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Assessment of Autotronics Servicing Skill Needs among Roadside Mechanics for the Use of Auto Scan Tools

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***Abstract*— This study examined the Autotronics Servicing Skills needs among Roadside Mechanics and Master Trainers using auto scan tools. Two research questions and two null hypotheses guided the study. The study was carried out in 9 local government areas of Kano State. The study population was 90 Roadside Mechanics, and Masters Trainers selected through a simple random sampling technique. The whole population was used for the study. A structured questionnaire validated by three experts from the Department of Technology Education, Modibbo Adama University, Yola and trial tested for internal consistency in the Ringim local government area of Jigawa State was used. The instrument yielded a reliability coefficient of 0.82. The instrument structured on 5 points Likert scale was used to elicit information on using the Onboard diagnostic (OBD2) and Launch code reader professional 123 (CRP123) for diagnosing vehicle systems faults. Data collected were analyzed using Microsoft Excel. Mean and standard deviation was used to answer the research questions. Z-test statistics were used to test the null hypotheses at a 0.05 significance level. The study found out that Roadside Mechanics need autotronics servicing skills in the use of OBD2 and CRP123 for diagnosing and fixing problems in the engine, transmission, airbag (supplemental restraint system SRS), anti-lock braking system (ABS), and emission-related systems. The study recommended that ASS acquisition centres should be established in Kano State by organizations like the Ministries of Labour, the National Directorate for Employment (NDE), the National Automotive Design and Development Council (NADDC), the National Board for Technical Education (NBTE) and so on to enable Roadside Mechanics and other people who wish to learn the skills to acquire the required training to meet up with the challenges ever increasing in the motor vehicle technology.**

***Index Terms*—Autotronics, Roadside Mechanics, Master Trainer**

I. Introduction

To enhance effective and diligent modern vehicle service delivery in Nigeria, Roadside Mechanics (RM) should embrace professional training and retraining in Autotronic Servicing Skills (ASS) acquisition. Roadside mechanics use tools to test, diagnose, service and completely repair any fault on the motor vehicle for safe, reliable operations according to the manufacturer's specifications. According to Ref. [1], the dynamism of ever-changing technology in different fields of science and technology requires sound and adequate training for every individual in technical education. The National Board of Technical Education (NBTE), in collaboration with the National Directorate of Employment (NDE) and the National Automotive Design and Development Council (NADDC), as the body assigned with the responsibilities of accreditation of RM curriculum and other requirements, complete training programs through non-formal education, these bodies should promote a view of Information and Communication Technology (ICT) as a tool for enriching the training and learning environment of motor vehicle mechanics work apprenticeship and technical education programs because of the ever-changing technological advancements in the modern world [2]. Emerging technologies in modern automobile systems require skills of automobile programs in the maintenance of engine ignition, fuel transmission, and brake and OBD2 systems; as such, roadside mechanics are also affected by these developments. Also, advancing information and communication skills affect motor vehicle mechanics [3]. In today's world, ICT is the digital processing and utilization of information using electronic computers [4]. It also comprised telecommunications equipment such as mobile phones, printers, scanners, etc. These pieces of equipment are now used for retrieving, diagnosing, and fixing problems in modern vehicles. Today integrated electronic systems, and complex computers regulate vehicles and their performance while on the road. Technicians and mechanics must have an increasingly broad knowledge of how motor vehicle components work and interact to enable them to incorporate ICT into their responsibilities. Computers in modern-day motor vehicle design are standard; they are found in the: braking; engine; airbag (SRS); transmission, among others [5]. They also asserted that RMs should be allowed to

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undergo a series of training to upgrade their technical knowledge in the use of diagnostic tools and primary vehicle electronics through various skills development funds as they contribute to the economic growth of a country. It calls for the RMs to adapt to roles and skills to cope with the emerging changes, as they are the primary agents of motor vehicle diagnoses and repairs in our environment today. The National Automobile Council, in its effort to ensure ASS had, in collaboration with other stakeholders, developed and launched a curriculum for teaching mechatronics in the informal sector, held a critique workshop on the curriculum, and concluded arrangements for its printing and launching [6].

The OBD2 is an automotive term referring to a vehicle's self-diagnose and reporting capabilities. OBD system gives the vehicle repairer access to the status of the various vehicle sub-systems. It provides the mechanic with a clue as to where to look when a problem occurs on the vehicle, but for one to use this tool, one must understand the principles behind its usage [7]. Also the CRP123 scan tool, on the other hand, is an automotive diagnostic tool, mainly developed to test four major systems, namely: engine, transmission, SRS, and anti-lock brake system (ABS); the CRP123 can read and clear fault codes of the engine, ABS, SRS and automatic transmission for more than 30 vehicle brands [7].

For one to be able to use this tool, he must be able to understand the principles behind its usage. While Ref. [3] pointed out that motor vehicle Master Trainers also lack experience in using auto scan tools to diagnose some vehicle systems faults. In addition, roadside Mechanics need to gain the technical knowledge to use modern vehicles' diagnostic tools and primary vehicle electronics [5].

Autotronics, as an aspect of automobile engineering, has shifted towards technology used in modern-day cars making the motor vehicle a complex technical system. This development has turned the mechanics' job from purely mechanical to including electronic technology. Thus, mechanics need to have broader base knowledge than in the past. The decline of standardized auto-mechanic preparation in the 1960s and early 1980s led to the emergence of RMs, who lacked adequate technical training to handle modern cars [8]. In addition to this, the NADDC (2010) stated that the RMs: lack an understanding of electrical and electronics (mechatronics) systems in modern cars, lack a standardized method of fault finding (step-by-step); improper tools, equipment and materials handling, among other things [9]. Hence, this development created the need for a new set of skills and knowledge for today's auto mechanics and technicians. Roadside mechanics should be allowed to upgrade their technical expertise in diagnostic tools and primary vehicle electronics [5]; as such, they need to update their technical knowledge. The diagnostic tools include the OBD2 and CRP123, designed to detect engine faults [7]. Facilities such as computers and auto-scan devices are essential tools for RMs. Thus, they should be available in garages if effective diagnoses and repairs are to be embraced in earnest. But the question is, are the facilities at the disposal of the RMs? If they are, are they using them effectively? Are they of international standard? Do the RMs know how to use modern vehicle repairs and diagnoses equipment effectively? The RMs play an essential role in the socio-economic development of Nigeria, as they provide most, if not all, services to car owners to make their car road worthy and protect our environment from the danger of global warming due to dangerous gases emission. The demand for competent and skilled RMs is one of the critical problems in handling some modern cars in Nigeria, and this calls for the skill improvement needs of RMs in ASS. Against this background, the researcher assessed Autotronics servicing skills needs by roadside mechanics for the use of auto scan tools in Kano State.

The study's primary purpose is to assess the Autotronics servicing skills needs among RMs for using Auto scan tools in Kano State. Specifically, the study assessed

1. The skill improvement needs of RMs and Master Trainers on using the OBD2 Scan tool for diagnosing engine emission-related problems.
2. Autotronics servicing skills need of RMs and Master Trainers on the use of CRP123 for diagnosing engine, transmission, airbag (Supplemental Restraint System SRS) and Anti-lock braking (ABS) systems.

II. METHOD

A descriptive survey research design was adopted for the study. The study was carried out in Kano State, which sought information from 90 respondents that comprised 63 RMs and 27 MTs, selected using simple random selection in nine local government areas. The whole population was used for the study. A structured instrument with 24 items (see Table I) was validated by three experts from Modibbo Adama University, Yola, and trial-tested in the Ringim local government of Jigawa State.

The instrument yielded a 0.82 reliability coefficient, section A, for respondent's data, and B, subdivided into two with 12 items each, to determine the ASS skills needed for OBD2 and CRP123. The response option was structured on a five-point Likert-type scale: 5= Very Highly Needed, 4= Highly Needed, 3= Needed, 2= Moderately Needed, and 1=Not Needed. The researcher employed the services of two assistants. Microsoft Excel was used for the data analysis. The data was analyzed using the Grand mean and standard deviation to answer the research questions. The decision rule was that any item with a mean below 3.50 is considered as needed. At the same time, any item with a mean of 3.50 and above was considered not required. Z-test was used to test the hypotheses at a 0.05 level of significance. The decision rule was to: reject Ho in favour of Ha if the computed value of the z-calculated exceeds z- critical. Otherwise, accept Ho as the calculated value of the statistics showed that z-cal was lower than the z-critical.

The following null hypotheses were postulated and tested at a 0.05 significant level, guiding the study.

1. There is no significant difference between the mean responses of roadside mechanics and master trainers on the mechanic's experience using OBD2 for servicing modern vehicles.
2. There is no significant difference between the mean responses of roadside mechanics and master trainers on the mechanic's experience in the use of CRP123 for

servicing modern vehicles.

TABLE I
INDICATORS OF RESPONSES OF ROADSIDE MECHANICS AND MASTER TRAINERS

S/N	Experience and knowledge needed
1	Locate the second generation onboard diagnostic OBD2 auto scan access point
2	Connect the OBD2 using appropriate connector
3	Turn on the vehicle ignition
4	Run the OBD2 diagnostic program
5	Check through the vehicle emission control system to access the diagnostic trouble codes from the vehicle control module
6	Record your findings
7	Check what the emission control system code means and see if they try fault indicated by the trouble codes need to be corrected before you clear the codes
8	Diagnose and repair the emission control system (fuel compression ratio and mixture combustion control)
9	Select the delete option on the OBD2 to clear the fault codes
10	Repeat items 3 to 6, recheck and reactivate the fault codes
11	Turn off the OBD2 and disconnect from the access point
12	Turn off the OBD2 and disconnect from the access point
13	Locate the Launch code reader CRP123 scan tool
14	Connect the CRP123 using the appropriate connector
15	Turn on the vehicle ignition
16	Turn on the CRP123
17	Run the diagnostic program
18	Check through the engine system to access the diagnostic trouble codes from the vehicle control module
19	Check what the engine system code means and see if they try fault indicated by the trouble codes needs to be corrected before you clear the codes
20	Record your findings
21	Carry out the repair of the engine system, adjust spark plugs to current specification, complete engine turn up overhaul the fuel pump, set ignition timing and clean and set contact breaker point in the distributor
22	Select the delete code option on the CRP123 to clear the fault codes
23	Repeat items 3 to 6 to recheck and reactivate the faults
24	Turn off the CRP123 and disconnect from the access point

III. RESULTS

The results of the data analysis are presented according to the research questions and hypotheses, as shown below.

A. First Research Question

What are the Autotronics service skills needed of Roadside Mechanics and Master Trainers in using the OBD2 scan tool in diagnosing engine emission-related systems faults? Table II analyzes and presents the data that answered this research question.

Table II presented the results of the analysis of Research Question 1, on the experience needed by RMs and MTs to use OBD2 to service modern vehicles. It revealed that respondents accepted all 12 items, which showed that the RMs and MTs need ASS for using OBD2. The mean responses ranged from 3.33 - 3.48, and the standard deviation from 0.27 - 0.32 revealed that the reactions are close to one another in their self-expressed views.

TABLE II
MEAN AND STANDARD DEVIATION OF RESPONSES OF ROADSIDE MECHANICS AND MASTER TRAINERS ON THE ASS NEEDS IN THE USE OF OBD2

S/N	$\bar{X}1$	$\bar{X}2$	SD1	SD2	$\bar{X}G$	SDG	R
1	3.48	3.36	0.06	0.01	3.39	0.31	N
2	3.51	3.42	0.08	0.02	3.48	0.32	N
3	3.36	3.28	0.01	0.06	3.33	0.30	N
4	3.36	3.52	0.01	0.08	3.41	0.27	N
5	3.43	3.50	0.03	0.07	3.48	0.32	N
6	3.29	3.36	0.05	0.01	3.34	0.32	N
7	3.43	3.50	0.03	0.07	3.48	0.32	N
8	3.30	3.35	0.04	0.01	3.34	0.30	N
9	3.29	3.36	0.05	0.01	3.34	0.30	N
10	3.52	3.36	0.08	0.01	3.41	0.27	N
11	3.36	3.29	0.01	0.05	3.34	0.30	N
12	3.30	3.35	0.04	0.01	3.34	0.30	N

NRMS = 63, NMTS = 27

Key: X1= Mean responses ofRMs, X2= Mean responses of MTs, XG = Grand Mean. SD1= Standard Deviation of RMs, SD2= Standard Deviation of MTs, SDG = Grand Standard Deviation R= Remarks, N= Needed, NRMS =Number of Roadside Mechanics, NMTS = Number of Master Trainers.

B. Second Research Question

What Autotronics servicing skills are needed by Roadside Mechanics and Master Trainers in using the CRP123 scan tool for diagnosing an engine, transmission, airbag (SRS), and anti-lock braking (ABS) systems? Table III analysed and presented the data that answered this research question.

TABLE III
MEAN AND STANDARD DEVIATION OF RESPONSES OF ROADSIDE MECHANICS AND MASTER TRAINERS ON THE ASS NEEDS IN THE USE OF CRP123

S/N	$\bar{X}1$	$\bar{X}2$	SD1	SD2	XG	SDG	R
13	3.36	3.52	0.01	0.03	**3.41**	**0.27**	N
14	3.36	3.48	0.01	0.02	**3.39**	**0.31**	N
15	3.50	3.43	0.03	0.02	**3.48**	**0.32**	N
16	3.36	3.29	0.01	0.03	**3.34**	**0.32**	N
17	3.52	3.36	0.08	0.01	**3.41**	**0.27**	N
18	3.50	3.43	0.03	0.02	**3.48**	**0.32**	N
19	3.29	3.36	0.02	0.01	**3.34**	**0.30**	N
20	3.43	3.50	0.01	0.02	**3.48**	**0.32**	N
21	3.30	3.35	0.02	0.01	**3.34**	**0.30**	N
22	3.36	3.29	0.01	0.03	**3.34**	**0.32**	N
23	3.43	3.50	0.01	0.02	**3.48**	**0.32**	N
24	3.30	3.35	0.01	0.01	**3.34**	**0.30**	N

NRMS = 63, NMTS = 27

Key: X1= Mean responses of RMs, X2= Mean responses of MTs, XG = Grand Mean SD1= Standard Deviation of RMs, SD2= Standard Deviation of MTs, SDG = Grand Standard Deviation R= Remarks, N= Needed. NRMS =Number of Roadside Mechanics, NMTS = Number of Master Trainers.

Table III revealed that all the 12 items on RMs ASS need on the use of CRP123 have mean responses which ranged between 3.33 - 3.48 and standard deviation from 0.27 - 0.32. It indicated that RMs needed ASS on using CRP123 for servicing modern vehicles.

C. First Hypothesis

There is no significant difference between the mean responses of roadside mechanics and master trainers on the mechanic's experience using OBD2 for servicing modern vehicles. The data used to test this hypothesis were analyzed using a t-test and presented in Table IV.

TABLE IV
REMASTERED SOFTWARE PACKAGE Z-TEST ANALYSIS OF THE RESPONSES OF RMS AND MTS ON RMS ASS NEEDS ON THE USE OF OBD2

Category	N	$\bar{X}$	Z-cal	Z-crit	Remarks
RM	63	4.05	-1.12	1.96	Accepted
MT	27	4.13			

Key: N= Number of respondents, X= Mean responses from respondents.

Table IV showed that the z-cal, which has a value of -1.12, is less than the z-crit, which has a value of 1.96 at a 0.5 significance level; therefore, the null hypothesis was accepted. That means the RMs and MTs believe that RMs needed training on using OBD2.

D. Second Hypothesis

There is no significant difference between the mean responses of roadside mechanics and master trainers on the mechanic's experience using CRP123 for servicing modern vehicles. The data used to test this hypothesis were analyzed using a t-test and presented in Table V.

TABLE V
Z-TEST ANALYSIS OF THE RESPONSES OF RMS AND MTS ON RMS ASS NEEDS ON THE USE OF CRP123

Category	N	X	Z-cal	Z-crit	Remarks
RM	63	4.0	- 0.71	1.96	Accepted
MT	27	4.09			

Key: N= Number of respondents, X= Mean responses from respondents.

Table V revealed that the z-cal, which has a value of -0.71, is less than the z-crit with 0.96 at a 0.5 significance level, so the null hypothesis was accepted. That means the RMs and MTs have the same opinion that RMs needed training on the use of CRP123.

III. DISCUSSION

The study's findings were discussed meticulously, aligning with the predefined research questions and hypotheses. The investigation revealed a significant gap in the skill set of Master Trainers and Roadside Mechanics in Kano State concerning the utilization of the OBD2 scan tool and CRP123 in their daily repair tasks on modern vehicles. The absence of Automotive Service Excellence (ASE) skills in this area highlights the pressing need for both Roadside Mechanics (RMs) and Master Trainers (MTs) to acquire expertise in the use of the OBD2 scan tool and CRP123 for servicing modern vehicles.

These findings corroborate the results obtained in a study conducted by Ref. [5] assessing the skills of roadside mechanics in diagnosing and fixing problems of modern electronically managed vehicles in Ghana." Just like the Kano State RMs and MTs, the roadside mechanics in Ghana also lacked ASE skills for servicing and repairing modern vehicles, emphasizing the universality of this knowledge gap across different regions.

Similarly, Ref. [12] indicates the necessity to enhance students' autotronics servicing strategies in science and technical colleges in Benue State. This finding further reinforces the argument that educational institutions should prioritize equipping future mechanics with the necessary skills and knowledge to tackle the complexities of modern automotive technology.

Moreover, Ref. [3], in their study investigating the use of auto scan tools for diagnosing vehicle systems faults, also found that motor vehicle mechanics trainers require capacity building to use such tools for effective vehicle systems diagnosis and repairs. This finding aligns with the present study's conclusions, highlighting the need for training and skill development programs focused on ASE using the OBD2 scan tool and CRP123.

The outcomes of hypotheses testing in the current study further substantiated the unanimous consensus among both Roadside Mechanics and Master Trainers, affirming their acknowledgement and acceptance of the dire necessity for training in Automotive Service Excellence regarding the use of OBD2 scan tool and CRP123 for servicing modern vehicles. The acceptance of both hypotheses underscores the urgency for action in addressing this skills gap through targeted training and educational initiatives.

As mentioned earlier, the findings from the studies shed light on a critical issue faced by roadside motor vehicle mechanics, namely, their need for essential computer skills necessary for effectively manipulating automotive digital diagnostic tools. This inadequacy poses significant challenges in diagnosing, repairing, and maintaining modern vehicles. The study by Ref. [13] underlines the insufficiency of computer skills among auto mechanics, indicating their inability to proficiently utilize modern diagnostic equipment, manufacturer's manuals, computers, and the internet in their repair practices. Similarly, the study by Ref. [5] reveals a parallel situation in Ghana, where roadside mechanics cannot effectively use modern diagnostic equipment and other essential tools, impeding their capacity to diagnose and resolve problems in modern vehicles accurately.

Furthermore, both studies emphasize the importance of various skills and resources in automobile repair. Ref. [13] highlights the correlation between employability skills, technical skills, managerial skills, access to essential tools, equipment, facilities, and financial resources, and auto mechanics' successful establishment and progression in the automobile business. It underscores that a comprehensive skill set and adequate resources are vital factors for individuals aspiring to thrive in this industry.

Additionally, the study by Ref. [3] identifies the pressing need for capacity building among motor vehicle mechanics trainers in using auto-scan tools for vehicle systems diagnosis and repairs. This finding underscores the significance of equipping trainers with the requisite skills and knowledge to impart this knowledge to future mechanics effectively.

Enhancing the trainers' competencies makes it possible to bridge the skills gap and ensure that mechanics are well-prepared to meet the demands of the modern automotive landscape.

Moreover, the study by Ref. [14] showcases the effectiveness of a training and assessment system incorporating an assistant drone in bridge inspection. This system identifies individual training needs and facilitates the development of the required skills and confidence among bridge inspectors to collaborate effectively with drones during inspection processes. By leveraging innovative technologies and training methodologies, this study highlights the potential for enhancing skills and improving the efficiency and accuracy of bridge inspections.

Ref. [15] presents advancements in the automation of surgical skill assessment in a different domain. Although the technique discussed in the study does not yet provide a reliable means of quantifying surgical skills, it represents a crucial step towards automating the assessment process. This development can enhance objectivity and efficiency in evaluating surgical proficiency, ultimately benefiting patient outcomes [16].

Collectively, these studies emphasize the imperative of addressing skills gaps, providing targeted training programs, and allocating adequate resources to enhance the skills of mechanics, trainers, and professionals in various domains, including automotive repair, business establishment, bridge inspection, and surgery. Recognizing the correlations between mastery and performance and implementing appropriate measures makes it possible to elevate performance levels, improve efficiency, and achieve better outcomes across these fields.

IV. Conclusion

Roadside mechanics and Master Trainers need ASS for the use of the OBD2 scan tool for diagnosing and repairing engine emission-related systems; they also need ASS for the use of the CRP123 scan tool for analysing an engine, ABS, Airbag (SRS), and transmission systems.

IV. Recommendations

Based on the findings from this study, the following recommendations have been put forward to meet the current needs of RMs ASS. The ASS acquisition centres should be established in Kano by organizations like the Ministries of Labor, NDE, NADDC, and NBTE in all the local Governments of the state to enable RMs and other people who wish to learn the skills to acquire the required training to meet up with the challenges ever increasing in the motor vehicle technology.

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