Journal of Informatics and Web Engineering
Vol. 3 No. 2 (June 2024) eISSN: 2821-370X

Development and Validation of Autotronic Training Module for Automobile Technology Students in Polytechnics in Southern Nigeria

Saue, Baritule Prince[1*], Chukuigwe, Ogbondah Nndameka[2], Bassey, Imaobong Sunday[3]

[1,3]Federal College of Education (Technical) Akoka, Lagos State, Nigeria
[2]Rivers State University, Port Harcourt, Rivers State, Nigeria
**Corresponding Author: (sauegodslead@gmail.com; ORCiD:0009-0001-3525-2828)*

Abstract - A research was carried out to create and verify an autotronic training module for students studying vehicle technology at polytechnics located in Southern Nigeria. The design used for the project was Research and Development (R&D). An observation has been made that the curriculum of polytechnics in Nigeria lacks sufficient substance on autotronics technology. As a result, lecturers have challenges in fully imparting the abilities that are essential for the professional world. Undoubtedly, there is now a disparity between the training that craftsmen receive and the skills that are demanded by industries. The research was carried out in the southern region of Nigeria. The research focused on a specific demographic of 1,443 respondents. All the lecturers teaching automobile technology were included in the study, and a purposive sampling technique was used to select 75 automobile technicians from the region. A grand total of 122 questionnaires were distributed to the respondents with the assistance of five research assistants, one hailing from each state. The researcher created an 86-item questionnaire called the Autotronic Training Module Questionnaire (ATMQ). The 5-point Likert scale includes answer alternatives such as Highly Appropriate (HA) - 5, Appropriate (A) - 4, Moderately Appropriate (MA) - 3, Inappropriate (I) - 2, and Highly Inappropriate (HI) - 1, respectively. The tools (Questionnaire and Multiple Choice Questions) underwent face and content validity assessment by three (3) experts. The instrument's internal consistency was assessed using Cronbach Alpha reliability, resulting in a coefficient of .88. The collected data were analysed using the mean and standard deviation to address the study objectives. Additionally, the hypotheses were tested using Analysis of Covariance (ANCOVA). A criteria mean of 3.5 or above was considered 'acceptable', while anything below was considered 'inappropriate'. In addition, the F-calculated (F-cal) ratio was compared to the .05 probability level of significance for each hypothesis. If the F-ratio is lower than the .05 probability level of significance, the null hypothesis was rejected; otherwise, it was accepted. The research concluded that the goals, materials, training facilities, training method, instructors' activities, students' activities, and assessment procedures are suitable for incorporation into the autotronic training module in polytechnics in Southern Nigeria.

Keywords: *Tertiary Institution*, *Polytechnic, Automobile Technology, Autotronic, Instructional Material and Module*

Received: 17 February 2024; Accepted: 30 April 2024; Published: 16 June 2024

I. INTRODUCTION

Improving the quality of learning is the only purpose of every effort and deliberate decision made throughout the learning process. The learning process has evolved from its inception with students meeting in person to a point where no such thing is necessary, yet students would still benefit from some kind of online instruction. Once upon

Journal of Informatics and Web Engineering
https://doi.org/10.33093/jiwe.2023.3.2.14

Published by MMU Press. URL: https://journals.mmupress.com/jiwe

a time, there was a scenario when the lecturer had near-total control over the input to the learning process. Now, books and the lecturer share that dominance, and technology, together with the professor, will eventually take centre stage via the adoption instructional module.

The use of instructional modules enhances students' subject-matter competence and their chances of successful completion of courses. This is due to the fact that well organised modules impart knowledge in a sequential fashion, much like constructing bricks, and use a pace-to-pace technique. Students are able to hone their abilities in a targeted manner within the context of an instructional programme. Unlike the conventional approach, where the sole resource for instruction is a textbook, this one allows the instructor to bring their own unique perspective to the classroom. Teachers rely heavily on instructional modules while presenting their subjects to students. When they first join the profession, most new instructors have not had much time to hone their craft. Lesson plans often make use of instructional resources. Teachers also need these resources in order to assess their students' progress via the completion of assignments, the development of performance tasks, and the administration of exams. An instructional module is a tool that teachers use to include active learning and evaluation into their classes. Instructional materials may be broadly defined as any tool that teachers utilise to better understand and communicate with their pupils. Their purpose is to enhance kids' abilities and boost their academic achievement in elementary, middle, and high school, as well as in college.

The purpose of a tertiary institution is to prepare students for careers and other roles in society. The primary goal of tertiary education in Nigeria, like in other countries, is to produce technocrats and other high-ranking officials who can run the economic machinery. Established with the express goal of meeting the educational manpower and development requirements of the country, tertiary institutions are a component of the educational system. After secondary school, students have the opportunity to continue their education in tertiary institutions in Nigeria, which include colleges of education, polytechnics, universities, and other similar programmes [1].

To earn credentials like the National Diploma (ND) and the Higher National Diploma (HND), students enrol in technical education courses at polytechnics. According to [2], a polytechnic is a non-university higher education institution that primarily teaches students courses in technical subjects, technology, industrial production, agriculture, commerce, and communication. It also provides them with the knowledge and skills needed to handle relevant tools and equipment, allowing them to develop effectively through both theoretical and practical experiences. At the conclusion of their time here, students will be able to work as entry-level technicians, higher-level technicians/technologists, or professionals in a variety of sectors, including automotive technology.

One of the many technology-based skill packages available in both formal and informal settings is automotive technology, with the latter offering an apprenticeship-style curriculum. The program's goal is to train future technicians and technologists to meet the demands of modern industry and technology. Training in autotronic technology, a need of industry 4.0, should lead to meaningful employment or self-employment for those who get skills in vehicle technology. They may stay current in global transport technology by learning mechatronics concepts and using diagnostic equipment or computers, as mentioned in [3]. Expertise in autotronic systems is necessary for designing, diagnosing, fixing, and maintaining modern automobiles [4]. One of the most critical issues with instructional delivery, according to the experts, is the lack of well-designed and comprehensive curricular material.

Low success among polytechnic students majoring in automotive technology is the focus of the current investigation. There was a concerted attempt to identify what went wrong. There may be a connection between the worrying problem and the fact that Nigerian polytechnics do not have enough course materials that deal with the present circumstances [5]. It is undeniable that instructional materials have an impact on students' success [6]. The present-day technical developments in the automotive industry throughout the globe are a direct result of modern vehicle technology, which is an output of ICT. One distinctive feature of the current technological boom is the variety of energy conservation measures put in place to protect our planet [7]. Students majoring in automotive technology in Nigerian polytechnics should be prepared to take advantage of these innovations in the field when they graduate. A lack of coverage of mechatronics subsystems in technical college automotive technology curricula is causing graduates to struggle when it comes to servicing and repairing vehicles with mechatronic systems [8]. According to No Wander [4], professors at Nigerian polytechnics struggle to provide students with a well-rounded education since the curriculum does not include enough material on autotronics technology. As a result, there is now a chasm between what students learn in school and what employers need from skilled workers [9]. But all of that said, the research "development and validation of autotronic training module in automobile technology in polytechnics in Southern Nigeria" was necessary.

Furthermore, this study is aimed at:
1. Determining the objectives, contents, training facilities, training strategy and evaluation strategy for inclusion in the autotronic training module for automobile technology students in polytechnics in Southern Nigeria.
2. To ascertain the effect of autotronic training module on automobile technology students in polytechnics in Southern Nigeria.

In achieving this, the following questions were posed.
1. What are the objectives, contents, training facilities, training strategy and evaluation strategy for inclusion in the autotronic training module for automobile technology students in polytechnics in Southern Nigeria?
2. What is the performance of polytechnics students before and after training with the developed autotronic training module for automobile technology students in polytechnics in Southern Nigeria?

To determine the efficiency of the training module, one null hypothesis was formulated and tested at .05 level of significance. Ho: There is no significant difference between the mean performance of students before and after training with autotronic training module for automobile technology students in polytechnics in Southern Nigeria.

II. LITERATURE REVIEW

The traditional focus of polytechnic education, often known as technology education, has expanded to include instruction on how to apply scientific knowledge and technical skills to the real-world challenges that people face on a daily basis [1]. In addition to doing applied research, polytechnics may take on any additional responsibilities assigned to them by their council [10]. To enrol at a polytechnic, you need to have a minimum of five (5) credits in relevant courses from your SSSC or GCE O' Level, or its equivalent. Providing a foundation for the successive advancement of technical and vocational education and training, technological innovation and development, and other related goals was the driving force behind the formation of polytechnics. In a similar vein, [2] defined polytechnic as an educational institution that prepares students for independent living and gainful work by teaching them the fundamentals of agriculture, industry, and commerce. Thus, polytechnic education guarantees the growth of professionals and technologists in a wide range of business- and vocational-related fields, such as automotive engineering technology.

So long as polytechnics are in existence, it will be crucial to invest in human capital development for research and the upkeep of current systems. Being up-to-date in global transport technology requires knowledge of diagnostic equipment or computers, as well as the ideas and principles of car electronics (autotronics) [3]. Vehicles in the automotive industry use electronic control systems that combine mechanical and electrical components. These systems include engine power, sensor system control (images, acceleration, pressure, temperature, etc.), and electro-mechanical control (Xby-wire, EFS, ABS, skid control, ECS, ETS, etc.). Consequently, modern cars come equipped with a plethora of electronic control devices. These include sensors, micro-controller units (MCUs), cameras and displays, on-board units (OBUs), satellite positioning systems, wireless communications, semiconductors, power devices, and even portable devices that link vehicles to customer service centres through bluetooth. [3]. The specified features allow the driver to avoid unstable or unexpected behaviour and stabilise the motion of the car. Car electronic systems (autotronics) play an increasingly essential role in enhancing automotive operation, safety, economy, and comfort.

Also, according to [17], there has been an upsurge in research on various automotive technologies for use in vehicles, such as traction control, antilock brakes, cruise control, and additional restraint systems. Graduates from technical institutes sometimes lack the knowledge and abilities necessary to properly service contemporary and hybrid vehicles, as pointed out by [12] due to the progressive decline of motor vehicle repair jobs caused by technological advancements. The rapid pace of technological advancement in automobile technology, along with ther fields, poses significant challenges to the current workforce. As a result, Nigerian polytechnics have developed an autotronic training module to meet the needs of their students.

Modules are sets of related lessons that focus on a certain idea or topic. The purpose of each module is to guide students towards the completion of certain, outlined goals. Individualised teaching is possible via the use of modules [14]. This gives students the freedom to study whenever it is most convenient for them. According to the researchers, a module is a self-contained part of a larger set of learning activities whose purpose is to guide the learner towards the achievement of specific, intentional goals. A module is a structured presentation of a predetermined collection of subjects that uses a combination of factual and conceptual learning with visual aids to help students grasp the material. Students may become better decision-makers and leaders in both professional and academic contexts by using a modular learning strategy in conjunction with technology advancements to

practise, prepare, and execute the necessary abilities [Friestad-Tate, et al. quoted in [13]. Module, when confronted with the challenge of creating learning in a big group, offers a more efficient mass education by providing more effective individual teaching. Presenting educational materials to show abilities and understanding is a self-instruction strategy. As stated in [15], a module is an independent and complete educational unit. A module's instructions should be very specific, including the unit's instructional goals, a list of learning activities to accomplish these goals, and assessment methodologies [16].

III. RESEARCH METHODOLOGY

Area of Study: The current research took place in the south-south area of Nigeria. The six (6) states that make up the South-South area are: Rivers, Cross River, Akwa Ibom, Delta, Bayelsa and Edo.

Research Design: The research used an R&D methodology. Research and development, or R&D, entails using research techniques to create new goods and processes, then using those same methods to test, assess, and improve those products and processes until they reach certain quality, effectiveness, or other standards [18]. As part of the process of creating this module, [19] made adjustments to R&D procedures like:

Phase I: *Data Collection* - Autotronic Training Module Questionnaire (ATMQ).was developed. And used to gather data from respondents.

Phase II: *Validity of Instrument* - The developed Autotronic Training Module Questionnaire (ATMQ) was distributed to three (3) experts for validation.

Phase III: *Development of Module* – Based on the responses of the respondents, the module was developed based in line with the objectives, contents, teaching strategies, teaching materials and evaluation processes; indicating teachers and students' activities.

Phase IV: *Assessment/Validity of Module* – The developed module was distributed to assessors/validates who were experts to assess the appropriateness of its content.

Phase V: *Revision* – The module was retrieved after fourteen (14) working days and the assessors'/validates' comments and recommendations effected and used to produce the finally copy of the module.

The figure 1 shows the steps taken in carrying out the study development and Validation of Autotronic Training Module for Automobile Technology Students in Polytechnics in Southern Nigeria. The step shows that the researchers first developed the instrument that was used in soliciting respondent's opinion, validated it with experts, also conducted a reliability test on the instrument. The researchers then developed the module based on the data gathered and sent it out for revision/assessment and was later retrieved and effected all necessary comments, then the module was used to train students and the final copy of module was produced.

Population of the Study: The targeted population for the study was One thousand, four hundred and forty-three (1443) respondents; comprising Three hundred and twenty-eight (328) Higher National Diploma One (HND 1) students, Forty-seven (47) lecturers teaching automobile technology and One thousand and sixty-eight (1,068) registered automobile technicians in Southern Nigeria.

Sample and Sampling Techniques: (Phase 1). The entire population of forty-seven (47) lecturers teaching automobile technology were used while a purposive sampling technique was used to select fifteen (15) automobile technicians from each state of the region which amount to seven-five (75) automobile technicians across the region. (Phase 2). To test the appropriateness of the module, three (3) polytechnics such as Federal Polytechnic Ikot-Ekpene, Akwa Ibom State, Delta State Polytechnic, Ozoro and Benson Saro Wiwa Polytechnic Bori, Rivers State were purposively selected in South-South Nigeria, and Higher National Diploma 1 (HND 1) students' intact classes were used to test the appropriateness of the module for inclusion in polytechnics curriculum in Nigeria.

Steps taken in developing the module are shown Fig. 1.

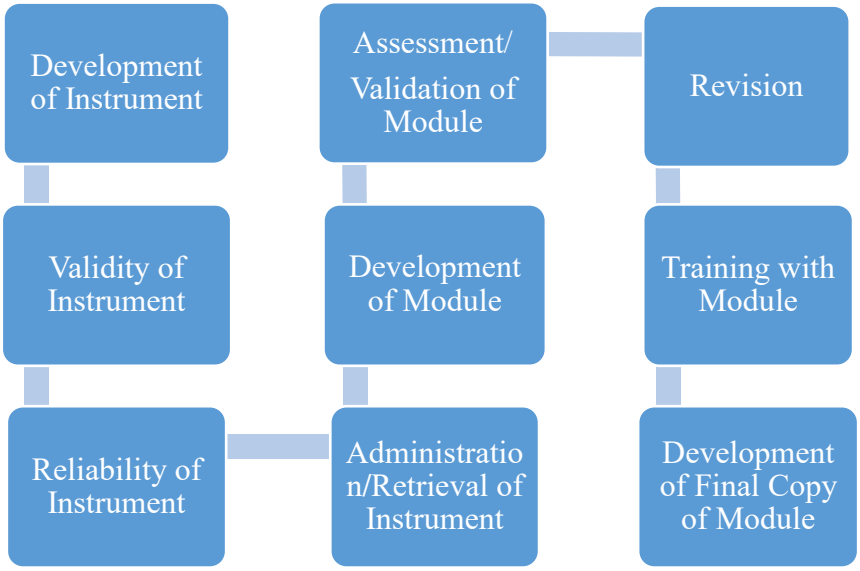

Fig 1. Steps taken in Developing Module [1]

Instrument: There were two (2) stages to the data gathering process. Initial Step: The Autotronic Training Module Questionnaire (ATMQ) was an 86-item survey that the researcher created. Respondents may choose from five possible outcomes on a 5-point Likert scale: Very Appropriate (HA): 5, Appropriate (A): 4, Moderately Appropriate (MA): 3, Inappropriate (I): 2, and Highly Inappropriate (HI): 1. The second phase included measuring the module's efficacy (validation) by giving students a multiple-choice exam with twenty-five (25) questions before and after the module. We gave the pre-test and collected the results before we started the training, and then we gave the post-test after we finished using the autotronics training module we made. Distributing 122 survey packets to potential participants was a team effort including five (5) research assistants, one from each state.

Validity of Instrument: One expert from the Automobile Technology Department at Federal College of Education (Tech) Akoka - Lagos, one from the Technical Education Department at Ignatius Ajuru University of Education Port Harcourt, and one from the Vocational and Technology Education Department at Rivers State University Port Harcourt verified the instrument's face and content validity. The instrument consisted of a questionnaire and multiple choice questions.

Reliability of the Instrument: A total of twenty (20) students and ten (10) professors from the Mechanical Engineering Technology Department at Federal Polytechnic Nekede in Imo State, as well as ten (10) autotronic technology vehicle mechanics in Lagos State, were trial tested to verify reliable instrument performance. To find out how reliable the instrument was, we utilised Cronbach's alpha reliability coefficient, which came out to be.88.

Data Analysis: To address the study objectives, we used descriptive statistics (mean and standard deviation). To verify the hypothesis, we employed Analysis of Covariance (ANCOVA). Appropriate responses were defined as those with a mean higher than 3.50. For each hypothesis test, we compared the F-ratio to the.05 probability level of significance; if the F-ratio was less than the.05 level of significance, we rejected the null hypothesis that there was no significant difference. If there is no statistically significant difference, then accept the null hypothesis. For this calculation, we consulted SPSS version 23, the Statistical Package for the Social Sciences.

Method of Training: Over the course of twelve (12) weeks, students in the study area engaged in rigorous and extensive instruction using the "Autotronic Training Module (ATM)" to hone their autotronics abilities. The next step was to compare the trainee's performance on the ATM exam to that of their counterpart who had received instruction using the more traditional, non-automatic approach.

IV. RESULTS AND DISCUSSION

Research Question 1: What are the objectives, contents, training facilities, training strategy and evaluation strategy for inclusion in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.?

Table 1: Mean and Standard Responses of Lecturers and Automobile Technicians on Autotronic Training Module [1]

S/N	Items	Lecturers and Automobile Technicians N = 122		
		$\bar{x}$	SD	Rmk
A	Objectives to be included in the autotronic training module			
1.	Engine Diagnostic/Management System	4.24	.74	Appr
2.	Digital/Communication System	3.79	1.09	Appr
3.	Ignition and Charging System	4.04	.95	Appr
4.	Electrical/Lighting System	3.65	.98	Appr
	Grand Mean	3.93	.94	Appr
B	Contents to be included in the autotronic training module			
i	Engine Diagnostic/Management System	3.95	.62	Appr
5.	Identify various workshop safety rules			
6.	Identify ECU voltage reference values	3.75	.933	Appr
7.	Install Onboard Diagnostics (OBD) II	3.62	.869	Appr
8.	Explain the function of crankshaft and camshaft position sensors	4.00	.823	Appr
9.	Identify and install engine coolant temperature sensor	3.79	.936	Appr
10.	Operate and maintain turbocharger (turbosystem)	3.70	.854	Appr
11.	Install and maintain condition-monitoring sensors	3.44	1.059	Appr
12.	Activate computer self-diagnosis for troubleshooting	3.59	.835	Appr
13.	Install and maintain engine speed sensor intake	4.03	.718	Appr
14.	Identify and install computer-controlled vehicle system	3.78	.65	Appr
15.	Install and maintain air-temperature sensor	3.93	.62	Appr
16.	Install and maintain Computerized Maintenance Management Systems (CMMS)	3.91	.66	Appr
17.	Analyze diagnosed data	3.65	1.065	Appr
18.	Troubleshoot fuel injectors circuit	3.67	1.016	Appr
19.	Identify air-to-fuel (A/F) ratio	4.16	.65	Appr
20.	Convert flash-type trouble codes into OBDII codes	4.02	.65	Appr
	Grand Mean	3.81	.80	Appr
ii	Digital/Communication System	4.00	1.13	Appr
21.	Identify and install coil-type and bi-metal gauges			
22.	Identify and install speed and crankshaft (PIP) sensors	3.88	.59	Appr
23.	Install speed sensor signal	4.12	.60	Appr
24.	Identify and diagnose warning indicator failure	3.80	.67	Appr
25.	Troubleshoot faults in coolant temperature indication circuit	3.70	.62	Appr
26.	Diagnose and test gauges through sender feed wire	4.04	.63	Appr
27.	Diagnose and maintain faults in air bag system	3.70	.62	Appr
28.	Install low oil level warning lamp (signal) system	3.63	.82	Appr
29.	Identify and install fuel level sensor signal	4.10	.65	Appr
30.	Identify and install parking (theft) sensor signal	3.74	.74	Appr
	Grand Mean	3.87	.70	Appr
iii	Ignition and Charging System			
31.	Identify sensor for ECU	3.61	.75	Appr

32.	Diagnose and record ignition timing using digital multimeter	3.84	.68	Appr
33.	Diagnose and maintain crankshaft and camshaft sensors	3.70	.78	Appr
34.	Carry out throttle cable inspection and adjustment	4.04	.50	Appr
35.	Explain mechanical commutation	3.88	.60	Appr
36.	Operate transistor driver circuit for breaker ignition system	4.08	.95	Appr
37.	Identify secondary wave pattern in multicylinder	3.63	.77	Appr
38.	Measure the resistance and voltage of a coil	4.38	.97	Appr
39.	Identify an inductive pickup ignition circuit	3.79	.80	Appr
40.	Diagnose and maintain defective reluctor sensor	3.51	1.93	Appr
41.	Conduct engine performance test using engine analyzer	3.86	.58	Appr
42.	Interpret and retrieve transmission Diagnostic Trouble Codes (DTC's)	3.58	.81	Appr
	Grand Mean	3.82	.84	Appr
C	Electrical/Lighting System			
43.	Diagnose simple light vanity circuit with multimeter	3.65	.98	Appr
44.	Install an interior light circuit operated by doors contact	4.19	.97	Appr
45.	Identify, diagnose and maintain faulty brake (stop) light circuit with multimeter	3.88	.81	Appr
46.	Identify and troubleshoot faulty Lo/Hi beam circuit	3.65	.92	Appr
47.	Install and maintain flasher and its' circuit	3.94	.85	Appr
48.	Install a hazard warning circuit	4.68	.58	Appr
49.	Identify, troubleshoot and maintain faulty hazard warning circuit	4.29	.84	Appr
50.	Install and maintain relay-operated headlamp circuit	3.92	.86	Appr
51.	Install and diagnose a complete vehicle lighting system	4.10	1.04	Appr
	Grand Mean	4.03	.87	Appr
D	Instructional facilities to be included in the autotronic training module			
52.	Pneumatic/hydraulic jack	3.57	.78	Appr
53.	Battery booster	4.00	.89	Appr
54.	Wheel positioner	3.85	.84	Appr
	Grand Mean	3.80	.83	Appr
E	Instructional strategy to be included in the autotronic training module			
55.	Demonstration	3.72	1.23	Appr
56.	Cooperative/collaborative strategy	4.37	.83	Appr
57.	Buzz method	4.01	.84	Appr
58.	Project-based teaching	3.66	1.45	Appr
59.	Problem-based teaching	3.68	.78	Appr
	Grand Mean	3.88	1.02	Appr
F	Teachers' Activities to be included in the autotronic training module			
60.	Explain and give note on safety rules	4.40	.81	Appr
61.	Shows student ECU voltage reference values	3.65	.98	Appr
62.	Illustrate the installation of Onboard Diagnostics (OBD) II while giving note	4.11	1.04	Appr
63.	Explain and give note on the function of crankshaft and camshaft position sensors	3.65	.98	Appr
64.	Demonstrate the installation of engine coolant temperature sensor and give note	3.94	.89	Appr
65.	The teacher shows the diagnose of a simple light vanity circuit using multimeter	4.19	.97	Appr
66.	The teacher demonstrate the diagnose and maintain of faulty brake (stop) light circuit using multimeter	3.95	.86	Appr
67.	The teacher identifies and troubleshoot faulty Lo/Hi beam circuit	4.50	.76	Appr
68.	The teacher diagnose and maintain crankshaft and camshaft sensors while giving note	4.11	1.04	Appr

69.	The teacher carried out throttle cable inspection and adjustment	3.79	1.09	Appr
70.	The teacher explains and give note mechanical commutation	3.65	1.07	Appr
	Grand Mean	3.99	.95	Appr
G	Students' Activities to be included in the autotronic training module			
71.	Observe and take note on safety rules	4.00	1.07	Appr
72.	Students identifies ECU voltage reference values	3.38	.63	Inappr
73.	Students practice the installation of Onboard Diagnostics (OBD) II while taking note	3.86	.55	Appr
74.	Students take note on function of crankshaft and camshaft position sensors	3.65	1.32	Appr
75.	Students demonstrate the installation of engine coolant temperature sensor and give note	4.01	1.07	Appr
76.	The students diagnose a simple light vanity circuit using multimeter	4.11	.93	Appr
77.	The students diagnose and maintain faulty brake (stop) light circuit using multimeter	4.09	.87	Appr
78.	The students identified and troubleshoot faulty Lo/Hi beam circuit	4.14	.43	Appr
79.	The students diagnose and maintain crankshaft and camshaft sensors while taking note	3.88	.89	Appr
80.	Students conduct throttle cable inspection and adjustment	3.88	.56	Appr
81.	Students listen and take note on mechanical commutation	3.74	1.11	Appr
	Grand Mean	3.88	.85	Appr
H	Evaluation strategy to be included in the autotronic training module			
82.	Norm-referenced Evaluation	4.04	.95	Appr
83.	Criterion-referenced Evaluation	4.40	.81	Appr
84.	Summative Evaluation	3.79	1.09	Appr
85.	Formative Evaluation	3.65	.98	Appr
86.	Ipsative Evaluation	3.78	1.12	Appr
	Grand Mean	3.93	.99	Appr
	Overall Grand Mean	3.893	.863	Appr

Key: Appr. = Appropriate

Table 1 above revealed the average mean and standard deviation of lecturers and automobile technicians on the objectives, contents, training facilities, training strategy, teachers' activities, students' activities and evaluation techniques for inclusion in the autotronic training module in polytechnics in Southern Nigeria are 3.893 and .863 respectively. More so, the respondent agreed that all the items are appropriate to be included in the training module except item number 72 with a mean and standard deviation value of 3.38 and .63 respectively.

Test of Hypothesis

Ho_1: There is no significant difference between the mean performance of students before and after with autotronic training module in polytechnics in Southern Nigeria.

Table 2 above shows the significance level of F at.000, which is less than.05. From Table 2 above, the F-calculated values for group is 40.643 which indicated that the developed autotronic module significantly improves the average performance of students majoring in automotive technology. As a result, at the.05 level of significance, we reject the null hypothesis that there is no significant difference in the mean performance of students at polytechnics in Southern Nigeria before and after using the autotronic training module. This is an indication that the experimental group that is, those trained with Autotronic Training Module (ATM) perform better or have higher achievement index than those train using the conventional method that is, those trained without Autotronic Training Module (ATM).

Table 2: Analysis of Covariance (ANCOVA) for test of significance on mean performance of students before and after training with the developed autotronic module [1]

Source	Sum of Squares	Df	Mean square	F	Sig.
Corrected Model	354334	1	2101.259	266.043	.000
Intercept	287.776	1	1082.8385	17.137	.000
PRE	1.228	1	7.898	.155	.694
Group	718.735	1	287.776	40.643*	.000
Error	2101259	120	1.228		
Total	7463.000	122			
Corrected Total	5050.089	121			

Significant at Sig < .05

The study found that:

1. Objectives such as Engine Diagnostic/Management System, Digital/Communication System, Ignition and Charging System and Electrical/Lighting System are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.
2. Contents are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.
3. Instructional facilities are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.
4. Instructional strategy are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.
5. Teachers' activities are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.
6. Students' activities are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.
7. Evaluation techniques are appropriate and should be included in the autotronic training module in automobile technology in polytechnics in Southern Nigeria.

This finding of the study is therefore significant to Nigeria and other developing countries because the developed module if put to use, contains an up-to-date skills capable of arming beneficiaries/students with workplace skills that will enhance sustainable self-independent and economic development of the nation. Furthermore, this finding is significant because vehicles with highly sophisticated technologies that are flown abroad for repairs or maintenance whenever they breakdown because the automobile graduates of Nigerian Polytechnics lack the skills to maintain such hybrid vehicles will be in the reverse order. According to [17], graduates of the automobile technology programme must acquire autotronics abilities in areas such as auto-electrical/electronic diagnosis, analysis, and maintenance if they want to be competitive in today's changing job market. They may stay current in global transport technology by learning mechatronic concepts and using diagnostic equipment or computers, as pointed out by [20], who agrees with these conclusions.

V. CONCLUSION AND FUTURE WORK

Developed in this research, the autotronic training module is an example of an educational package containing a single conceptual unit of subject matter. Its purpose is to assist students meet the goals of the module. Researchers found that instructors, technologists, and technicians in the automotive sector all agreed that students will be well-prepared for the workforce if they adhered to the course material and completed the developed module. Because of this, the created module is suitable in light of the present shift in the automotive sector. This study's results informed the following suggestions: Government agencies such as the Federal/State MoE, TetFund, ETF, etc., should immediately establish and equip autotronics laboratories/workshops with the necessary facilities for effective training. Additionally, the government should retrain automobile technology lecturers and technologists at polytechnics in accordance with the content of the developed modules. It is imperative that the National Board for Technical Education (NBTE) incorporates the developed module into the curriculum so that graduates can stay up with the current revolution in automobile technology.

The following were suggested for further work:

1. Development of inverter air-conditioning training module for craftsmen in refrigeration and air-conditioning in technical colleges in Nigeria

2. Development of capacity training module on solar inverter installation and maintenance skills in technical colleges in Nigeria

ACKNOWLEDGEMENTS

The researchers are greatly indebted to God who has made this study a success. On a special note, the researchers also thank Dr. C.C.R. Wordu for his encouragement. However, this study was NOT sponsored by any agency, institution or organization.

AUTHOR CONTRIBUTIONS

Saue, Baritule Prince: He contributed in Conceptualization, Writing, Compiling and Articulating Wordings, Review and Editing, and Supervision.
Chukuigwe, Ogbondah Nndameka: He contributed through developing the Instrument, Administration, Methodology Validation, Test Reliability Administer Questionnaire, Writing and Set Marking Guide and Investigation.
Bassey, Imaobong Sunday: She contributed in Resources, Analysing and Interpreting the Data and Produce Final Results / Findings.

CONFLICT OF INTERESTS

The authors declare NO conflict of interest.

REFERENCES

[1] B. P. Saue, I. S. Bassey, K. J. Nnadi & I. A. Onyeaju. Impact of autotronic technology skills acquisition in upskilling automobile technology graduates for workplace transformation in Rivers State, Nigeria. International Journal of Academic and Applied Research (IJAAR), Vol. 7, pp. 31 – 38, 2023.

[2] Sofoluwe."Re-engineering vocational and technical education for sustainable development in North Central Geo-Political Zone, Nigeria". Academic Journal, Vol. 8, No.19, pp.1842 – 1849, 2013

[3] M. A. Napoles, A. Generold, & C.A. Ticmon, The effects of learning spaces at home on the students' performance in new normal. Puissant, Vol. 4, pp. 801 – 821, 2023

[4] Y. Zhang, L. Sun, H. Song & X. Cao. "Ubiquitous WSN for healthcare: Recent advances and future prospects." IEEE Internet Things Journal, Vol. 1, pp. 311 – 318, 2024.

[5] O. Opeyemi, & U. Benjamin, Strategies for enhancing roadside motor vehicle mechanics on basic computer skills for effective manipulation of automotive digital diagnostic tools in Nsukka urban of Enugu State. https://doi.org/10.11648/J.AJMIE.20200506.11.2023

[6] S. Edessa, Impacts of insufficient instructional materials and higher education systems in teaching Biology. Addis Ababa University, Addis Ababa, Ethiopia, 2022

[7] L. Bot, P. B. Gossiaux, C. P. Rauch, & S. Tabious, "Learning by doing: A teaching method for active learning in scientific graduate education." European Journal of Engineering Education, Vol. 30, No. 1, pp. 105 – 119, 2022.

[8] H. F. Alshahad, Design simple instructional package of Arabic language learning for non-Arabic speakers. Journal of Kerbala University, Vol. 1, No.11, pp. 50-56, 2023

[9] Y. P. Wang-Yubiao, "Vehicle CAN network system teaching device." https://patents.google.com/patent/CN201122361Y/en, 2024

[10] S. Sadiq, & S. Zamir, Effectiveness of modular approach in teaching at university level. Journal of Education and Practice, Vol. 5, No. 17, pp. 103 -109, 2024.

[11] C. O.Olumorin, A. Yusuf, U. A. Ajidagba, & A. A. Jekayinfa, Development of instructional materials from local resources for art-based courses. Asian Journal of Information Technology, Vol. 9, No. 2, pp. 107 – 110, 2023.

[12] J.Yang, Y. Zheng, X. Gou, K. Pu, Z. Chen, & Q. Guo, Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: A systematic review and meta-analysis. International Journal of Infectious Diseases, Vol. 94, pp. 91 – 95, 2023

[13] D. Xu, & S. S. Jaggars, Performance gaps between online and face-to-face courses: Differences across types of students and academic subject areas. The Journal of Higher Education, Vol. 85, pp. 633 – 659, 2022. https://www.doi.org/10.1353/jhe.2014.0028

[14] Y. B. Rajabalee, & M. I. Santally, Learner satisfaction, engagement, and performances in an online module: implications for institutional e-learning policy. Education and Information Technologies, Vol. 26, pp. 2623 – 2656, 2022.

[15] C. N. P. Olipas, & R. A. G. Cochanco, The information technology students' cognitive determinants and its relationship to academic performance. International Journal of Advanced Engineering Research and Science, Vol. 8, No. 3, pp. 381 – 389, 2022

[16] M. N. Modebelu, & A. Joseph, Strategic planning procedure: An imperative for effective management of higher education in Nigeria. Mediterranean Journal of Social Sciences. http://www.mcser.org/images/stories/MJSS-Special, 2012

[17] S. Gurjeevan, K. Kamal, P.A. Gazal, & S. Sukhjinder, Use of mechatronics in today's industry. https://www.researchgate.net/publication/289871726, 2014

[18] Y. Li, M. Karim, & R. Qin, A virtual-reality-based training and assessment system for bridge inspectors with an assistant drone. IEEE Transactions on Human-Machine Systems. https://doi.org/10.1109/thms.2022.3155373, 2022

[19] M. D. Gall, J. P. Gall, & W. R. Borg, Educational research: An introduction (8th Ed.). Pearson Education, 2007

[20] B. K. Jangir, "Cheap parking assist system using 8051 family." https:// www.researchgate.net/publication/327423680, 2022.