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Content Validity and Reliability of Electronic Braking Systems Troubleshooting and Maintenance Manual for Automobile Craftsmen in Nigeria

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The study determined the content validity and reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria. Two research questions were raised and answered. The study used descriptive survey research design using cross sectional type. The study was conducted in Federal Capital Territory (FCT), Abuja, Kaduna, Kano, Lagos and Plateau States, Nigeria. The population for the study was 43 non-teaching and 56 teaching Subject Matter Experts (SMEs) from National Automotive Design and Development Council (NADDC) and Industrial Training Fund (ITF) and affiliated institutions offering automobile mechatronics training programme. Purposive Sampling Technique (PST) was used to sampled nine SMEs consisting of four non-teaching and five teaching for testing the content validity and reliability of the manual. The instruments used for data collection was a Manual Content Validity Index (MCVI). Data were collected by administering the draft copies of electronic braking systems troubleshooting and maintenance manual and MCVI to the nine SMEs. The data collected were analyzed using content validity index formula and Cronbach's Alpha statistical technique. Findings from the study revealed that, the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria is valid and reliable. The study recommended that, the two most relevant stakeholders in automotive maintenance industry (National Automotive Design and Development Council and Industrial Training Fund) in Nigeria should provide a conducive atmosphere for testing the effectiveness of the electronic braking systems troubleshooting and maintenance manual on the skill performance of automobile craftsmen.

Keywords: Automobile Craftsmen, Manual, Reliability & Validity.

1. Introduction

The term electronic braking systems could be seen as the type of braking systems that utilizes electronic pulse to accomplish reduction in vehicular speed. The systems are largely designed to regulate the motion or retard a moving vehicle within the shortest possible time and distance in unusual events that include: sudden braking, under slippery road condition among others. According to Kline (2019), the advantages of electronic braking systems include increase in braking comfort and enhance greater degree of safety when compare to mechanical braking systems. Kline further stated that, 40% of the faults identified on modern automobile are related to electronic braking systems. There are several types of electronic braking systems that include: Anti-lock Braking System (ABS), Automatic Traction Control (ATC) and Electronic Stability Control (ESC). In order

to maintain these systems, automobile craftsmen are required to be efficient in troubleshooting.

Troubleshooting is a procedure of finding faults as well as the causes of the faults through visual inspection, testing and verifying faulty components in order to carryout maintenance on automobile systems and subsystems. According to Michael (2018), troubleshooting is a systematic process of problem solving required by automobile craftsmen in order to effectively carry out maintenance on modern automobiles. Modern automobile with electronic braking systems are poorly maintained due to absence of skills in troubleshooting among automobile craftsmen which stripped automobile users of the benefits of the systems (Matthew & Rouse, 2018). Maintenance is a process of fixing or servicing automobile systems in order to improve

it functional capacity. Cîmpan *et al.* (2013) stated that, the most challenging task in automobile maintenance industry is the maintenance of modern automobiles including those equipped with electronic braking systems is. The inability to carryout effective maintenance on electronic braking systems may result to fatal accident and loss of resources. Tashtoush *et al.* (2010) revealed that, car owners are stripped of the full advantages of electronic braking systems due to poor maintenance skills among automobile craftsmen.

Automobile craftsmen refer to individual trained in technical colleges to specialize in automobile services and maintenances. Idris and Arah (2015) stated that, automobile craftsmen are trained persons with the knowledge, skills and attitudes towards automobile maintenance. Edeh (2016) revealed that, automobile craftsmen in Nigeria are undoubtedly deficient in carrying out troubleshooting and maintenance of electronics braking systems equipped on modern automobiles. Enhancing the technical skill level of automobile craftsmen without engaging them in skill acquisition training that would take them away from their work could be successful through the use of manual such as electronic braking systems troubleshooting and maintenance manual.

The electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria was developed by Arah *et al.* (2021) to provide self-explanatory sequential procedures for accomplishing various tasks in troubleshooting and maintenance of electronic braking systems. The aim of the manual was to equip automobile craftsmen with the requisite skills in troubleshooting and maintenance of electronic braking systems. The benefits of a valid and reliable manual 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. The development of electronic braking systems troubleshooting and maintenance manual was achieved through the professional services of subject matter experts.

Subject Matter Experts (SMEs) are individuals highly knowledgeable and skilful in a particular area of human endeavour. Mohammed (2018) disclosed that, SMEs could either be teaching and non-teaching. In the context of this study, teaching SMEs are trained individuals with minimum qualification of Higher National Diploma or Bachelor Degree in Automobile

Technology or related field that are imparting to students the theoretical and practical knowledge of automobile electronic systems. While non-teaching SMEs are individuals with technical competency and with more than five-year experience in troubleshooting and maintenance of automobile electronic systems. Arowolo (2017) noted that, SMEs play significant role in the development of a manual as they ascertained its reliability and content validity.

Content validity is the degree at which information in the manual satisfies the need to which it is designed for. Victor, (2016) defined content validity of a manual as a measure of the extent to which results from SMEs regarding the quality of the information in a manual can be generalized. Manual content validity could be seen as the extent to which a manual accurately measures the theoretical and practical concepts it is developed to measure. A valid manual revealed the degree of its reliability. Reliability refers to the consistency or authenticity of measuring or analyzing tools. Jamaludin *et al.* (2011) defined manual reliability as the tendency to which judgment on the content validity of a manual produce the same result when it is measured at least twice. A valid and reliable manual holds the tendencies to guarantee the acquisition of skills on the troubleshooting and maintenance of electronic braking systems.

In other words, the implication of the lack of a valid and reliable manual capable of enhancing skill performance in troubleshooting and maintenance of electronic braking systems is that, automobile craftsmen in Nigeria will probably remain in 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 competencies in troubleshooting and maintenance of electronic systems. Therefore, this study sought to determine the validity and reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria in order to ensure its usability.

1.1 Statement of the Research Problem

Modern automobiles are equipped with highly sophisticated advances in technology aimed at improving the safety, comfort and fuel economy. These technological advancements contributed in making the task of troubleshooting and maintenance of automobile to be difficult for automobile craftsmen in Nigeria. According to Michael (2018), it is very obvious that, high percentage of the automobile craftsmen in

Nigeria is finding it difficult in diagnosing, troubleshooting and maintaining electronic systems on modern automobiles. Numerous authors such as Ogbuanya and Idris (2014), Udogu (2015) and Alabi *et al.* (2019) conducted researches in order to address the challenges of shortage of skills among automobile craftsmen. Despite the efforts of these authors, automobile craftsmen are still unable to carry out troubleshooting and maintenance services on modern automobiles. The challenge propelled Arah *et al.* (2021) to develop the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria. In order to ensure the usability of the developed manual, the need to establish its validity and reliability became necessary. Hence, it is against this backdrop that the researchers sought to determine the content validity and reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria in order to ensure its usability.

1.2 Aim and Objectives of the Study

The study aimed at establishing the content validity and reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria. Specifically, the objectives of the study were to determine the:

1. Content validity of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria.
2. Reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria.

1.3 Research Questions

The following research questions were raised and answered:

1. What is the content validity of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria?
2. What is the reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria?

2. Materials and Methods

Descriptive survey research design using cross sectional design was used. The study was conducted in Federal Capital Territory (FCT), Abuja, Kaduna, Kano, Lagos and Plateau States, Nigeria. The area was selected because, these are the only locations where National Automotive Design and Development Council (NADDCC) and Industrial Training Fund (ITF) owned and affiliated institutions offers 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 population for the study was 99 Subject Matter Experts (SMEs) that consisted of 43 non-teaching and 56 teaching from NADDCC and ITF owned and affiliated institutions offering automobile mechatronics training programme 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. Purposive Sampling Technique (PST) was used to sample nine out of the 99 SMEs used in the development of the manual to test its content validity and reliability. The nine SMEs (consisting of four non-teaching and five teaching) were purposively selected based on their expertise in the development of manual. The selection of the nine SMEs is supported by Othman in Mohammad *et al.* (2013) who argued that, six to nine SMEs are adequate in examining the constructs validity and reliability of a module or manual.

The instruments used for data collection was a Manual Content Validity Index (MCVI) designed on a five-point rating scale consisting of five parts with five items each to determine the validity of the manual based on objectives, subject matter, organization, language and usefulness. The MCVI was adopted from Rowena (2015) and modified to suit the study. The instruments were 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.

Data were collected by administering the draft copies of electronic braking systems troubleshooting and maintenance manual and MCVI to the nine SMEs in order to establish its contents validity and reliability indices. The data collected were analyzed using content validity index formula by Sidek and Ahmad (2005) and Cronbach's Alpha statistical technique. The Cronbach's Alpha statistical technique was used to answered research question two while research question one was answered using the content validity index formula presented as:

$$\frac{\text{Total score of the Expert (x)}}{\text{Maximum Score Obtainable (25)}} = \text{Manual Content Validity Index}$$

Decision regarding the validity and reliability of the electronic braking systems troubleshooting and maintenance manual was based on the postulation of Sidek and Ahmad (2005) that, obtained MCVI and Cronbach's Alpha coefficient value above 0.7 indicates good validity and reliability.

3. Results and Discussion

3.1 Research Question One

What is the content validity of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria?

Table 1: Experts' Mean Scores and Content Validity Index of Electronic Braking Systems Troubleshooting and Maintenance Manual for Automobile Craftsmen in Nigeria

S/N	Experts	Mean Scores Obtained	MCVI (Scores Obtained/25)	Decision
1	Objectives	22.89	0.92	Valid
2	Subject Matter	22.78	0.91	Valid
3	Organization	22.89	0.92	Valid
4	Language	23.22	0.93	Valid
5	Usefulness	23.11	0.92	Valid
	Overall	22.98	0.92	Valid

Table 1 shows that, the MCVI obtained on the objectives, subject matter, organization, language and usefulness of the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria ranged between 0.91-0.93 and with overall validity index of 0.92. These indices indicated that, the content of electronic braking

systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria is valid.

3.2 Research Question Two

What is the reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria?

Table 2: Reliability Index of Electronic Braking Systems Troubleshooting and Maintenance Manual for Automobile Craftsmen in Nigeria

S/N	Experts	Number of Items	Cronbach's Alpha	Decision
1	Objectives	5	0.85	Reliable
2	Subject Matter	5	0.88	Reliable
3	Organization	5	0.72	Reliable
4	Language	5	0.76	Reliable
5	Usefulness	5	0.72	Reliable
	Overall	25	0.81	Reliable

Table 2 shows that, the Cronbach's Alpha values obtained on the objectives, subject matter, organization, language and usefulness of the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria ranged between 0.72-0.88 and with overall reliability index of 0.81. These indices indicated that, the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria is reliable.

3.3 Findings

1. The content of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria is valid.
2. The electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria is reliable.

3.4 Discussion of Findings

Finding on the content validity of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria revealed that it is valid. This entailed that,

the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen can achieve the objectives it was designed for. The finding is similar to the finding of Jamaludin *et al.* (2011) on the development of a drug abused rehabilitation module that shown good validity of 0.91 validity index and high reliability coefficient of .95. The educational implication of this finding is that, the manual holds the potential to enhance the skill performance of automobile craftsmen in the troubleshooting and maintenance of electronic braking systems and also reinforce the benefits of self-learning approach for self-development.

Finding on the reliability of electronic braking systems troubleshooting and maintenance manual for automobile craftsmen in Nigeria revealed that it is reliable. This entailed that, the electronic braking systems troubleshooting and maintenance manual for automobile craftsmen is consistent. The finding is similar to the finding of Kasim and Ahmad (2018) on the development of a PRO-STEM module for teaching the topic of biodiversity and ecosystem to promote the application of Higher Order Thinking Skills

(HOTS) and 21st century skills among secondary school students that revealed the content validity value of 0.98 and the reliability coefficient of 0.92. The educational implication of this finding is that, the electronic braking systems troubleshooting and maintenance manual holds the potential to produce consistent learning outcomes among automobile craftsmen if utilized.

4. Conclusion

Based on the findings of the study, it is concluded that, the electronic braking systems troubleshooting and maintenance manual is valid and reliable through teaching and non-teaching Subject Matter Experts' judgment. Therefore, these promising findings justified the need for the use of electronic braking systems troubleshooting and maintenance manual by automobile craftsmen in Nigeria. Thus, the manual when judiciously and persistently used would help the intended automobile craftsmen to achieve better self-development throughout their career. The findings of the study will encourage stakeholders in automobile maintenance industry to adopt such an approach to develop a diverse range of manual to foster the skill performance of automobile craftsmen in troubleshooting and maintenance of other electronic systems.

4.1 Recommendations

Based on the findings of the study, it was recommended that, the two most relevant stakeholders in automotive maintenance industry (National Automotive Design and Development Council and Industrial Training Fund) in Nigeria should:

1. Provide a conducive atmosphere for testing the effectiveness of the electronic braking systems troubleshooting and maintenance manual on the skill performance of automobile craftsmen.
2. Earnestly embrace the electronic braking systems troubleshooting and maintenance manual after it is confirmed effective in enhancing skill performance and make it available to automobile craftsmen in order to foster a holistic balanced self-development.

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ensuring the electronic braking systems troubleshooting and maintenance manual is valid and reliable.

Conflict of interest

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

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