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Developing Students Process Performance Skills on Engine Overhauling, Gear Box and Vulcanization in Motor Vehicle Mechanics Work in a Depressed Economy in North-East Nigeria

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ABSTRACT
Students Process Performance in Motor Vehicle Mechanics Work in Government Science and Technical Colleges in North-Eastern States of Nigeria was developed and validated for this study. The study was guided by three research questions. The study employed instrumentation research design. The population of the study was 236 comprising 28 motor vehicle mechanic work teachers and 208 NTC III motor vehicle mechanic work students. The random sampling technique was used to select 10 NTC III motor vehicle mechanics work students from each school sampled while all the motor vehicle mechanics work teachers were used for the study. The instrument was validated by six experts. The mean scores from 3.50 was accepted while any mean less than 3.50 was not accepted for inclusion in the instrument. The result of the study showed that 3 tasks and 57 out of 72 operations were found appropriate for inclusion in the instrument. The instrument was found to possess a reliability coefficient of 0.84. It was recommended that National Business and Technical Examination Board, West African Examination Council, National Examination Council and Motor Vehicle Mechanic Work Teachers should acquaint themselves with the knowledge and use of the instrument IESPPMVM.
Keywords: Motor Vehicle Mechanic Works, process performance skills,

INTRODUCTION

The program of Motor Vehicle Mechanic Works in Nigerian technical colleges is designed to produce competent motor vehicle craftsmen for Nigeria technical and industrial development (Aruku, 2012). Therefore, teachers teaching Motor Vehicle Mechanic Works at the technical college level must acquire the right skills to impart to the learners in order for them to acquire the right skills for gainful employment.

Motor vehicle practical skills enable graduates of technical colleges to apply appropriately the skills they learned from the process of carrying out tasks in a typical Motor Vehicle Mechanic Workshop setting. According to Okwelle, Okoye and Okeke (2012), process skills are organized and coordinated forms of physically observable activities exhibited in the process of carrying out tasks in technical and vocational education and other related fields. Process skill activities form major part of instruction in technical and vocational education programme. The quality of learning outcome demonstrated by students of a training programmes determines the extent to which behavioural objective have been achieved (Okwelle, 2011). Technical education and training can be measured through the ability of students at the end of a programmes of study to apply the process skills learned (Mansell, 2013). It is necessary for educators to determine the extent to which set objectives are achieved through evaluation using an instrument.

Motor Vehicle Mechanics work programme/training in Nigerian technical college was planned to produce craftsmen and master craftsmen who should be competent and skilful to carryout routine

services and repair of all types of vehicles (NBTE, 2003). The trade involves repairs and maintenance of brakes, engines, gearbox, vulcanization, fuel system, wheel alignment and wheel balancing of a vehicle etc. Motor Vehicle Mechanic craftsman is expected to test, diagnose, service and completely repair any fault relating to the conventional automobile assembly main units and systems to the manufacturers' specifications, Nigeria Board for Technical Education (NBTE, 2003). The requirements of these tasks demand process skills for use in Technical Colleges to improve motor vehicle mechanic works instruction as well.

A complete overhaul of engine may happen only once or twice during its life and is not the simplest of tasks. However, there are considerable advantages in the overhaul process. It extends the life of the engine significantly and returns performance to or near to the level of a new engine. Engine is designed to have a life of thousands of hours and if one follows the recommended service schedules correctly, that is exactly what it will deliver. However, at some point even a thoroughly observed maintenance regime may not be sufficient and the engine may need overhauling. The principal advantage of overhaul is greatly improved performance at a considerably lower cost than replacing the engine with a new one. By replacing many of the main parts of the engine but retaining the core elements, such as the main engine block, one can make appreciable savings on the cost of simply replacing it, even taking into account the engineering time that is needed for this process (Aruku, 2012).

Similarly, Abd-el-Aziz (2013) stated that overhauling engine will yield positive results, exactly what you choose to replace will depend on the areas where your engine performance is less than it was. If there is such a thing as a typical engine overhaul, it will involve the boring out of the cylinders, along with the installation of new piston rings, bearings and gaskets. Crankshafts and cylinder heads can either be replaced or reconditioned. The rebuilding process restores the engine compression and it is the efficiency of this compression process which allows the engine to generate more power. Another advantage is that because the engine operates more efficiently again, fuel economy should improve in line with this. Automobile engineers are trained to carry out complete engine overhauls, and they have access to specifications and the latest part numbers to ensure that engine performance is fully restored, which returns performance to or near to the level of a new engine. Engine cylinder have to withstand huge pressures and extremely high temperatures, which is why it is essential to have the best quality product.

Statement of the Problem

In technical and vocational education, changes have occurred in the areas of teacher preparation, provision of instructional facilities, instructional delivery, methodologies, and evaluation practices. The researcher found that most technical colleges lack adequate training facilities and materials for evaluating the acquired knowledge and skills, hence examiners find it difficult to evaluate process performance test particularly in Motor Vehicle Mechanic Works. That is why examiners use product ratings leaving process ratings. The product evaluation used for evaluating Motor Vehicle Mechanic Works in technical colleges will not give appropriate level of practical skills acquired by the students.

Purpose of the Study

The purpose of this study was to develop and validate an instrument for evaluating students' process performance in Motor Vehicle Mechanic Works (IESPPMVM) in Government Science and Technical Colleges in North-East, Nigeria.

Specifically, the study:

1. Determine students' process performance tasks on engine overhauling at the technical college level.
2. Determine students' process performance tasks on the gear box at the technical college level.
3. Determine students' process performance tasks on vulcanization at the technical college level.

Research Questions

The following research questions guided the study.

1. What are the operations on engine overhauling considered appropriate for inclusion in the instrument for evaluating students' process performance tasks at the technical college level?
2. What are the operations on gearbox considered appropriate for inclusion in the instrument for evaluating students' process performance tasks at the technical college level?

3. What are the operations on vulcanization considered appropriate for evaluating students' process performance tasks at the technical college level?

RESEARCH METHODS

Research Design

This study employed instrumentation research design. Instrumentation research design is appropriate for use when introducing new procedures, technologies or instrument for educational practices (Gay, 2012). This study becomes an instrumentation research targeted toward development and validation of an instrument for evaluating students' process performance in Motor Vehicle Mechanic Works at the technical college level.

Area of the Study

The study was conducted in the North-Eastern geopolitical region of 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, 2013). The North-East comprises of Bauchi, Gombe, Borno, Yobe, Adamawa and Taraba states.

Population of the Study

The population of the study was 236, comprising 28 Motor Vehicle Mechanic Works teachers and 208 NTC III motor vehicle mechanic works students of 2016/2017 academic session of North-East, Nigeria.

Sample and Sampling Technique

Cluster and purposive sampling was used to select one school from each state. The random sampling technique was used to select 10 NTC III MVM students from each school sampled while all the Motor Vehicle Mechanic Works teachers were used for the study because the population was small and manageable.

Procedure for Development of the Instrument

The instrument for this study, titled Instrument for Evaluating student process Performance in Motor Vehicle Mechanic Works (IESPPMVM) was developed based on the suggestions of Cluzeau (2002); Samarakkody *et al. (*2010) and Okwelle, Okoye and Okeke (2012) motor vehicle mechanic works practical evaluation conducted by NABTEB and teachers are mere product rating and not skill manipulation ratings of students. Similarly, Ombugus and Ogbuanya (2014) stated that this method has limitation due to its inability to evaluate the process of carrying out tasks and operations. Therefore, this study adapts stages approach in the procedural development of the instrument. The stages include:

1. Identification of tasks cluster (content areas) in motor vehicle mechanic works
2. Developing a table of specification/test blue print
3. Writing out items for the draft IESPPMVM
4. Item analysis
5. Trial test of IESPPMVM
6. Administer IESPPMVM for further content validation by Motor Vehicle Mechanics Work teachers
7. Final assembly of IESPPMVM
8. Field test/Try-out final IESPPMVM assembled.

Following a detailed review of NBTE (2003) curriculum for the award of National Technical Certificate (NTC), tasks and instructional objectives relating to this major Motor Vehicle Mechanic Work skills area were extracted from the curriculum based on the criteria review of relevant literature, these objectives were transformed into basic task statements.

At stage 3, a table of specification of two way grids were identified; the horizontal was lists of basic task statements (content areas) and the vertical axis was lists of instructional objectives. This is with the view to ensuring that all task areas and various levels of behavioural objectives were adequately covered. The 3 task areas were further analysed based on available literature, to generate items or operation statements.

At stage 3 and 4, the evaluation instrument IESPPMVM item was written by expressing the extent of the appropriateness or otherwise of performing each of the operations and five-point descriptive rating

scale with assigned values of 5, 4, 3, 2 and 1 respectively was used to form the initial copy of IESPPMVM.

Instrument for Data Collection

The questionnaires IESPPMVM were arranged in two parts: I and II. Part I sought personal data, while Part II had 6 tasks which comprise 103 items dealing with Motor Vehicle Mechanic Works evaluation. Five-point rating scale of Highly Appropriate (HA), Appropriate (A), Moderately Appropriate (MA), Inappropriate (IA), Highly inappropriate (HI), was written against each of the Motor Vehicle Mechanic Works skill statements with a corresponding assigned value of 5, 4, 3, 2, and 1 respectively.

Validation of the Instrument

The draft copy of IESPPMVM was subjected to face validation by experts. At stage 5 in the procedural development of IESPPMVM the validates were made up of two lecturers from the Department of Technology Education, Modibbo Adama University of Technology, Yola, two lecturers from the Department of Vocational and Technology Education, Abubakar Tafawa Balewa University, Bauchi and two Lecturers from Federal College of Education Technical Potiskum.

The experts were requested to read through the draft copy of IESPPMVM and advice on the appropriateness of the items of IESPPMVM based on the content of NTC Motor Vehicle Mechanic Works curriculum to ensure the items contain all the aspects of the course that should be included in the instrument and on any area of ambiguity or disarrangement of the entire structure noticed and make any suggestions that will improve the status and quality of the instrument.

Reliability of the Instrument

A trial test of the draft IESPPMVM, (the 6-stage of the IESPPMVM procedural development) was carried out as part of the sample. The 10 NTC III students of the Department of Motor Vehicle Mechanic Works drawn from the two sample schools, GSTC Geidam and Damagum based on their locations, adequacy of models of equipment, materials and tools necessary for implementing the test. The sample schools were used for trial test of the validated IESPPMVM instrument for the purpose of ascertaining its initial reliability coefficient.

The teachers observed and scored the students' performance as they carry out each task. The internal consistency of items of IESPPMVM was determined using Cronbach Alpha Formula, which estimated the initial reliability coefficient of the IESPPMVM at 0.82. The choice of Cronbach Alpha in establishing the reliability coefficient was informed by the fact that no time interval is involved in administering the test and it excludes some resources of error arising from psychological disposition, fatigue, health etc. (Uzoagulu, 2011).

Cronbach Alpha was used for computing the internal consistency which was developed by Cronbach. It provides a reliability result for instruments or tests composed of items of varying point, values or attitude scales that provides responses such as highly appropriate, appropriate, inappropriate, and highly inappropriate.

Procedure for Data Collection

Draft copy of IESPPMVM was administered personally to the practicing motor vehicle mechanic work teachers by the researcher with the help of research assistants. The instrument IESPPMVM was finally assembled for the try-out/field test on the 60 sampled NTC III motor vehicle mechanic works.

Method of Data Analysis

The data collected were analysed using mean and standard deviation in relation to the research questions. The calculated mean score of 3.50 and above was considered appropriate to be included in the IESPPMVM. On the other hand, any item with mean score less than 3.50 was considered inappropriate for inclusion in the instrument.

The internal consistency was calculated using a Cronbach Alpha Formula with the aid of a statistical package for social sciences (SPSS) version 20. Any item with a reliability index of 0.70 and above was accepted for inclusion in IESPPMVM, but any item with a reliability index below 0.70 was rejected based on statistical consideration (Nunnaly in Aliyu, 2012).

RESULTS AND DATA ANALYSIS

Research Question 1

What are the operations on engine overhauling considered appropriate for inclusion in the instrument for evaluating students' process performance in motor vehicle mechanic works at the technical college level?

In order to answer this research question, the mean and standard deviation of teachers' responses were calculated. The summary is presented in Table 1.

Table 1: Mean and Standard Deviation of Teachers/Instructors of Motor Vehicle Mechanic Works on Engine Overhauling

Item No.	Ability to:	Responses $\bar{X}$	δ	Remark
1.	wash the engine for overhauling	3.44	0.43	IA
2.	disconnect the battery terminals of an engine for overhauling	3.67	0.85	A
3.	loose the engine seat using assorted spanners	3.78	0.73	A
4.	loose propeller shaft using appropriate tools	4.10	0.70	A
5.	remove the gear box using appropriate tools	3.56	0.61	A
6.	loose and remove clutch collision using appropriate tools	3.47	0.54	IA
7.	remove power steering using appropriate tools	3.62	0.78	A
8.	loose and remove radiator hoses using appropriate tools	4.10	0.72	A
9.	loose and remove the injector pump collision using appropriate tools	4. 31	0.76	A
10.	loose the kick starter using appropriate tools	4.21	0.68	A
11.	loose and remove the turbo charger hoses with 11, 17, screw driver/combination rings	3.43	0.54	A
12.	loose and remove seat cap with 17, 22, combinations/rings	3.46	0.60	IA
13.	loose and remove the alternator using appropriate tools	4.30	0.81	A
14.	loose and remove the engine manifold hoses using appropriate tools	4.07	0.63	A
15.	use hydraulic lifter to lift the engine down from the chassis	3.88	0.86	A
16.	loose and remove turbo charger hoses from radiator and the engine manifold	3.43	0.34	IA
17.	loose and remove the engine valve cover using appropriate tools	3.51	0.62	A
18.	loose and remove the aluminium bracket using 13,17, combination /ring	3.37	0.45	IA
19.	loose and remove the nozzles using appropriate tools	4.40	0.73	A
20.	loose and remove top cylinder bolt using appropriate tools	3.85	0.84	A
21.	turn the engine by the side and remove the bottom plate using appropriate tools	4.17	0.74	A
22.	loose and remove connecting rod bolt nuts using appropriate tools	3.95	0.79	A
23.	remove the piston from the cylinder bore	3.80	0.83	A
24.	loose and remove clutch disc using appropriate tools	4.33	0.68	A
25.	remove flywheel using appropriate tools	3. 97	0.86	A
26.	remove timing cover with 13,17 socket spanner	4.21	0.73	IA
27.	remove the timing chain using appropriate tools	3.35	0.42	IA
28.	loose and remove main bearing cap nut to lift crank shaft from the crank case of the engine using appropriate tools	3.69	0.81	A
29.	wash components using petrol before assembling	3.95	0.76	A
30.	leave components of the engine to dry up for 10-20 minutes	4.14	0.81	A
31.	replaced with new piston rings using appropriate tools	3.69	0.78	A
32.	tight the top cylinder using appropriate tools	3.90	0.72	A
33.	assembled all the components of the engine dismantled one after the other	3.41	0.44	IA
34.	select correct engine oil and its treatment	3.48	0.53	IA
35.	tight bottom plate using appropriate tools	4.07	0.74	A
36.	put the engine oil, to correct gauge	3.66	0.75	A
37.	mount the engine back to its seats on the chassis using hydraulic lifter	4.21	0.71	A
38.	tight the seat engine using appropriate tools	4.14	0.81	A
39.	set valve timings to its correct specification using appropriate tools	3.71	0.80	A
40.	set valve and fly wheel timings using filler gauge and kick starter with fly wheel pinion	3.49	0.46	IA
41.	check petrol/diesel level in the tank	4.32	0.72	A
42.	start the engine for testing	4.09	0.79	A
43.	leave the engine for some time in idling position	3.71	0.77	A
44.	observe safety rules.	4.20	0.71	A
Grand Mean		3.98	0.75	

KEY: $\bar{X}$= Mean of Teachers, δ= Standard Deviation, A= Appropriate, IA= Inappropriate, $\bar{X}_G$=Grand Mean*= Appropriate for inclusion into IESPPMVM

Table 3 indicates that the mean ($\bar{X}$) responses of the items ranged from 3.51 to 4.40. Task One: Thirty-four out of forty-four operations had their mean scores above the cut-off point of 3.50, which qualifies 34 operations/practical skills items appropriate for inclusion in the IESPPMVM. The standard deviation(δ) of the items ranged from 0.61 to 0.86. This implies that Motor Vehicle Mechanic Works teachers were very close in their ratings.

Thirty-four out of forty-four expected Motor Vehicle Mechanic Work practical skills, operations on task one, engine overhauling were considered appropriate and therefore included in the final copy of the developed instrument IESPPMVM.

Research Question 2

What are the operations on gearbox considered appropriate for inclusion in the instrument for evaluating students' process performance in motor vehicle mechanic works at the technical college level?

In order to answer this research question, responses from Motor Vehicle Mechanic Works teachers were considered. Their means were analysed and conclusions were reached as presented in Table 2.

Table 2: **Mean and Standard Deviation of Motor Vehicle Mechanic Works Teachers/Instructors on Gear Box**

Item No. Ability to:	Responses $\bar{X}$	δ	Remark
45. loose and remove gear box housing using appropriate tools	4.30	0.81	A
46. loose and remove the gearbox front housing using appropriate tools	3.55	0.66	A
47. loose and remove gear box oil pump using appropriate tools	3.72	0.76	A
48. loose and remove shooter using appropriate tools	3.84	0.89	A
49. remove lay shaft from the gearbox using appropriate tools	4.26	0.76	A
50. remove damage teeth where possible	3.43	0.55	IA
51. remove selector fork from the gearbox	3.40	0.57	IA
52. remove synchronizer from gearbox	4.26	0.76	A
53. tight new synchronizer using appropriate tools	3.78	0.68	A
54. tight the gear box using appropriate tools	3.73	0.76	A
55. observe safety rules	3.65	0.64	A
Grand Mean	3.89	0.74	

KEY: $\bar{X}$= Mean of Teachers,δ= Standard Deviation, A= Appropriate, IA= Inappropriate, $\bar{X}_G$=Grand Mean*= Appropriate for inclusion into IESPPMVM

Table 3 indicates that the mean ($\bar{X}$) responses of the items ranged from 3.55 to 4.30. Task Two: Nine out of eleven operations had their mean scores above the cut-off point of 3.50, which qualifies 9 operations/practical skills items appropriate for inclusion in the IESPPMVM. The standard deviation (δ) of the items ranged from 0.64 to 0.89. This shows that Motor Vehicle Mechanic Works teachers were very close in their ratings.

Nine out of eleven expected Motor Vehicle Mechanic Work practical skills, operations on task two, gearbox were considered appropriate and therefore included in the final copy of the developed instrument IESPPMVM.

Research Question 3

What are the operations on vulcanization considered appropriate for evaluating students' process performance in motor vehicle mechanic works at the technical college level?

In answering this research question, the responses of teachers were analysed as shown in Table 3.

Table 3: Mean and Standard Deviation of Motor Vehicle Mechanic Works Teachers/Instructors on Vulcanization

Item No.	Ability to:	Responses $\bar{X}$	δ	Remark
56.	jack up the vehicle using appropriate tools	3.75	0.76	A
57.	loose the tyre nut using appropriate tools	4.02	0.64	A
58.	inflate the tubeless tyre with air to gauge and check leakage	3.78	0.81	A
59.	check the proper seating of tyre on rim using appropriate tools	4.16	0.76	A
60.	clean leakage area found on the tyre using appropriate tools	3.50	0.74	A
61.	apply rubber solution to the surface area of leakage	3.77	0.78	A
62.	take a rubber patch and cut to specification for the correct size to seal the leakage area and press rubber patch firmly for proper holding	4. 13	0.72	A
63.	allow 10-15 minutes before tightening the tyre to check any leakage	4. 00	0.79	A
64.	tight the tyre using appropriate tools	4. 14	0.84	A
65.	loose the jack small to allow the tyre down for tightening	3. 76	0.84	A
66.	burn with fire for 10-15 minutes by tightening it in vulcanizes furnace	3.42	0.47	IA
67.	loose it from the furnace	3.42	0.47	IA
68.	put water to cool the surface area	3.45	0.47	IA
69.	tight the tyre to correct specification using appropriate tools	4. 09	0.82	A
70.	use air compressor machine to inflate the tyre to gauge	3.78	0.71	A
71.	remove the jack completely	3.67	0.64	A
72.	observe safety rules.	3.97	0.68	A
Grand Mean		3.89	0.75	

KEY: $\bar{X}$= Mean of Teachers, δ= Standard Deviation, A= Appropriate, IA= Inappropriate, $\bar{X}_G$=Grand Mean*= Appropriate for inclusion into IESPPMVM

Table 5 indicates that the mean ($\bar{X}$) responses of the items ranged from 3.50 to 4.16. Task Three: Fourteen out of seventeen operations in the task had their mean scores above the cut-off point of 3.50, which qualifies 14 operations/practical skills items appropriate for inclusion in the IESPPMVM. The standard deviation(δ) of the items ranged from 0.64 to 0.84. This indicates that Motor Vehicle Mechanic Works teachers were very close in their ratings.

Fourteen out of seventeen expected Motor Vehicle Mechanic Work practical skills, operations on task three, vulcanization were considered appropriate and therefore included in the final copy of the developed instrument IESPPMVM.

Findings of the Study

The results of the study revealed the following findings:

i. Thirty-four out of forty-four expected Motor Vehicle Mechanic Work practical skills, operations on task one, engine overhauling were considered appropriate and therefore included in the final copy of the developed instrument IESPPMVM.
ii. Nine out of eleven expected Motor Vehicle Mechanic Work practical skills, operations on task two, gearbox were considered appropriate and therefore included in the final copy of the developed instrument IESPPMVM.
iii. Fourteen out of seventeen expected Motor Vehicle Mechanic Work practical skills, operations on task three, vulcanization were considered appropriate and therefore included in the final copy of the developed instrument IESPPMVM.

CONCLUSION

The major findings of this study serve as a basis for drawing conclusion that IESPPMVM is a valid and reliable rating instrument that could be used in evaluating students' practical skills performance in Motor Vehicle Mechanic Works in technical colleges. It is expected that Motor Vehicle Mechanic Works teachers in technical colleges in North-East may now be able to use an objective, comprehensive and systematic instrument to effectively evaluate students' process performance in Motor Vehicle Mechanic Works. In so doing, the teachers would be able to show proof the scores and grades that they award. Furthermore, it is believed that students' process performance in Motor Vehicle Mechanic Works especially the practical aspect would be improved.

RECOMMENDATIONS

The following recommendations were made based on the findings of this study.

1. NABTEB, NECO and WAEC should recommend the use of the IESPPMVM in technical colleges in the North-East/Nigeria.
2. Seminars and workshops should be organized for teachers on process performance at the technical college level.
3. Technical college teachers should use IESPPMVM, structure their contents into relevant tasks in their respective subject areas.
4. Teachers teaching MVM should as well use IESPPMVM in conducting student's continuous assessment so as to work on reliable result from the beginning of the assessment procedure.
5. Researchers should use the IESPPMVM procedure as a model for development and validation of similar instrument in other subject areas.

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