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# DEVELOPMENT OF HYBRID ELECTRIC VEHICLE MAINTENANCE MODULE FOR CRAFTSMEN IN NORTH-CENTRAL, NIGERIA

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***Abstract:*** *The study developed Hybrid Electric Vehicle Maintenance Module for Craftsmen in North-Central, Nigeria. Two research questions were raised and answered as well as two null hypotheses were formulated and test at 0.05 level of significant. Mixed Method Research Design was adopted for this study. The study was conducted in North-Central Nigeria. 128 respondents comprising of 50 industry-based SMEs, 27 school-based SMEs and 51 MVM craftsmen from the seven organizations associated with the maintenance of Hybrid Electric Vehicles in the study area. The study utilized the whole population of the study. The instruments were subjected to face and content validation by three experts. The reliability of HEVMDQ was established using Cronbach's Alpha statistics and yielded overall reliability coefficient of 0.88 and the reliability of HEVMSPT was established using Kendall's tau coefficient of concordance and yielded coefficient values of 0.91, 0.86 and 0.84. Data were collected by administering copies of the instruments through hand delivery. The quantitative data collected was analyzed using mean, Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) while qualitative data collected was analyzed using thematic analysis. The study revealed that there was no significant difference (significant value ≥0.05) between the mean responses of school-based and industry-based experts on the facilities and evaluation strategies for the HEV maintenance module for MVMW craftsmen. Based on the findings, the study recommended among others that: The National Board for Technical Education should include the identified objective into Motor Vehicle Mechanic Works curriculum used for training MVM craftsmen through the process of curriculum review in order to equip them with the required competencies in the maintenance of HEV.*

***Keywords:*** *Development, Hybrid electric vehicle, maintenance, module, craftsmen*

## Introduction

Motor vehicles are the most common means of transportation in Nigeria, and thus play a very important role in the economic development of the Country. This is due to the fact that goods and services are predominantly hauled from the point of production through the market to the point of consumption by means of motor vehicles (Adebumiti & Faniran, 2014). Motor vehicles are the predominant means of transportation because they have a far-reaching ability to get to interior places, where most of the transportation means are unable to reach. However, motor vehicles are not immune to breakdowns and faults, due to wear and tear. On the basis of this, therefore, the services of trained personnel, such as motor vehicle mechanics, are required from time to time to carry out maintenance and repair of motor vehicles.

Motor Vehicle Mechanics' Work (MVMW) is a trade in Nigerian technical college system that equipped students with skills in the maintenance and repairs of motor vehicles. NBTE (2016) stated that MVMW is one of the trade programmes obtainable in technical colleges in Nigeria designed to produce competent skilled craftsmen with quality knowledge of the working principles of motor vehicles, the techniques and safety practices involved in the maintenance and repairs of motor vehicles. As stated in the Motor vehicle mechanics' work curriculum and course specifications, the goal of the trade is to produce motor vehicle maintenance craftsmen who should understand the basic principles of operation and carry out general maintenance and reconditioning work on vehicle engine, fuel injection system as well as other systems and sub systems that constitutes motor vehicle (NBTE, 2016). Every trade offered at the technical college level, has five

components; General education, Theory and related courses, Workshop practice, Industrial training/production work, and Entrepreneurship training. These five components are embedded in the course specifications to cater for the knowledge and skills needed by MVMW craftsman. Due to the high technology involved in the construction of these components, MVMW craftsmen required high level competency to ensure their maintenance.

Maintenance can be described as a way of repairing or servicing used equipment or machine in order to enhanced its functioning capacity. According to Mohammed (2008), maintenance involves functional checks, servicing, repairing or replacing components. The maintenance of motor vehicles, especially the modern vehicle, is a challenge among craftsmen in Nigeria. Matthew and Ede (2010) noted that there has being a continual evolution in design intended to achieve faster, more reliable, more streamlined, cleaner and safer vehicles with enhanced comfort, fuel economy and longevity. Matthew and Ede further revealed that harnessing new technologies into the vehicles have made the modern automobiles an assemblage of a group of sophisticated technologies. This sophistication, according to Oluwale *et al*. (2013), has made most MVMW craftsmen inefficient in the maintenance and repair of modern vehicles especially the HEVs. In oder to equip MVMW craftsmen with the necessary skills to carryout the maintenance of HEVs, there is need for training packages such as a training module.

A training module is a teaching kit that contains the learning contents necessary for achieving expected learning outcomes . According to Uduafemhe and Raymond (2019), a training module is a well-developed course material that conatins rich learning contents, which when successfully completed is capable of equipping craftsmen with the desired competencies. Mangal and Mangal (2012) defined a training module as a book with learning activities intended to facilitate the learner's performance. As noted in Gaitanidis *et al.* (2018), training modules have some important benefits, these include: greater flexibility in planning and organizing educational process; greater efficiency and cost-effectiveness of educational process; better response to the labour market needs; and more efficient response to individual needs and capacities of students and adult students. Gatawa (2009) noted that, the acquisition of skills for the maintenance of HEVs can be effectively achieved only with the available relevant facilities.

Facilities can generally be defined as building, properties and proper infrastructures that include material that contribute to teaching and learning. According to Ndukwe and Allen (2018), facilities have the potential for enhancing students' learning. Facilities in the context of this study refers to all the instructional facilities and equipment needed in the workshop for the purposes of enhancing the acquisition of skills necessary for the maintenance of HEVs. These facilities according to Alberta (2015) include: diagnostic scan tool, computer, software packages, power gauge and lifts among others. However, besides theuse of facilities to to acquire the needed skills in the maintenance of HEVs, instructors must adopt suitable evaluation strategies.

Evaluation stategies are proceses of collecting information on the extents to which stated objectives are achieved. According to Amadi and Lazarus (2017), evaluation strategies are concern with assessing the effectiveness of educational packages such as training modules. The importance of evaluation strategies in ascertaining the the effectiveness of training module cannot be over emphasized. Raine (2018) stated that, evaluation strategies serves as ceteria for determining the extent to which the objectives of a module are achieved. Thus, ascertaining the suitable evaluation strategies for the development of effective module require the expertise of professionals known as Subject Matter Experts.

Subject Matter Experts (SMEs) in the context of this study are people who are highly knowledgeable and skilful in a particular area of human endeavour. The SMEs are important in the development of the module on HEVs maintenance because, they will determine the steps, related knowledge, attitudes, performance standards, tools and materials needed (Naqvi *et al.*, 2017). The SMEs in the context of this study are school-based and industry-based experts. The

school-based experts are highly trained people, with or without professional registration, who have worked for years teaching the maintenance of motor vehicle mechanics. In the same vein, industry-based experts are trained personnels who have spent years carrying out automotive maintenance. Nonetheless, there is need to hypothesise between the responses of school-based and industry-based experts in order to provide enough statistical evidence that, their responses regarding the development of HEVs maintenance module is appropriately needed for craftsmen in Nigeria does not occur by chance. As submitted by Uduafemhe *et al.* (2018), the contributions of SMEs is vital to the development of an effective module.

Furthermore, lack of an effective module for the maintenance of HEVs might possibly contribute to the loss of employment opportunities on the part of MVMW craftsmen. The loss of employment opportunities among MVMW craftsmen is a threat to the social and economic development of Nigeria. This implied that, a module that will provide organized skills delivery system to equip MVMW craftsmen with the competencies in HEVs maintenance is needed. Hence, the development of HEVs maintenance module for MVMW craftsmen in North-Central, Nigeria is needed.

## Statement of the Problem

MVMW craftsmen in Nigeria are trained to carryout the maintenance of different types of automobile. Unfortunately, there seems to be a lack of sufficient manpower to handle the effective maintenance and repairs of sophisticated vehicles, especially HEVs. Maigida and Ogwo (2013) observed that, effective maintenance of modern automobile such as HEVs appears to be a serious challenge among MVMW craftsmen in Nigeria. This could be due to the curriculum used for training present MVMW craftsmen does not contain the contents on the maintenance of sophisticated vehicles like HEVs. Efforts have been made to address the challenge of skill shortage among MVMW craftsmen in Nigeria by several authors that include Idris and Ogbuanya (2016), Audu *et al.* (2020) among others.

The efforts of these authors seems not effective in addressing the lack of skills among MVMW craftsmen in Nigeria in order to carry out the maintenance of HEVs. Okafor (2021) confirmed that, vast majority of MVMW craftsmen in Nigeria suffers the lack off skills to carryout basic maintenance services on modern automobiles such as electric and hybrids. The persistence of skills shortage among MVMW craftsmen is a threat to socio-economic development of Nigeria. Audu *et al.* (2020) stated that, lack of necessary expertise holds the tendencies to render MVMW craftsmen jobless or semi-jobless.

## Purpose of the Study

1. Identify the facilities required for the HEV maintenance module for MVMW craftsmen
2. Determine the evaluation strategies to findout if the objectives of the HEV maintenance module for MVMW craftsmen are achieved

## Research Questions

The following research questions guided the study:

1. What are the facilities required for the HEV maintenance module for MVMW craftsmen?
2. What are the evaluation strategies to findout if the objectives of the HEV maintenance module for MVMW craftsmen are achieved?

## Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance:

**$HO_2$:** There is no significant difference between the mean responses of school-based and industry-based experts on the facilities required for the HEV maintenance module for MVMW craftsmen

**$HO_3$:** There is no significant difference between the mean responses of school-based and industry-based experts on the evaluation strategies to findout if the objectives of the HEV maintenance module for MVMW craftsmen are achieved

## Methodology

The study used survey research design. The mixed method research design is the type of design that involves the collection of both quantitative and qualitative data. This study was carried out in North-Central Nigeria. The targeted population of the study is 128 respondents comprising of 50 industry-based SMEs, 27 school-based SMEs and 51 MVM craftsmen from the seven organizations associated with the maintenance of Hybrid Electric Vehicles in the study area. Due to the manageable size of the study population, the study utilized the whole population. Though, purposive sampling technique was use to select seven SMEs one each from the seven organizations from which the population for the study is drawn for determining of the objectives of the HEV maintenece module developed.

Questionnaire was used as the instruments for data collection for this study. The instruments was faced and content validated by three experts: one each from the Department of Industrial and Technology Education, Federal University of Technology Minna, Department of Higher Education, Federal Capital Teritory and Examination Development Department, National Examination Council.

The validated instrument used for data collection were trial tested to determine their reliability using split half reliability method on 5 industry-based SMEs, 5 school-based SMEs and ten MVM craftsmen in Business Apprenticeship Training Centre, Zaria, Kaduna State. The choice of Kaduna State for the trial testing exercise was based on the fact that it does not form part of the study area. The reliability indix of 0.88.

Data for the study was collected through the aministration of questionnaire and face-to-face interview. The quantitative data collected was analyzed using descriptive and inferential statistics while qualitative data collected was analyzed using thematic analysis. The descriptive statistics using mean was used to answer research questions two to five.

## Results

**Table 1: Mean responses of school-based and industry-based experts on the facilities required for the HEV maintenance module for MVMW craftsmen**

| S/N | Items | $\overline{X}_1$ | $\overline{X}_2$ | $\overline{X}_A$ | Remark |
|---|---|---|---|---|---|
| | **Facilities for the Maintenance of DC-DC Converter** | | | | |
| 1 | Four-channel oscilloscope | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 2 | Digital multimeter | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| 3 | Pulse or arbitrary-waveform generator | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 4 | Voltage sources | 4.36 | 4.30 | 4.33 | Agreed |
| 5 | Electronic loads | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 6 | Screwdriver sets | 4.67 | 4.70 | 4.68 | Strongly Agreed |
| 7 | Spanners sets | 4.38 | 4.35 | 4.36 | Agreed |
| 8 | Lock plier sets | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| 9 | Heat gun | 4.57 | 4.72 | 4.64 | Strongly Agreed |

| | | | | | |
|---|---|---|---|---|---|
| 10 | wire crimping tools | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| 11 | wire stripping tool | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 12 | Electric drill | 4.38 | 4.33 | 4.35 | Agreed |
| 13 | Drill bit | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 14 | Bi-direction scanner | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 15 | Jack stands | 4.38 | 4.30 | 4.34 | Strongly Agreed |
| 16 | Jack | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| | **Facilities for the Maintenance of Traction Motor** | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 17 | Torch or hand lamp light | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| 18 | Sprit / Petrol | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 19 | Cloth/Rag | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 20 | Hexagonal head bolts | 4.36 | 4.28 | 4.32 | Agreed |
| 21 | Lifting hook | 4.63 | 4.58 | 4.61 | Strongly Agreed |
| 22 | Taped hole | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 23 | Steel bar (20 mm in diameter) | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 24 | Vessel | 4.34 | 4.30 | 4.32 | Agreed |
| 25 | Kerosene | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| 26 | Degreasing agent such as ethyl alcohol | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 27 | Millivoltmeter (multimeter- 50mV) | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 28 | Ovality testing gauge | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| | **Facilities for the Maintenance of Traction Battery** | | | | |
| 29 | troubleshooting kits (On Board Diagnostics) | 4.41 | 4.37 | 4.39 | Agreed |
| 30 | Insulated gloves | 4.63 | 4.58 | 4.61 | Strongly Agreed |
| 31 | Protective goggles | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 32 | Screwdriver sets | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 33 | Spanners sets | 4.38 | 4.40 | 4.38 | Agreed |
| 34 | Lock plier sets | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| 35 | Multimetre | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 36 | Insulated gloves | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| 37 | Protective goggles | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 38 | Screwdriver sets | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 39 | Spanners sets | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 40 | Lock plier sets | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 41 | Multimetre | 4.36 | 4.35 | 4.35 | Agreed |
| | **Grand Mean** | **4.55** | **4.60** | **4.57** | **Strongly Agreed** |

Table 1 shows the mean responses of the respondents on facilities required for the HEV maintenance module with average grand mean of 4.57. Based on the stated criteria for real limit of numbers, this implied that, the respondents strongly agreed with the 41 items as the facilities required for the HEV maintenance module for MVMW craftsmen.

**Table 2: Mean responses of school-based and industry-based experts on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved**

| S/N | Evaluation Strategies | $\overline{X}_1$ | $\overline{X}_2$ | $\overline{X}_A$ | Remark |
|---|---|---|---|---|---|
| | **Pre Assessment** | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 1 | Entry skill test | 4.67 | 4.70 | 4.68 | Strongly Agreed |
| 2 | Concept mapping | 4.41 | 4.40 | 4.40 | Agreed |
| 3 | Drawing ideas related to the topic or content | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| 4 | Information survey | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 5 | Interest survey | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| 6 | Open-ended questioning | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 7 | Self-evaluation | 4.39 | 4.35 | 4.37 | Agreed |
| 8 | Students' work sample | 4.63 | 4.58 | 4.61 | Strongly Agreed |
| 9 | Students' demonstration and discussion | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 10 | Instructors' prepared pretest | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 11 | Instructors' checklist | 4.39 | 4.37 | 4.38 | Agreed |
| | **Formative Evaluation** | | | | |
| 12 | Structured class presentations | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| 13 | Structured peer evaluations | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 15 | Practice test | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 16 | Structured writing evaluations | 4.36 | 4.30 | 4.33 | Agreed |
| 17 | Structured interviews | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 18 | Structured observations | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| | **Summative Evaluation** | | | | |
| 19 | Partner/peer evaluation | 4.50 | 4.60 | 4.55 | Strongly Agreed |
| 20 | Quizzes | 4.57 | 4.72 | 4.64 | Strongly Agreed |
| 21 | Exams | 4.59 | 4.67 | 4.63 | Strongly Agreed |
| 22 | Final project | 4.57 | 4.65 | 4.61 | Strongly Agreed |
| 23 | Survey | 4.38 | 4.33 | 4.35 | Agreed |
| 24 | Structured course evaluation | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 25 | Standardized assessment | 4.66 | 4.70 | 4.68 | Strongly Agreed |
| 26 | Structured midterm report | 4.61 | 4.65 | 4.63 | Strongly Agreed |
| 27 | Posttest | 4.67 | 4.70 | 4.68 | Strongly Agreed |
| | **Grand Mean** | **4.57** | **4.63** | **4.60** | **Strongly Agreed** |

Table 2 reveals the mean responses of the respondents on the evaluation strategies to find out if the objectives of the HEV maintenance module are achieved with average grand mean of 4.60. Based on the stated criteria for real limit of numbers, this implied that, the respondents strongly agreed with the 27 items as the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved.

**Table 3**: **One-way ANOVA for the test of significant difference between the mean responses of school-based and industry-based experts on the facilities required for the HEV maintenance module for MVMW craftsmen**

| Source | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 4.741 | 1 | 4.741 | 87.981 | .099* |
| Within Groups | 8.192 | 75 | .054 | | |
| Total | 12.933 | 76 | | | |

Table 3 revealed that Significant (P) value for the test of significant difference between the mean responses of school-based and industry-based experts on facilities required for the HEV maintenance module for MVMW craftsmen is .099 which is greater than .05. This implied that, there is no significant difference between the mean responses of school-based and industry-based experts on facilities required for the HEV maintenance module for MVMW craftsmen. Hence, the null hypothesis two is accepted.

**Table 4**: **One-way ANOVA for the test of significant difference between the mean responses of school-based and industry-based experts on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved**

| Source | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | .476 | 1 | .683 | 19.863 | .102* |
| Within Groups | .866 | 75 | .087 | | |
| Total | 1.653 | 76 | | | |

Table 4 revealed that Significant (P) value for the test of significant difference between the mean responses of school-based and industry-based experts on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved is .102 which is greater than .05. This implied that, there is no significant difference between the mean responses of school-based and industry-based experts on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved. Hence, the null hypothesis three is accepted.

## Discussion of Findings

The findings formed a strong base to which the maintenance contents and facilities were carefully selected for the HEV maintenance module developed for MVMW craftsmen. The findings also agreed with the assertion of Okoye and Eze (2016) that these objectives must contain the task in practical terms to be performed by craftsmen in identifying the symptoms of malfunction, determining the most likely cause and eliminating the potential causes in the DC-DC converter, traction motor and traction battery. The implication of this finding is that, contents developed based on the identified objectives hold the potential to equip MVMW craftsmen with the requisite skills in the maintenance of HEV.

The findings on the facilities required for the HEV maintenance module for MVMW craftsmen revealed 41 items that include four-channel oscilloscope, digital multimeter, a pulse or arbitrary-waveform generator, common hand tools (screwdriver, spanners, lock pliers, etc.), heat gun, stripping tools, electric drill, drill bits, torch or hand lamp light, commutator with sprit / petrol and cloth, hexagonal head bolts for removing all the bolts tightening the bearing bracket, lifting hook, and taped hole among many others. The finding implied that the identified facilities are required for effective maintenance of DC-DC converter, traction motor and traction battery.

The finding is in line with Destraz *et al*. (2016) that affirmed the facilities required for the maintenance of DC-DC converter include four-channel oscilloscope to enable simultaneous viewing of the most-critical signals and digital multimeter to assist in accurately setting or monitoring steady-state voltages and currents during test procedures, and may also be used to confirm the accuracy and stability of voltages and currents measured by the oscilloscope and associated probes.

In addition, the test for the significant difference between the mean responses of school-based and industry-based experts on the facilities required for the HEV maintenance module for MVMW craftsmen revealed there is no significant difference. This clearly pointed out that, the mean responses of school-based and industry-based experts did not differ on the facilities required for the HEV maintenance module for MVMW craftsmen. The finding is similar to the findings of Uduafemhe *et al.* (2018) that revealed no significant difference between the mean responses of Electrical/Electronics industrial personnel and teachers on the additional cognitive and psychomotor skills contents for the installation and troubleshooting of; satellite transmission, satellite reception, television camera, and closed-circuit television systems respectively. The findings revealed high similarity level between the responses of school-based and industry-based experts on the facilities required for the HEV maintenance module for MVMW craftsmen.

Findings on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved revealed 27 items that include pre-assessment or diagnostic, formative, summative, confirmative, norm-referenced, criterion-referenced, ipsative evaluation strategies. The finding is related to the findings of Osinem (2008) who opined rigorous evaluation strategies such as formative, summative, confirmative, norm-referenced, criterion-referenced, ipsative evaluation strategies delivers the feedback on a continuous basis throughout the implementation of a programme. The finding implied that the identified evaluation strategies are capable to provide effective feedback on the extent to which the objectives of the HEV maintenance module for MVMW craftsmen are achieved.

Moreover, the test for the significant difference between the mean responses of school-based and industry-based experts on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved revealed there is no significant difference. This is an indication that school-based and industry-based experts shared similar opinion on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved. The finding is similar to the findings of Bakare (2017) that showed no significant difference among the mean responses of lecturers, instructors of electrical/electronic technology, supervisors and roadside cell phone technicians on the objectives facilities, delivery systems, evaluation techniques and activities required for the development of cell phone maintenance training modules for national diploma students. The findings indicated high similarity level between the responses of school-based and industry-based experts on the evaluation strategies to find out if the objectives of the HEV maintenance module for MVMW craftsmen are achieved.

## Conclusion

The study developed Hybrid Electric Vehicles (HEV) maintenance module for Motor Vehicle Mechanic Works craftsmen in North-Central, Nigeria. The findings of the study identified facilities and evaluation strategies. These findings formed basis for the development of the HEV maintenance module capable of enhancing the skill performance of MVMW craftsmen in North-Central, Nigeria. Thus, the module when used would help the intended MVMW craftsmen to achieve better self-development throughout their career. It will also encourage stakeholders in automobile maintenance industry to adopt such an approach to develop a diverse range of module to foster the skill performance of MVMW craftsmen in the maintenance of other systems in HEVs.

Therefore, it is concluded that the HEV maintenance module is capable of improving the skill performance of MVMW craftsmen in Nigeria significantly.

## Recommendations

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

1. The National Board for Technical Education should include the identified objective into Motor Vehicle Mechanic Works curriculum used for training MVM craftsmen through the process of curriculum review in order to equip them with the required competencies in the maintenance of HEV.

2. The National Automotive Design and Development Council should make the identified facilities readily available, accessible and affordable to MVM craftsmen in Nigeria by ensuring the Federal Government waive taxes on facilities for the maintenance of HEV.

3. Automobile technology instructors should adopt the identified evaluation strategies during training for MVMW craftsmen in order to ensure the objectives of the HEV maintenance module are achieved.

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