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DEVELOPMENT AND VALIDATION OF INSTRUMENT FOR ASSESSING STUDENTS' PRACTICAL SKILLS IN SUSPENSION SYSTEM IN NORTH-EAST NIGERIA

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ABSTRACT
The study aimed to develop and validate an instrument for Assessing Students' Practical Skills in Suspension System (IASPSSS) at Technical Colleges in North East-Nigeria. Five purposes and five research questions guided the study. The study employed an instrumentation research design. The population of the study consisted of 556 respondents, including 58 motor vehicle mechanics work (MVMW) teachers and 498 National Technical Certificate (NTC) III MVMW students. Five experts validated and five MVMW teachers rated the instrument. Simple random sampling technique was used to select 60 NTC III MVMW students from the six sampled school. All the 14 MVMW teachers in the sampled schools were used as an assessors. The data generated were analyzed using Mean and Standard Deviation., and Factor Analysis was conducted for construct validation. Reliability of the instrument was determine using Cronbach Alpha. The respondents agreed that all the four identified task areas on suspension system existed in NBTE NTC curriculum with an average cumulative mean of 3.99 and standard deviation of 0.69, indicating a high level of agreement. The 34 students' practical skills items were rated as "Appropriate," with an overall cumulative mean of 4.09 and standard deviation of 0.67, indicating a high level of agreement among the respondents. Factor analysis was performed to validate the IASPSSS and it confirmed four major task skills areas accounted 92.12% of the total variance explained, with eigenvalues for these skill areas exceeding 1. These findings meet the required criteria, thereby confirming the validity of the instrument. Likewise, the instrument demonstrated high reliability, with a Cronbach Alpha coefficient of 0.99 based on the scores of 60 students rated by 14 teachers. It was therefore recommended for adoption for NABTEB, WAEC, and NECO for certification and use by MVMW teachers in Technical Colleges.

Keywords: Assessment Instrument, suspension system, practical skills, motor vehicle mechanic work.

INTRODUCTION

Technical and Vocational Education and Training (TVET) is the foundation of technological, social and economic development of any nation, Nigeria inclusive. The objectives of TVET courses

offered in technical colleges in Nigeria are meant for the acquisition of practical and applied skills as well as basic scientific knowledge (Abel, 2019; Danyaro, 2018). Part of the efforts towards achieving these objectives is by taking suspension system. It is an aspect of a module offered by motor vehicle mechanic students at technical college and when successfully completed can be used for employment purposes (National Board for Technical Education, 2023).

The module emphasized the need for students to be exposed to practical experiences through practices and maintenance centered on providing the students with the practical skills (psychomotor skills) which takes place in the workshop where the students carry out practical task and operations in suspension, steering and braking systems components (NBTE, 2023). It aimed at providing training to individuals interested in vehicle repair and maintenance for competence in suspension, steering and braking systems areas and consequently providing them with employment for earning a living (NBTE, 2023). Thus, leading to the development of the psychomotor domain.

The psychomotor domain of educational objectives is concerned with the practical or motor skills possessed by students, although it is possible to construct objectives tests and essay tests for the measurement of practical skill development, such tests have their own limitations, therefore, psychomotor skills are best assessed through the use of the practical skills rating scale. The processes in rating practical skills according to Mamuda (2017) comprises of the various task to be carried out, statement of the degree of accuracy in performing the tasks, the weighted values for each category of the observable skills should be employed when assessing practical projects. The researcher further stated that assessment instrument with practical skill rating is an appropriate procedure for finding out the extent to which vocational and technical education has attained its stated objectives.

According to Asukwo, Akpan and Yusuf (2019) an effective assessment technique is expected to assess the step-by-step practical activities carried out by the students. Offor (2014) revealed that when teachers' assessment instrument fell short of expectation and so would the teaching be. The harm in these is that the decisions taken based on assessment results are misleading because the results of assessment are not true reflection of the learning possessed by holders of the results. The researcher further stated that the goal of developing assessment instrument is to improve students' performance.

Practical training is a unique aspect of a technical college programme that can be defined as an act of doing, making, manipulating and practicing the theoretical knowledge gained with the uses of materials, tools and equipment. Practical skill assessment is an instrument for determining the extent to which students can demonstrate the practical competencies posed in motor vehicle mechanics work using process test items while the examiner is observing the student performing the operations involved. Mbaya (2022) stressed the need for observing and rating of step-by-step procedures in assessing manipulative skills in vocational and technology education programmes. The most appropriate instrument for assessing technical education students for psychomotor skills is test of competence on the skills they have acquired.

The MVMW students require practical skills to diagnose service and completely repair any fault relating to automobile systems to the manufacturers specification. The importance of possessing practical skills among craftsmen can never be over emphasis because it empowers them to solve practical problems as well as it can differentiate between a novice and an expert in that profession. (Ochogba, 2021). It therefore becomes necessary for technical colleges to equip the students with practical skills in maintenance and repair in suspension system.

The regular maintenance of suspension system's components is optimal for safety of the drivers, passengers and other road users. Suspension system's is the system of tires, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Neglecting the systems can result in poor performance, uneven tire wear, and even jeopardize

one's safety and that of other road users (Schnubel, 2020). Regular maintenance routine, inspections and repairs help to ensure that the vehicle's suspension system function properly for a long time (Eric, 2020).

Therefore, MVMW students in Technical Colleges should be fully exposed and equipped with appropriate skills in carrying out the practical task in automobile systems' components as outlined the NBTE NTC curriculum. According to Khatete and Chepkoech (2018); Ochogba and Ordu (2019); Okwelle and Ojotule (2018); Olaleye (2023) when Technical college students are fully exposed to practical training in their different areas of trade such as motor vehicle mechanic work, plumbing, weaving and computer would enable them to be self-reliant. Practical skills acquisition remains the major goal of technical education and this helps to satisfy the personal work needs of the individual and the society in general (Chen, Wang, Kirschner and Tsai, 2018). Topi, Karsten, Brown, Alvaro, Donnellan, Shen and Thouin, (2017) opined that the acquisition of practical skills prepares students for a specific occupation in industries and competences to exploit life's opportunities. The training obtained in technical college can be measured through the ability of students at the end of a programmes of study to apply the practical skills learned (Gowon, Eric and Oluyinka, 2020).

Motor vehicle mechanics is described as one of the subjects offered in technical colleges that provides students with practical skills relevant for the repair and maintenance of automobiles and its parts (Ochogba, 2021). However, Titus, Gowon and Olumoko, (2020) revealed that, teaching and learning of auto mechanic in technical colleges appears to be dominated by oral presentation without practical. Consequently, the students are unable to retain their learning to apply it to new situations. This, according to Abidiak, Nduononwi and Akpan (2017); Osidipe (2017); Maina (2021); Mamman and Auta, (2020) result to students graduating with inadequate or complete absence of practical skills in the MVMW trade area.

In the same vein, Nyapson (2015) observed that MVMW curriculum prepares graduates of Technical Colleges to have inadequate skills in motor vehicle maintenance and repairs which has rendered most of them jobless and not able to contribute to the national economy. Technical College graduates neither set up their own workshops nor being employed by automobile industries. The problem could be associated with the types of assessment techniques used in Technical Colleges to assess cognitive domain of educational objectives to measure only the recall of facts and which is considered unsuitable for such a skill oriented learning programme. This assessment techniques only rates a very few processes leaving out major procedural steps required to perform and finish a task, thereby rendering it invalid and unreliable for assessing the skills of student in suspension system.

Skill oriented module of suspension, steering and braking systems cannot be successfully carried out using written essay, this task rest on the teachers or the national examination bodies to design and develop appropriate test instrument in the psychomotor domain that can adequately assess the process skills possessed by the student Assessment instrument is the standard activities developed to support the assessment method used to collect the evidence of student competence (Australia Skills Quality Authority, 2020). Assessment of practical skills (psychomotor skills) can be carried out by evaluating the chronological process in which the tasks are carried out (process assessment). The purpose of psychomotor skills assessment is to ensure that the students can manipulate tools and equipment to attain the task specification that can serve as a valid and reliable predictor of skills acquisition in workshop practice and maintenance (Gowon, Eric & Olumoko, 2020). Assessment is basically placed highly among the activities of teaching learning process.

In measuring the extent to which mastery has been achieved or attained in the psychomotor skill of student in suspension system at the technical college, and for the test instrument to be good enough to measure the expected performance of students, it is expected that the developed test

instrument must possess and satisfy certain psychometrics properties. Psychometric properties is the characteristics of a test that determine its quality and effectiveness in measuring what it is intended to measure (Solomon and Ihebom 2024). These properties include various factors such as validity, reliability, and norms.

Therefore, grasping these properties is vital for anyone involved in developing or using tests. They help ensure that a test delivers accurate and consistent results, it indicates that a test provides precise, reliable, and unbiased outcomes. Psychometric properties of a test item involve the mental measuring abilities of a test following certain peculiarities or characteristics that helps to distinguish it or expected to be possessed by the test item such as item validity and reliability (Solomon and Ihebom, 2024).

The validity of test items is the extent to which practical skills test items or psychomotor skill test items outlined in the curriculum for suspension, steering and braking systems measures what it is designed to measure by the test and it is the process of establishing or confirming the ability of a research document to solve the problem which it is designed to solve or what it was intended to measure (Atikuzzaman, Ahmed and Zabed, 2023; Mohajan, 2017). Therefore, an instrument is considered "valid" if it measured what it set out to measure. An instrument with high validity will measure accurately the particular qualities it is supposed to measure. The validity of practical process skill test in MVMW is the extent to which the students intended practical competencies outlined in the curriculum are covered by the test.

Pritha (2020) revealed that certain threat to validity or prevent the test items from functioning as intended and thereby lowering the validity of the interpretations from the test results. Any defect in the construction of the test that prevents the test items from functioning as intended will contribute to the invalidity of the interpretations to be drawn from the measurement, and all these identified threats will be taken into consideration to ensure the validity of the performance-based test instrument. In so doing the students' performance will be observed individually as they carry out systematic operations to complete their given tasks. This is to help observer determine the extent of individual's student's mastery of skills taught. Reliability on the other hand refers to the degree to which an assessment tool produces stable and consistent results (Middleton, 2023). In other words, the reliability of assessment instrument is the extent to which the student intended practical competencies outlined in the NTC curriculum are covered by the assessment items.

Doman and Arbon (2011) stated that instrument validation and reliability is guided by four basic criteria, first the instrument should provide a good coverage of the instructional effectiveness of teachers and concerns of the students. Secondly, the instrument structure should be consistent with general psychometric principles in that it should possess several internally consistent, mutually exclusive scales. Thirdly, individual scale items should be sensitive to different levels of concerns of students in the study, and fourthly the instrument should be relatively economical to administer, answer, score and analyse. Since instrument for evaluation are generally dependent upon specific curriculum content and are considered to be a test of the terminal rather than future behaviour, there is the need to validate this instrument since it provides a more scientific and objective opportunity for evaluating learning, both skills and knowledge than ordinary teacher made achievement and other tests.

Justifying the need for validation of an instrument for assessing students practical skills in suspension system in technical colleges in North East, Nigeria, Mamuda (2020); Abdulkarim, Ya`u, and Yidi (2020); Mbaya (2022) pointed out that there seems to be great difficulty on the part of the teachers in conducting adequate and unbiased process skills assessment in technical colleges in North east, Nigeria. The development and validation of instrument for assessing students' practical in suspension system at technical colleges' level, in terms of psychomotor skills acquisition is the main focus of this research work.

Statement of the Problem

Motor vehicle mechanic work is one of the 32 trade programmes introduced by the Federal Government for Technical Colleges in Nigeria, with suspension system being a core competency area under the NBTE National Technical Certificate (NTC) Curriculum. Students are expected to acquire and demonstrate practical skills in diagnosing, repairing, and maintaining suspension system's components to meet industry safety and performance standard for certification by NABTEB, WAEC, and NECO. However, in Technical Colleges across North East Nigeria, there is no Standardized and validated instrument for objectively assessing students' practical skills in suspension system.

Reports from Aminu, (2015); Abdulhakim; Ya`u and Yidi (2020) and Mbaya, (2022) pointed out that the current mode of assessing the practical skills in trades subjects in Technical Colleges through the use of multiple choice and essay test questions used by NABTEB in their examinations is structured in the Blooms taxonomy of the cognitive domain and the practical examination make use of an evaluation technique in form of marking scheme checklist. The approach used by the teachers after classroom instruction is tailored to the pattern adopted by the examination bodies in measuring the achievement of student. This scheme merely highlights the major skills to be rated but lacking in details, the various stages of specific skills involved in the process of carrying out the given task. The implication of this is that the scores and grades assigned to student in practical works by the teacher or examiner may not be the true representative of their performances.

Based on these practices of assessment by the teachers and the examination bodies, some of the operations of each of the major task areas in suspension, steering and braking systems could not be attained. Hence, students complete the programme without actually acquiring the skills needed in the work place or to be self-reliant. The use of the marking scheme checklist to assess the practical process skills is not feasible in suspension, steering and braking systems. In order to improve the standard of assessment instrument for suspension, system, there is the need to use valid and reliable assessment instrument that takes into account the processes of practical activities leading to the final practical activity.

Aim and Objectives of the Study

The aim of this study was to develop and validate instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria. Specifically, the study sought to:

1. Identify the major task areas from National Technical Certificate (NTC) curriculum for suspension system.
2. Determine the operations that are consider appropriate for inclusion into the instrument for assessing students' practical skills in suspension system.
3. Determine the validity of the instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria.
4. Determine the reliability of the instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria.
5. Develop the instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria.

Research Questions

The following research questions guided the study:

1. What are the major task areas identified from NBTE NTC curriculum for suspension system?
2. What are the operations that are consider appropriate for inclusion in the instrument for assessing students' practical skills in suspension system?

3. What is the validity of the instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria?
4. What is the reliability of the instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria?
5. What is the developed instrument for assessing students' practical skills in suspension system at technical college level in North-East, Nigeria?

Research Design

This study employed instrumentation research design. According to Okoye and Auta (2021) an instrumentation research design deals with the process of developing an instrument for assessing performance of students or obtaining data for making decisions. This indicates that instrumentation research design is appropriate for developing and validating instrument for assessing students' practical skills.

Area of the Study

The study was conducted in the North-East, Nigeria. This region is located within geopolitical boundaries of latitude 6.26 East and longitude 4.193 North East of the equator. Its total land area is 103.639m2 (Atlas, World Map, in Mamuda, 2020). The North-East comprises of Bauchi, Gombe, Borno, Yobe, Adamawa and Taraba states.

Population of the Study

The population of the study consisted of 556, including 58 Motor Vehicle Mechanic Work teachers and 498 NTC III motor vehicle mechanic works students of 2024/2025 academic session of North-East, Nigeria.

Sample and Sampling Technique

Simple random sampling technique was used to select 60 NTC III MVMW students from six sampled school. All the 14 MVMW teachers in the sampled schools were used as an assessors.

Instrument for Data Collection

NBTE NTC curriculum for motor vehicle mechanic work and Instrument for Assessing Students Practical Skills in Suspension System (IASPSSS) were used for the data collection. The IASPSSS was tried out on 60 MVMW students rated by 14 MVMW teachers using a five points rating scale to identify the major task areas from the NTC curriculum for assessing students' practical skills on suspension system and determine the operations to be consider appropriate for inclusion IASPSSS.

Below shows the step by step procedure followed in the development and validation of an instrument for assessing suspension system in technical colleges in North East, Nigeria.

1. Stating the purpose of the IASPSSS
2. Identification of the major task areas from the curriculum
3. Drive basic practical skills from the task areas
4. Writing out items for the IASPSSS
5. Administer the IASPSSS to experts for face and content validation.
6. Administer the IASPSSS to the MVMW teachers for rating
8. Pilot test the IASPSBS on MVMW students
9. Final assembly of IASPSSS
10. Tried out final IASPSSS

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Validation of the Instrument

NBTE NTC curriculum for motor vehicle mechanic work and IASPSSS were submitted to five experts for face and contents validation and factor analysis was perform to validated the instrument for assessing students' practical skills in suspension system (IASPSSS).

Reliability of the Instrument

The reliability (internal consistency) of IASPSSS was determined using Cronbach alpha method. Mamuda (2017) posited that Cronbach's Alpha method is used when the instrument had a lot of assessment items and in clusters. The reliability (internal consistency) of the IASPSSS was determined in two stages. The stages were discussed under the following sub-headings:

Method of Data Collection

Data for the study was collected by the researcher with help of six research assistants. Two MVMW teachers pilot tested the IASPSSS on 10 MVMW students in Government Science Technical College Bukuru, Jos Plateau State. The final draft IASPSSS was tried out on 60 NTC III MVMW students' of 2024/2025 academic session and rated by 14 MVMW teachers.

Method of Data Analysis

The data obtained was computed using Statistical Package of Social Sciences (SPSS) version 30. Data collected for research questions one and two were analyzed using mean and standard deviation. Factor Analysis was performed to validate the IASPSSS for research question three. Cronbach Alpha method was used to analyze the reliability for research question 4. Research question five revealed the developed IASPSSS. The calculated mean score of 3.0 and above was considered appropriate for inclusion in the IASPSSS. On the other hand, any item with mean score less than 3.0 was considered inappropriate for inclusion in the instrument.

The mean scores was interpreted base on the true class limits of real whole numbers. In identifying the major task areas in NTC curriculum and determining the appropriateness of the instrument for inclusion in IASPSSS. Similarly, any item with a reliability index of 0.70 and above will be accepted for inclusion in IASPSSS, but any item with a reliability below 0.70 will be rejected based on statistical consideration (Mamuda, 2017).

Results of the Study

Research Question 1: What are the major task areas on suspension system from the NBTE NTC curriculum?

Table 1 presents the mean ratings and standard deviations of MVMW teachers on the major task areas in suspension system as outlined in the NBTE NTC curriculum. The data show that all the identified task areas were rated as "Appropriate," with an overall cumulative mean of 3.99 and a standard deviation of 0.69, indicating a high level of agreement among the respondents. The highest ratings were observed for replacing lower control arm ($\bar{x}$ = 4.29, SD = 0.61).

Table 1: Mean and Standard Deviation of MVMW Teachers on the Major Task Areas from NTC Curriculum on Suspension System (N = 14)

S/N	Major Task Areas identified from NTC Curriculum on Suspension System	$\bar{x}$	SD	Rmk
Suspension System				
1.	Removing worn shock absorber	3.93	0.73	Appropriate
2.	Replacing ball joint.	3.93	0.73	Appropriate
3.	Replacing lower control arm.	4.29	0.61	Appropriate

4.	Adjusting front-end suspension.	3.79	0.70	Appropriate
	Average Cumulative Mean	**3.99**	**0.69**	**Appropriate**

Key: $\bar{x}$ ***= Mean Response, SD = Standard Deviation, Rmk = Remark***

Research Question 2: What are the operations consider appropriate for inclusion in the instrument for assessing students' practical skills on suspension system at technical colleges in North-East, Nigeria?

Table 2 presents the mean ratings and standard deviations of MVMW teachers on the operations considered appropriate for inclusion in the instrument for assessing students' practical skills in suspension system in technical colleges in North-East Nigeria. The responses of the 14 teachers revealed that all the 34 operations listed were rated as appropriate for inclusion. The mean ratings range from 3.71 to 4.50, and standard deviation of 0.39 to 1.07 respectively which falls within the decision benchmark of 3.00 and above. This indicates that the respondents agreed to a very high extent that the identified operations were appropriate for assessing students' practical skills. For instance, operations such as "Ability to observe safety rules" recorded the highest mean scores of 4.36 to 4.50 indicating unanimous agreement on their critical importance. This high level of consensus suggests a strong alignment with NBTE curriculum guidelines and industry expectations for skill acquisition. All of the standard deviations are low, indicating consistency in responses. Overall, the data supports the inclusion of all the identified tasks as valid components for constructing a practical skill assessment instrument that reflects essential competencies in suspension system.

Table 2: Mean and Standard Deviation of MVMW Teachers on the Operation to be Considered Appropriate for Inclusion in the IASPSSS (N = 14)

S/N	Suspension System	$\bar{x}$	SD	Rmk
Task1: Students' Practical Skills on Removing old Shock Absorber				
1.	Ability to raise the car up using jack.	4.07	0.62	Appropriate
2.	Ability to place stands under the car to provide additional support and safety.	4.07	0.83	Appropriate
3.	Ability to use a socket wrench to remove the wheels to gain access to the shock absorbers.	3.93	0.47	Appropriate
4.	Ability to lose the bolts securing the shock absorbers.	4.00	0.55	Appropriate
5.	Ability to remove the bolts and nuts using a socket wrench.	4.14	0.66	Appropriate
6.	Ability to carefully remove the old shock absorbers.	4.07	0.73	Appropriate
7.	Ability to observe safety rules.	4.36	0.63	Appropriate
Task2: Students' Practical Skills on Replacing Ball Joint				
8.	Ability to jack up the car.	4.21	0.70	Appropriate
9.	Ability to place stands under the car to provide additional support and safety.	3.86	0.77	Appropriate
10.	Ability to remove the wheel.	4.29	0.47	Appropriate
11.	Ability to disassemble the transmission to access the nut securing the ball joint to the knuckle.	3.71	1.07	Appropriate

12.	Ability to lose the screws or nuts securing the ball joint to the track control arm and steering knuckle.	3.86	0.66	Appropriate
13.	Ability to use a suitable puller to release the ball joint cone from its point of attachment to the steering knuckle and gently force the suspension arm downward to remove it from its housing with the aid of a lever.	3.71	0.61	Appropriate
14.	Ability to remove the old ball joint.	4.00	0.68	Appropriate
15.	Ability to install the new bolt joint.	4.29	0.73	Appropriate
16.	Ability to observe safety rules.	4.50	0.52	Appropriate
Task3: Students' Practical Skills on Replacing a Lower Control Arm				
17.	Ability to raise and support the vehicle with a jack.	4.00	0.55	Appropriate
18.	Ability to lose the lug nuts on the wheel.	4.07	0.62	Appropriate
19.	Ability to locate the control arm and remove connected parts.	3.86	0.66	Appropriate
20.	Ability to unbolt the lower control arm.	3.93	0.47	Appropriate
21.	Ability to remove the old control arm.	4.21	0.58	Appropriate
22.	Ability to install the new control arm.	4.21	0.58	Appropriate
23.	Ability to lower the vehicle.	4.00	0.39	Appropriate
24.	Ability to observe safety rule.	4.29	0.61	Appropriate
Task4: Students' Practical Skills on Adjusting Front-End Suspension				
25.	Ability to use a jack to lift the front of the vehicle.	4.21	0.70	Appropriate
26.	Ability to place axle stand on each side of the vehicle designated lift points to support it.	4.21	0.70	Appropriate
27.	Ability to lose the nuts on the tie rods and other adjustable suspension components.	4.07	0.73	Appropriate
28.	Ability to adjust the tie rods by turning them with a wrench until the desired alignment setting is achieved.	4.14	0.86	Appropriate
29.	Ability to adjust camber, turn the camber bolts or use camber adjustment tools to achieve the correct angle.	4.14	0.66	Appropriate
30.	Ability to check Caster (If Adjustable).	4.00	0.55	Appropriate
31.	Ability to tighten all loosed nuts with the manufacturer's specified torque.	4.14	0.66	Appropriate
32.	Ability to carefully remove the axle stands and lower the vehicle to the ground.	4.07	0.73	Appropriate
33.	Ability to pay attention to steering wheel alignment and vehicle tracking.	4.14	0.66	Appropriate
34.	Ability to observe safety rules.	4.50	0.65	Appropriate
	Average Cumulative Mean	**4.09**	**0.67**	**Appropriate**

Key: $\bar{x}$ ***= Mean Response, SD = Standard Deviation, Rmk = Remark***

Research Question Three: What is the validity of the instrument for assessing students' practical process skills in suspension system at technical colleges in North-East, Nigeria?

Factor analysis was performed to validate the IASPSBS and it revealed 6 major task skill areas identified from the NTC curriculum for braking system and it accounted for 92.12% of the

total variance explained, with eigenvalues for these skill areas exceeding 1. These findings meet the required criteria, thereby confirming the validity of the instrument. This means that every operation included in the instrument strongly aligned with its respective domain of practical skill and was considered valid by the factor analysis criteria. Therefore, the results affirm that the instrument is a valid tool for assessing the practical skills of motor vehicle mechanics students in the specified domains.

Table 3: Results of Factor Analysis for Validity of the Instrument for Assessing Students' Practical Skills in Suspension System

Criteria	Recommended Value	Observed Value	Remark
KMO	> 0.60	Exceeded 0.60	Meets criterion
Bartlett's Test of Sphericity	Significant at P < 0.05	Significant at P < 0.05	Meets criterion
Communalities	> 0.50	All> 0.50	Meets criterion
Eigenvalues	> 1.00	All > 1.00	Meets criterion
Total Variance Explained	≥ 60%	92.12%	Meets criterion
Anti-Image Correlation Coefficient	≥ 0.50	All ≥ 0.50	Meets criterion

Research Question Four: What is the reliability of the instrument for assessing students' practical skills in suspension system at technical colleges in North-East, Nigeria?

Table 4a showed the reliability coefficients of the Instrument for Assessing Students' Practical Skills in Suspension System in Technical Colleges in North-East Nigeria, as determined using Cronbach's Alpha. The analysis was based on scores obtained by 60 students as rated by 14 teachers. The overall reliability coefficient of the instrument was 0.99, which is within the "very high" range. This result demonstrates that the instrument is highly reliable and consistent in measuring students' practical skills in the specified automotive system and is therefore suitable for use in technical colleges in the region.

Table 4a: Reliability Coefficient of the Developed Instrument for Assessing Students' Practical Skills in Suspension Systems in Technical Colleges (N = 60)

S/N	Suspension System	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Remark
Task 1: Students' Practical Skills on Removing Old Shock Absorber				
1	Ability to raise the car up using jack.	0.759	0.993	Reliable
2	Ability to place stands under the car to provide additional support and safety.	0.778	0.993	Reliable
3	Ability to use a socket wrench to remove the wheels to gain access to the shock absorbers.	0.707	0.993	Reliable
4	Ability to lose the bolts securing the shock absorbers.	0.658	0.993	Reliable

5	Ability to remove the bolts and nuts using a socket wrench.	0.684	0.993	Reliable
6	Ability to carefully remove the old shock absorbers.	0.735	0.993	Reliable
7	Ability to observe safety rules.	0.762	0.993	Reliable
Task 2: Students' Practical Skills on Replacing Ball Joint				
8	Ability to jack up the car.	0.757	0.993	Reliable
9	Ability to place stands under the car to provide additional support and safety.	0.740	0.993	Reliable
10	Ability to remove the wheel.	0.781	0.993	Reliable
11	Ability to disassemble the transmission to access the nut securing the ball joint to the knuckle.	0.745	0.993	Reliable
12	Ability to lose the screws or nuts securing the ball joint to the track control arm and steering knuckle.	0.607	0.993	Reliable
13	Ability to use a suitable puller to release the ball joint cone from its point of attachment to the steering knuckle and gently force the suspension arm downward to remove it from its housing with the aid of a lever.	0.776	0.993	Reliable
14	Ability to remove the old ball joint.	0.500	0.993	Reliable
15	Ability to install the new bolt joint.	0.640	0.993	Reliable
16	Ability to observe safety rules.	0.706	0.993	Reliable
Task 3: Students' Practical Skills on Replacing a Lower Control Arm				
17	Ability to raise and support the vehicle with a jack.	0.696	0.993	Reliable
18	Ability to lose the lug nuts on the wheel.	0.701	0.993	Reliable
19	Ability to locate the control arm and remove connected parts.	0.734	0.993	Reliable
20	Ability to unbolt the lower control arm.	0.713	0.993	Reliable
21	Ability to remove the old control arm.	0.753	0.993	Reliable
22	Ability to install the new control arm.	0.628	0.993	Reliable
23	Ability to lower the vehicle.	0.689	0.993	Reliable
24	Ability to observe safety rule.	0.760	0.993	Reliable
Task 4: Students' Practical Skills on Adjusting Front-End Suspension				Reliable
25	Ability to use a jack to lift the front of the vehicle.	0.833	0.993	Reliable
26	Ability to place axle stand on each sides of the vehicle designated lift points to support it.	0.832	0.993	Reliable
27	Ability to lose the nuts on the tie rods and other adjustable suspension components.	0.726	0.993	Reliable

28	Ability to adjust the tie rods by turning them with a wrench until the desired alignment setting is achieved.	0.588	0.993	Reliable
29	Ability to adjust camber, turn the camber bolts or use camber adjustment tools to achieve the correct angle.	0.743	0.993	Reliable
30	Ability to check Caster (If Adjustable).	0.656	0.993	Reliable
31	Ability to tighten all loosed nuts with the manufacturer's specified torque.	0.614	0.993	Reliable
32	Ability to carefully remove the axle stands and lower the vehicle to the ground.	0.629	0.993	Reliable
33	Ability to pay attention to steering wheel alignment and vehicle tracking.	0.743	0.993	Reliable
34	Ability to observe safety rules.	0.889	0.993	Reliable
	Instrument Reliability		**0.99**	**Reliable**

Table 4b showed the summary of the reliability analysis for each cluster of tasks within the Developed Instrument for Assessing Psychomotor Skills of Motor Vehicle Mechanic Trade Students in technical colleges. The instrument was rated by 14 teachers across 60 students and covered 4 major task areas derived from the NTC curriculum. The cluster demonstrated high reliability with Cronbach Alpha Reliability Indices (CARI) ranging from 0.896 to 0.939 and Fleiss Kappa multi-rater agreement indices ranging from 0.801 to 0.917. All indices were statistically significant at $p < 0.001$, indicating strong consistency among raters and internal coherence within clusters. Notably, the highest reliability was observed in clusters like removing worn shock absorber (CARI = 0.939). The cumulative mean for the entire instrument across the clusters was 0.917 for CARI and 0.836 for Fleiss Kappa, further confirming the instrument's overall reliability and consistency in evaluating students' psychomotor skills. These results affirm that the instrument is dependable/reliable for assessing practical competencies in suspension systems in technical colleges.

Table 4b: Summary of the Cluster and Fleiss Multi-Rater Reliability of the Developed Instrument for Assessing Psychomotor Skills of MVMW Trade Students (No. for Rater = 14, No. of Students = 60)

S/N	Major Task Areas Identified From NTC Curriculum	No. of Raters	No. of Items	Cluster CARI	Kappa - Rater Indices	Indices Significant	Remark
Suspension System							
1.	Removing worn shock absorber	14	07	0.939	0.807	0.000	Reliable
2.	Replacing ball joint.	14	09	0.896	0.801	0.000	Reliable
3.	Replacing lower control arm.	14	08	0.902	0.818	0.000	Reliable
4.	Adjusting front-end suspension.	14	10	0.928	0.917	0.00	Reliable

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Cumulative Mean	**14**	**34**	**0.917**	**0.836**	**0.000**	**Reliable**

Key: CARI = Cronbach Alpha Reliability Index

Research Question Five: What is the developed instrument for assessing students' practical skills in suspension system at technical colleges in North-East, Nigeria?

Table 5. The developed instrument for assessing students' practical skills in suspension system in technical colleges in North-East Nigeria is highly structured, task-specific, and competency-based. It is focusing on one of the major automotive system; suspension system and it is aligned with the NTC curriculum and outlines detailed, step-by-step psychomotor tasks with clear performance indicators and a standardized five-point scoring rubric ranging from "Excellent" to "Very Poor." The instrument evaluates both technical execution and adherence to safety protocols, culminating in a total score that is converted to a percentage and interpreted using a five-level competency scale: Expert, Proficient, Competent, Advanced Beginner, and Novice. This structured format ensures consistency, objectivity, and clarity in assessment, making the instrument both comprehensive and practical for evaluating students' hands-on proficiency in real MVMW workshop settings.

Table 5: Developed Instrument for Assessing Students' Practical Skills in Suspension and System in Technical College level

ASSESSING STUDENTS PRACTICAL SKILLS IN SUSPENSION SYSTEM

Name of Student:…… Gender:……

Class:…… Date:……

Duration:……

S/N	SKILLS	RUBRICS				
Task1: Students' Practical Skills on Removing Old Shock Absorber		5	4	3	2	1
1	Ability to raise the car up using jack.					
2	Ability to place stands under the car to provide additional support and safety.					
3	Ability to use a socket wrench to remove the wheels to gain access to the shock absorbers.					
4	Ability to lose the bolts securing the shock absorbers.					
5	Ability to remove the bolts and nuts using a socket wrench.					
6	Ability to carefully remove the old shock absorbers.					
7	Ability to observe safety rules.					
Task2: Students' Practical Skills on Replacing Ball Joint						
8	Ability to jack up the car.					
9	Ability to place stands under the car to provide additional support and safety.					
10	Ability to remove the wheel.					
11	Ability to disassemble the transmission to access the nut securing the ball joint to the knuckle.					
12	Ability to lose the screws or nuts securing the ball joint to the track control arm and steering knuckle.					

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13	Ability to use a suitable puller to release the ball joint cone from its point of attachment to the steering knuckle and gently force the suspension arm downward to remove it from its housing with the aid of a lever.					
14	Ability to remove the old ball joint.					
15	Ability to install the new bolt joint.					
16	Ability to observe safety rules.					
Task3: Students' Practical Skills on Replacing a Lower Control Arm						
17	Ability to raise and support the vehicle with a jack.					
18	Ability to lose the lug nuts on the wheel.					
19	Ability to locate the control arm and remove connected parts.					
20	Ability to unbolt the lower control arm.					
21	Ability to remove the old control arm.					
22	Ability to install the new control arm.					
23	Ability to lower the vehicle.					
24	Ability to observe safety rule.					
Task4: Students' Practical Skills on Adjusting Front-End Suspension						
25	Ability to use a jack to lift the front of the vehicle.					
26	Ability to place axle stand on each sides of the vehicle designated lift points to support it.					
27	Ability to lose the nuts on the tie rods and other adjustable suspension components.					
28	Ability to adjust the tie rods by turning them with a wrench until the desired alignment setting is achieved.					
29	Ability to adjust camber, turn the camber bolts or use camber adjustment tools to achieve the correct angle.					
30	Ability to check Caster (If Adjustable).					
31	Ability to tighten all loosed nuts with the manufacturer's specified torque.					
32	Ability to carefully remove the axle stands and lower the vehicle to the ground.					
33	Ability to pay attention to steering wheel alignment and vehicle tracking.					
34	Ability to observe safety rules.					
TOTAL SCORE OBTAINED						

Note: Students' score should be converted to 100 marks using the formula

score= $\frac{x}{N} X\frac{100}{1}$

where x = Student's total score obtained and
N = Maximum obtainable score

Scoring Rubric:
Excellent = 5, Very Good = 4, Good = 3, Poor = 2, Very Poor = 1

KEY:
70-100 Expert
60-69 Proficient
50-59 Competent
45-49 Advanced Beginner
0-45 Novice

Competency Level:.....

Teacher's Name:.....
Sign and Date:.....

Findings of the Study

Based on the results of the analysis presented, the following are the findings of the study:

1. Four (4) major task areas identified from the NTC curriculum for suspension system.
2. Thirty (34) operations (students' practical skills items) derived from the NTC curriculum for motor vehicle mechanics were considered appropriate for inclusion in the instrument for assessing students' practical skills in suspension system (IASPSSS).
3. The IASPSSS was found to be valid.
4. The IASPSSS was found to be reliable.
5. The developed IASPSSS was highly structured, task specific and competency based

Discussions of the Findings

The study revealed that all 4 identified task areas and 34 operations in suspension system from the NBTE NTC curriculum were rated as appropriate by MVMW teachers. This finding is in agreement with Mbaya (2022), who asserted that effective skill acquisition in technical education depends on the integration of industry-relevant operations into the assessment framework, thereby ensuring that learners are not only taught but also evaluated on practical tasks that mirror real-life work situations. Similarly, Abdulhakim et al., (2022) emphasized the importance of capturing core job-related functions in technical education assessments, noting that when evaluation instruments reflect the full scope of industrial expectations, they promote authentic performance measurement. Mbaya (2022) argued that the quality of vocational assessment instruments improves significantly when task-specific operations are clearly articulated, as this fosters uniformity in skill evaluation across institutions and enhances graduate readiness for workplace challenges.

The findings of the study revealed that the instrument for assessing students' practical skills in suspension system was highly valid, as all 34 skill items recorded a factor loading of 1.000, far exceeding the 0.35 benchmark for overlapping variance. This finding is strongly supported by Moses, Medugu, Mohammed and Wafudu (2017), who emphasized that instruments intended for assessing hands-on skills must exhibit clear empirical alignment between each item and the skill domain they represent, noting that high factor loadings eliminate ambiguity in interpretation and enhance diagnostic accuracy. The study revealed that the instrument yielded a Cronbach Alpha coefficient of 0.99, indicating an exceptionally stable and cohesive tool for evaluating students' workshop-related competencies in the areas of suspension, steering, and braking mechanisms within technical college settings. This outcome aligns with the view of Okwelle and Nnodim (2022) who asserted that a reliability index approaching 1.00 is not only statistically desirable but practically essential in technical and vocational education, where assessment must capture consistent performance across various instructional and environmental conditions.

The findings of the study revealed that the structure of the developed instrument was comprehensive and pedagogically sound. The outcome was quantified into percentage scores and interpreted using a five-level competency framework, offering a detailed and criterion-referenced evaluation of students' skills. This is in agreement with the report by Yusuf and Asukwo (2022) who emphasized that assessment tools designed for evaluating practical competencies must not only align with the curriculum but also incorporate tiered rubrics that can distinguish varying degrees of learner mastery. The authors asserted that such instruments improve objectivity and make performance assessments more meaningful to both instructors and students.

Recommendations

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

1. **NABTEB should pilot IASPSSS in technical colleges in North East**. NABTEB should approve IASPSSS for use in the 2027/2028 session in selected technical colleges in the North East states with 6 colleges as test centers, to scale up if results are consistent
2. **MVMW teachers should intergrate IASPSSS into teaching and assessment:** Teachers should use IASPSSS checklist during practical lessons and end-of-terms assessments. The checklist break skills into step-by-step tasks, so it can be used directly in the workshop without extra training.
3. **Technical college teachers should run 2 days' workshop for MVMW teachers:** organize workshops at state level to train teachers on how to use IASPSSS; scoring, recording results, and giving feedback. Each college should nominate at least 2 MVMW teachers to attend.
4. **Researchers should use IASPSSS as a model for other trades:** researchers developing assessment tool for electrical, braking or engine systems should follow the same validation procedures used here. This will speed up development and ensure quality.
5. **NERDC should adopt IASPSSS as standard tool for suspension assessment:** NERDC should review and include IASPSSS in national MVMW guidelines across all technical colleges in Nigeria.
6. **Colleges should use IASPSSS to structure lesson plan and practical tasks:** Heads of department should align weekly practical schedules with 4 major task areas. This makes lessons delivery more focused and makes it easier to track students' progress.

Conclusion

Based on the findings, it can be concluded that the instrument for assessing students' practical skills in suspension system (IASPSSS) is a valid and reliable tool for assessing NTC iii MVMW students as built on 4 major task areas and 34 specific operations drawn directly from NBTE NTC curriculum ensuring full coverage of the skills required for the trade. Validation confirmed that IASPSSS accurately measures the intended practical skills, while reliability it produces consistent results across students and raters. Therefore, IASPSSS is suitable for use in technical colleges for both formative and summative assessment of suspension system practical skills, and can contribute to more objective, standardized, and industry – relevant evaluation of students' competence.

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