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Effect of Electronic Braking Systems Troubleshooting and Maintenance Manual on Skill Performance of Automobile Craftsmen in Nigeria

Arah A. Saidu,* Audu Rufai, Abdulkadir Mohammed, Umar I. Yakubu and Idris A. Mohammed

The study determined the effect of electronic braking systems troubleshooting and maintenance manual on the skill performance for automobile craftsmen in Nigeria. One research question was raised and answered. Also, one null hypothesis was tested at 0.05 level of significance. True Experimental Research Design (TERD) using one group pretest-posttest design was adopted for this study. The study was conducted in Federal Capital Territory (FCT) Abuja, Kaduna, Kano, and Lagos States, Nigeria. The targeted population for the study was 75 automobile craftsmen comprising of 48 males and 27 females. The instrument for data collection was Electronic Braking Systems Troubleshooting and Maintenance Skill Performance Test (EBSTMSPT). The reliability of EBSTMSPT was established using Kendall's tau coefficient of concordance and yielded 0.84 and 0.86 for part A and B respectively. The data collected were analyzed using mean, and Analysis of Covariance (ANCOVA). Statistical Package for Social Sciences (SPSS) version 27 was used for all data analysis. Findings from the study revealed that, the electronic braking systems troubleshooting and maintenance manual had positive effect on the skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC. The study recommended among others that, automobile craftsmen in Nigeria should embrace the use of electronic braking systems troubleshooting and maintenance manual in order to enhance their skill performance in troubleshooting and maintenance of ABS, ATC and ESC.

Keywords: Craftsmen, Manual, Skill Performance, Troubleshooting and Maintenance.

1. Introduction

Electronic braking systems refer to the types of braking system that uses electronic means to achieve braking action. Electronic braking systems are generally designed to control the speed of the moving vehicle or bring it to rest in a shortest possible distance during special events such as sudden braking, under slippery road condition among others. Kline (2019) maintained that, electronic braking systems increase braking comfort and improve high degree of safety compared to other type of braking systems. The most common types of electronic braking systems are Anti-lock Braking System (ABS), Automatic Traction Control (ATC) and Electronic Stability Control (ESC). Kline further stated that, about 40% of the defects detected on modern automobile correspond to electronic braking systems. The maintenance of these systems requires that, the automobile craftsmen must be effective in troubleshooting.

Troubleshooting is a problem-solving technique aimed at identifying the root cause of faults in the maintenance of components on a system. According to Michael (2018), troubleshooting is a systematic approach to problem solving which is inadequately possessed by technicians in order to effectively carry out maintenance on modern automobiles. Matthew and Rouse (2018) noted that, vast majority of automobile equipped with electronic braking systems suffer disrepair due to lack of troubleshooting skills on the part of automobile craftsmen due to poor maintenance. Maintenance is a way of repairing or servicing used equipment or machine in order to make for enhanced functioning capacity. Cimpan et al. (2013) argued that, the maintenance of modern automobiles especially those equipped with electronic braking systems is the most challenging task in automobile maintenance industry. The consequences of operational failure of electronic braking systems may result to fatal

accident and loss of resources. Tashtoush *et al.* (2010) also stressed that, despite the importance of electronic braking systems, the car owners are stripped of the full benefits attached to the systems due to lack of effective maintenance skills among automobile craftsmen.

Automobile craftsmen in Nigerian context refer to graduates of Motor Vehicle Mechanic Works programme at technical colleges trained to carryout troubleshooting and maintenance of automobiles. According to Idris and Arah (2015), automobile craftsmen are trained persons with the knowledge, professional experience, skills and techniques related to automobile maintenance. Edeh (2016) further revealed that, it is undoubtedly clear that automobile craftsmen in Nigeria have deficiencies in troubleshooting and maintenance of electronics braking systems in modern automobiles. Improving the expertise level of automobile craftsmen without necessarily engaging them in any form of training capable of taking them away from work was achieved through the development of electronic braking systems troubleshooting and maintenance manual.

The electronic braking systems troubleshooting and maintenance manual is a book aimed at providing automobile craftsmen with the step by step guidance in troubleshooting and maintenance of electronic braking systems. Arah *et al.* (2021) revealed that, the benefits of the manual to automobile craftsmen include the efficacy in connecting new information to former knowledge and providing a basis for enhancing skills self-acquisition process. Rastogi and Nameeta (2013) opined that, manuals in general, possessed the capacity to allow learner acquire competences at their own pace. In order words, the valid and reliable electronic braking systems troubleshooting and maintenance manual was developed to enhance the skill performance of automobile craftsmen.

The skill performances of automobile craftsmen described the details of acquired learning objectives demonstrated by the conclusion of a unit of the manual. Abu-Moghli *et al.* (2015) disclose that, skill performance expresses the degree to which the demonstration of learning objectives occurs. The skill performances of automobile craftsmen in troubleshooting and maintenance of electronic braking systems is generally low (National Automotive Design and Development Council NADDC, 2019). The recorded low skill performance among automobile craftsmen in Nigeria results to technical disconnection with global trends in automobile maintenance industry. Olaitan and Ikeh (2015) noted that, this technical disconnection negatively affects the socioeconomic development of Nigeria as many automobile craftsmen are jobless or semi jobless due to lack of skills. Therefore, this study sought

to determine the effect of electronic braking systems troubleshooting and maintenance manual on the skill performance for automobile craftsmen in Nigeria.

1.1 Statement of the Research Problem

The automobiles of nowadays are highly equipped with sophisticated technologies innovations to improve on safety, comfort and fuel economy. These improvements have made it difficult for automobile craftsmen to discharge their primary functions. Michael (2012) confirmed that, it is a common knowledge that a large proportions of the automobile craftsmen in Nigeria find it extremely difficult to diagnose, troubleshoot and maintain modern automobiles. Several studies have been made to address the shortcomings notable among them include Ogbuanya and Idris (2014), Udogu (2015) and Alabi *et al.* (2019). Despite these efforts, the inability of automobile craftsmen to carryout troubleshooting and maintenance services on modern automobiles persists. This negative development led to the development of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria by Arah *et al.* (2021). In order to ensure the usability of the developed manual, the need to establish its effectiveness became necessary. Hence, it is against this backdrop that, the researchers sought to determine the effect of electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in Nigeria.

1.2 Aim and Objective of the Study

The study aimed at determining the effect of electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in Nigeria. Specifically, the objective of the study sought to determine the effect of:

1. Electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in troubleshooting and maintaining ABS, ATC and ESC.

1.3 Research Questions

The following research question was raised and answered:

1. What is the effect of electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC?

1.4 Hypotheses

The following null hypothesis was formulated and tested at 0.05 level of significance:

H₀: There is no significance difference between the skill performance scores of male and female automobile craftsmen that learnt troubleshooting and maintenance of ABS, ATC and ESC using electronic braking systems troubleshooting and maintenance manual

2. Materials and Methods

True Experimental Research Design (TERD) using one group pretest-posttest design was adopted for this study. The TERD was considered suitable for the study because it accommodates randomization of subjects and automobile craftsmen cannot be found in an intact class. The study was conducted in Federal Capital Territory (FCT), Abuja, Kaduna, Kano, and Lagos States, Nigeria. The area was selected because; it had the National Automotive Design and Development Council (NADDCC) and Industrial Training Fund (ITF). Also, the location had the affiliated institutions offering automobile mechatronics training programme for craftsmen in Nigeria. The NADDCC and ITF were selected for this study simply because; they are the two major stakeholders in the development and utilization of manuals for automobile craftsmen in Nigeria. The targeted population for the study was all the 75 automobile craftsmen comprising of 48 males and 27 females from the NADDCC and ITF owned and affiliated institutions that include: Autolady Engineering Technology Nigeria Limited, Abuja, Lady Mechanic Initiative, Lagos, AFEME Mechatronics School, Mogadishu Cantonment, Abuja, ITF Model Skills Training Centres in Abuja, Kano and Lagos, and Business Apprenticeship Training Centre, Zaria. The instrument used during data gathering was Electronic Braking Systems Troubleshooting and Maintenance Skill Performance Test (EBSTMSPT).

The EBSTMSPT was developed by the researcher and consisted of two practical questions used to assess automobile craftsmen skill performance in troubleshooting and maintenance of electronic braking systems. The EBSTMSPT was subjected to content validation by three experts, one each from Department of Industrial and Technology Education, Federal University of Technology (FUT), Minna, Nigeria,

Department of Examination Development (Auto Mechanic Unit), National Examination Council (NECO), Minna, Nigeria and Department of Automobile Electrical/Electronics, Automedics Nigeria Limited, Abuja. Furthermore, the reliability of EBSTMSPT was established by trial testing the instruments on 8 ascertained automobile craftsmen from Kaura Danali Motors, Minna, Niger State, Nigeria. Kendall's tau coefficient of concordance was used to establish the inter-rater reliability of EBSTMSPT and yielded 0.84 and 0.86 for part A and B respectively. Data were collected through true experiment.

The experiment was conducted in three stages within seven weeks to measure the effectiveness of the electronic braking systems troubleshooting and maintenance manual on the skill performance of automobile craftsmen. The first stage of the experiment involved the administration of EBSTMSPT to all the automobile craftsmen by their instructors in the first week of the study as pre-test to measure the skills they possessed in troubleshooting and maintenance of electronic braking systems. The second stage of the experiment involved the administration of the manual to all the automobile craftsmen by their instructors immediately after the first stage of the experiment. At this stage, the automobile craftsmen were expected to self-learn the contents of the manual for a period of six weeks. The six weeks was considered enough time to allow automobile craftsmen self-study the contents of the manual by the Subject Matter Experts involved in the development of the manual. Nevertheless, the third stage of the experiment involved the administration of EBSTMSPT to all the automobile craftsmen by their instructors in the seventh week of the study as post-test to measure the skill performance in troubleshooting and maintenance of electronic braking systems. The data collected were analyzed using mean, and Analysis of Covariance (ANCOVA). Statistical Package for Social Sciences (SPSS) version 27 was used for all data analysis.

3. Results and Discussion

3.1 Research Question One

What is the effect of electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC?

Table 1: Skill Performance Scores of Automobile Craftsmen that Learnt Troubleshooting and Maintenance of ABS, ATC and ESC using Electronic Braking Systems Troubleshooting and Maintenance Manual

Craftsman	N	Pre-test Mean	Post-test Mean	Mean Gain
Male	48	34.04	75.37	41.33
Female	27	33.03	76.00	42.97

Table 1 shows that, the male automobile craftsmen had a mean score of 34.04 in the pre-test and 75.37 in the post-test with a pre-test, post-test mean gain of 41.33. The female automobile craftsmen had a mean score of 33.03 in the pre-test and 76.00 in the post-test with a pre-test, post-test mean gain of 42.97. These mean gains implied that, electronic braking systems troubleshooting and maintenance manual had positive effect on skill performance

of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC.

3.2 Hypothesis One

There is no significance difference between the skill performance scores of male and female automobile craftsmen that learnt the troubleshooting and maintenance of ABS, ATC and ESC using electronic braking systems troubleshooting and maintenance manual

Table 2: Analysis of Covariate on the Significance Difference between the Skill Performance Scores of Male and Female Automobile Craftsmen that Learnt the Troubleshooting and Maintenance of ABS, ATC and ESC Using Electronic Braking Systems Troubleshooting and Maintenance Manual

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	22.735 ^a	2	11.368	.827	.441
Intercept	1696.699	1	1696.699	123.488	.000
Pretest	15.985	1	15.985	1.163	.284
Group	11.276	1	11.276	.821	.368 [*]
Error	989.265	72	13.740		
Total	429664.000	75			
Corrected Total	1012.000	74			

a. R Squared = .022 (Adjusted R Squared = -.005)

Table 2 shows the F calculated value for the groups is .821 with a significant of F at .368 which is above .05 stated level of significance. The results indicated that there is no statistically significance difference between the skill performance scores of male and female automobile craftsmen that learnt the troubleshooting and maintenance of ABS, ATC and ESC using electronic braking systems troubleshooting and maintenance manual. Hence, the null hypothesis stated was withheld.

3.3 Findings

1. Electronic braking systems troubleshooting and maintenance manual had positive effect on the skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC.
2. There was no significance difference between the skill performance scores of male and female automobile craftsmen that learnt the troubleshooting and maintenance of ABS, ATC and ESC using electronic braking systems troubleshooting and maintenance manual.

3.4 Discussion of Findings

Finding on the effect of electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC revealed positive. This implied that, electronic braking systems troubleshooting and maintenance manual enhanced the skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC. The finding is related to the findings of Adékunle (2013) in his study on development and validation of an Auto Mechanics Intelligent Tutor (AMIT) for teaching Auto-mechanics trades concepts in technical colleges that revealed students that were taught Auto-mechanics trades concepts using AMIT obtained higher mean scores in cognitive and skill performance than others. The implication of this finding is that, the electronic braking systems troubleshooting and maintenance manual utilized is capable of adequately enhancing the skill performance of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC.

Furthermore, the test for significance difference between the skill performance scores of male and female automobile craftsmen that learnt the

troubleshooting and maintenance of ABS, ATC and ESC using electronic braking systems troubleshooting and maintenance manual revealed not statistically significant. The finding is related to the finding of Maelbera (2018) that revealed no significance difference between the mean achievement scores of technologists taught refrigeration and air-conditioning using modules and those not taught in South-South, Nigeria. The no significance difference between the skill performance scores of male and female automobile craftsmen is a clear indication that, electronic braking systems troubleshooting and maintenance manual is not gender biased.

4. Conclusion

The study provided insights on the effect of electronic braking systems troubleshooting and maintenance manual on skill performance of automobile craftsmen in Nigeria. The results obtained revealed that, the skill performances of automobile craftsmen in troubleshooting and maintenance of ABS, ATC and ESC were enhanced using electronic braking systems troubleshooting and maintenance manual. Furthermore, the enhanced skill performance scores of male and female automobile craftsmen in troubleshooting and maintenance of electronic braking systems does not differ statistically. Though, it is also important that, the effects of the manual on the cognitive performance and interest of automobile craftsmen are ascertained. Therefore, it is concluded that, the electronic braking systems troubleshooting and maintenance manual is capable of improving the skill performance of automobile craftsmen in Nigeria significantly.

4.1 Recommendations

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

1. Automobile craftsmen in Nigeria should embrace the use of electronic braking systems troubleshooting and maintenance manual in order to enhance their skill performance in troubleshooting and the maintenance of ABS, ATC and ESC.
2. National Automotive Design and Development Council and Industrial Training Fund in Nigeria should make mass production of electronic braking systems troubleshooting and maintenance manual in order to enhance the skill performance of automobile craftsmen in troubleshooting and the maintenance of ABS, ATC and ESC.

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Conflict of Interest

The authors declared no conflict of interests regarding the publication of this article.

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