	HR

From table 11, the respondents agreed that all the items are highly required for heat ventilation and engine cooling system diagnosis and repair with mean range of 2.50-3.49. It implies that the items are highly required in heat ventilation and engine cooling system diagnosis and repair.

TABLE 12: Mean ratings of the responses of respondents on how to carry out operating systems & related controls diagnosis & repair.

S/N	Items	Mean	Remarks
61.	Diagnose malfunctions	3.19	HR
62.	Inspect and test A/C heater, resistors: perform necessary action.	3.28	HR
63.	Test and diagnose A/C compressor clutch systems: perform action.	3.31	HR
64.	Diagnose malfunctions in the vaccum and mechanical components.	3.17	HR
65.	Inspect and test A/c heater control panel.	3.27	HR
66.	Inspect and test A/c heater control cable and linkages	3.11	HR
67.	Inspect A/C heater ducts doors etc.	3.23	HR
68.	Check operation of automatic and semi automatic heating.	3.11	HR

From table 12 above, the respondents are in harmony that the items are highly required for operating system of a heating and ventilation system with 2.50-3.49. This implies that the items are very highly required in heat ventilation and engine control system and repair.

TABLE 13: Mean ratings of the responses of respondents on refrigerant recovery, recycling & handling.

S/N	Items	Mean	Remarks
69.	Perform correct use and maintenance of refrigerant equipment	3.19	HR
70.	Follow repair manual in replacing faulty components of alternator.	3.13	HR
71.	Dismantle components of alternator according to repair manual.	3.30	HR
72.	Check resistance of IC with multimeter	2.97	HR
73.	Replace faulty components.	3.28	HR
74.	Assemble components of alternator according to repair manual.	2.91	HR

From table 13 above, the respondents agree that the items 69,70,71,72,73,74 are highly required for refrigerant recovery, recycling and handling in HVAC with mean range of mean range of 2.50-3.49. This implies that the items are highly required for refrigerant recovery in HVAC.

TABLE 14: Mean ratings of the responses of respondents on how to adjust tension of fan belt.

S/N	Items	Mean	Remarks
75.	Select special service tool	3.25	HR
76.	Inspect fan belt to identify cracks	3.04	HR
77.	Adopt method for adjusting fan belt.	3.06	HR
78.	Observe safety precautions.	3.24	HR
79.	Check tension of fan belt using SST.	3.19	HR
80.	Report faults to department.	3.11	HR

From table 14 above, the respondents agreed that the items 75,76,77,78,79,80 are highly required for Adjustment of the tension of fan belt with mean range of 2.50-3.49. This implies that the items are highly required for adjusting tension of fan belt

TABLE 15: Mean ratings of the responses of respondents on how to adjust computer and mechatronics system.

S/N	Items	Mean	Remarks
81.	Retrieve and record stored OBD I diagnostic trouble code.	3.00	HR
82.	Retrieve and record stored OBD II diagnostic	3.25	HR
83.	Diagnose the causes of emissions	3.16	HR
84.	Diagnose emissions resulting	3.02	HR
85.	Check for module communication error using scan tool	3.03	HR
86.	Inspect and test computerized engine control system sensors	3.25	HR
87.	Interpret scan tool	2.94	HR
88.	Access and use service information	3.17	HR
89.	Diagnoses drivability and emissions resulting from malfunction	2.88	HR

From table 19, the respondents agree that the items all items are highly required for computer/mechatronics system with mean range of 2.50-3.49. This implies that the items are highly required for computer/mechatronics system.

Research question 2: What are the various sources for skill acquisition by auto electrician graduate for success in automotive servicing?

Table 16: Mean ratings of the responses of respondents on the various sources for skill acquisition by auto electrician graduate for success in automotive servicing.

S/N	Item	Mean	Remarks
90.	Automotive shop safety.	3.32	Agreed
91.	Electrical theory and circuit diagnosis	3.10	Agreed
92.	Automotive batteries maintenance	3.22	Agreed
93.	Instrumentation	3.17	Agreed
94.	Lighting system alignment	3.20	Agreed
95.	Starting system glow and spark plug, petrol and diesel engine test	3.11	Agreed
96.	Testing faults on power windows, radio antenna.	3.09	Agreed
97.	Use of tools e.g ring spanner set, wire stripper, soldering iron etc	3.00	Agreed
98.	Equipment maintenance.	3.28	Agreed
99.	Reading and interpretation of machine manuals	2.95	Agreed

The Table above shows that the respondents agree that all the items are various sources for skill acquisition by auto electrician graduates for success in automotive servicing with mean range of 2.50-3.49.

5. Discussion of findings

Based on the findings on the competencies required by auto electrician graduate, it was discovered that Diagnose faults in Starting system of vehicle, Repair Starter Motor of Vehicle, Install the Starter Motor In The Vehicle, Diagnose faults in Charging system of vehicle, Replace Faulty Components of Alternator, Adjust Tension of Fan Belt, Diagnose Fault in Lighting System of the Vehicle, Repair lighting system of the Vehicle, Replace Fuses/Connectors of Lighting System, Replace Light Bulbs of the Vehicle, Align the Head Lights of the Vehicle, Inspect conventional ignition system components, Test ignition system and components and identify faults, Service ignition system and components, Repair conventional ignition system components, Heating, ventilation & engine cooling systems diagnosis & repair, Operating systems & related controls diagnosis & repair, Refrigerant recovery, recycling & handling with its task were highly required by auto electricians for success in automotive servicing. The finding is also in agreement with one of the principles vocational and technical education that the only reliable source of content for specific training in an occupation is the experience of the masters of that occupation.^[16] The finding is also in agreement with Martin^[15] who attributed the trend of unemployment and under employment due to the mismatch between skills demand in the workplace and those provided by the schools. It will be worthwhile to know that success in automotive servicing is dependent on the proper teaching and instruction of these above competencies to school. The second findings reveal that the various sources of skill acquisition are very much needed in automotive servicing. This is in line with Miller^[17] and Barnhart, (1997) who posited that vocational/technical training will be effective if the instructor has had successful experience in the application of skills and knowledge to the operation and processes he undertakes to teach.^[18,19,20,21]

6. Conclusion

The inability of the technical and vocational college automobile electrical graduate to put knowledge obtained from the school into practical use in actual job situation is as a result of lack of necessary competencies required for actual work, this poses a challenge both to the government and teachers involved in training. Steps should be taken to reverse this ugly situation in order to prepare technical college students adequately for employment in the world of automotive technology.

Recommendations

Based on the findings of this study the following recommendations were made:-

1. Prototypes of modern motor vehicle and up to date equipment, tools and facilities should be made available for the teaching of students in technical colleges.
2. Motor vehicle Electronics teachers should be allowed to go for refresher courses/workshop in the automobile industry to update their practical skills.
3. Curriculum of Technical colleges should be reviewed on a regular basis to reflect workplace needs.
4. The learning environment should be a replica of working environment.
5. Within the competency list, Core competency items, which are essential for entry-level students, are required to be taught. Knowledge of these tasks is highly needed to integrate for increasing activity in automotive technology.

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