# AUTOMECHATRONICS: URGENT FUNDAMENTAL NEED FOR CONTEMPORARY AUTO TECHNOLOGY EDUCATION IN NIGERIA

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## Abstract

*It is generally believed that the globe today is technology-driven. This is sequel to the overwhelming influence technology is having virtually on everything about contemporary life. Prominent of the ways technology is making this impact is through automobiles. Necessary today almost as "life" itself, automobiles appear to have assumed one field that has experienced highest varieties of emerging technologies. Scarcely has a month or year passed in recent times without emergence of a modified or completely new brand of vehicle. Prime basis of these innovations remains the cross-disciplinary automechatronics units/systems. The existence and utilization of these multi-faceted units/systems in design and construction of modern vehicles raise the scale of demand for keeping or maintaining such state-of-the-art vehicles in Nigeria. Maintenance problems arising from little or no possession of the mechatronics skills/knowledge by available maintenance personnel are better imagined than expressed. This paper focused on the urgent need for adequate incorporation of the automechatronics in automotive technology education which main purpose is to prepare the vehicle maintenance personnel in the country. Elements such as, state-of-the-art mechatronics, automechatronics and automobile technology, were considered. It was among others revealed that automotive technology course in one of the main technology education institutions in Nigeria -the polytechnics - has little or no room for the state-of-the-art automechatronics. Immediate/regular updating of automotive technology programmes vis-a-vis the state-of-the-art automobile technologies, establishment of free automobile re-training centers, and like, were recommended.*

**Keywords:** Automechatronics, electromechanical, automotive technology, technology education

The word automechatronic can be broken into three salient parts of automobile, mechanics and electronics. Automobile simply refers to motor vehicle. Mechanics deals with motions and the causative forces, or the act of machine construction/operation. Electronics involves the study/application of electronic circuits/devices. When these, especially the later (mechanics and electronics), are combined (i.e. mechatronics), they represent units that are mechatronic-based. Such units may exist (and function) in their separate entities like the robots, or built in other (larger) units, such as automobiles.

Automobiles appear to assume the fastest growing industry - influenced mainly by related mechatronics. At the inception of its manufactures, motor vehicle came out purely as a mechanical unit, without any electrical unit. The first automobiles were powered by first steam engines, around 1768. First car powered by an internal gasoline combustion engine was in 1807 designed by Francois Isaac de Rwaz(Yogi, 2014). Yogi maintained that the actual journey of modern vehicles began in 1886 when German inventor, Karl Benz, created an automobile that featured wire wheels with a four–stroke engine fitted between the rear wheels. Cox (2013) revealed that Hahz patented the first gasoline powered car, but was not the original visionary of self-propelled vehicles. Like others, Benz patented his own basic vehicular parts such as water radiator, carburetor that could improve the motor car. Such improvement needs/work and increased availability of automobiles necessitated the emergence of related personnel training outfit/programmes for the maintenance and further improvement of the vehicles. Some of such programmes in Nigeria are as existing in technical colleges and polytechnics – a form of technology education.

Technology education is post-secondary education in technology offered in polytechnics, monotechnics and colleges of education technical. According to Federal Republic of Nigeria (NPE, 2013), polytechnics shall among others, give training and impart the necessary skills for the production of technicians, technologist and other skilled personnel who shall be enterprising and self-reliant. These technicians/technologists should be able to create, improve or maintain related technologies such as motor vehicles. The specific area that deals with (maintenance of motor) vehicles in the polytechnics is known as automobile technology or simply, auto technology. It is usually found in the broad field of mechanical engineering – plant/engineering/manufacturing (option). This implies that a mechanical engineer or automotive technician or technologist from these polytechnics is expected to demonstrate competence in maintenance of motor vehicles.

It is common knowledge however that most vehicles found on Nigeria roads and homes today are state-of-the-art vehicles that are highly sophisticated mainly by the ever emerging mechatronics units. This situation may suggest that the multi-disciplinary mechatronics has becomes a phenomenon which technology education with its allied personnel generation programmes, cannot do without. The otherwise neglect may result or have resulted in unfortunate maintenance situation in use of

vehicles today in the country. Just as it is with most Nigerians, experience has led most scholars such as Obroku (2015), and Adekunle (2013), into viewing most Nigerian mechanics as incredibly incompetent. Obroku observed the technicians' non performance even in shops of the very ones that may have state-of-the-art gadgets – maintaining that one's car that went in can still come off worse than the state it went in there in the first place.

This paper was among others intended to highlight the importance of automechatronics to automotive technology education in Nigeria. Awareness of such multi-disciplinary significance in technology education or automotive technology (at the polytechnics) may be utilized in helping to improve the technicians' competence in automobile repairs in Nigeria.

**Auto (or Automotive) Technology**

Automotive Technology (AT) refers simply to multi-vocational discipline which primary focus is on the study of fundamental theory and repairs of motor vehicles. Some of the modules or sub units of AT include, auto electrical work, auto body repair and spray painting. AT is usually offered in Polytechnics which are one major kind of technology education institutions. Other kinds of technology education are monotechnics and colleges of education, technical. Students studying automotive technology are among others tending to be experts in repairing and maintaining all kinds of automobiles (Pathway, 2013). All these qualities/skills expected of the automotive technicians/technologists are taught them at the institution according to the content of the (course) curriculum.

In Revised Curricula for Technical Colleges and Polytechnics (2009),which appear to be a replication of National Board for Technical Education (NBTE, 2001), curriculum and course specifications for AT are considered under broad mechanical engineering discipline – manufacturing engineering/power and plant engineering. Like specific reflections on practical and theoretical general objectives are in curricula made for National Diploma (ND) and Higher National Diploma (HND) as follow.

For ND: General objectives – Theoretical.

- Understand historical and technical developments of the modern vehicle and the emergence of the peston type internal combustion engines.
- Understand the fundamental cycles of operation of the petrol, diesel and other internal combustion engines.
- Understand the component parts of an auto engine
- Understand the fuel system of petrol and diesel engine
- Understand engine cooling and lubrication
- Know the minor electrical components of a vehicle and describe their

- Know the major electrical components of a vehicle and describe their functions.
- Understand the general principles of the transmission systems
- Understand the general principles of the transmission systems.
- Know the construction processes of vehicle bodies
- Understand the principles of steering mechanisms
- Know types of tyres and its care
- Know the braking systems and their operating principles
- Know the braking systems and their operating principles
- Know the modern features of the automobile.

**Practical**

- Understand the basic engine dimensions that influence the engine power
- Demonstrate skills in the service and maintenance of fuel system
- Demonstrate skills in service and maintenance of engine cooling and lubrication system
- Demonstrate skills in the service and maintenance auto electrical components
- Demonstrate skills in the service and maintenance of transmission system
- Demonstrate skills in the service and maintenance of steeling mechanism
- Demonstrate skills in service and maintenance of tyres
- Demonstrate skills in the service and maintenance of braking system
- Master the features of modern automobile.

For HND: General objectives -Theoretical

- To know and understands automotive vehicle systems.
- Know vehicle body construction and body styling With different body structure
- Describe Commercial vehicle body
- Know, understand and describe vehicle dynamics systems
- Know, understand and describe vehicle steering systems
- Know, understand and describe brake systems
- Know vehicle transmission system
- Know, understand automotive gear box
- Know, describe propeller and drive shafts
- Know and understand final drive
- Know and understand Automotive Electrical starting system.
- Know, understand Auto-charging system
- Know and understand Battery
- Know and understand auto-ignition system

- Know and understand vehicle lighting system, and wipers
- Understand wheel and tyre types and safety precautions when removing fitting wheels and tyres.

**Practical**

- Identify and repair chais frames, body and body styling
- Identify and maintain vehicle dynamics and steering systems
- Identify and maintain brake and transmission system
- Identify and maintain Automotive Electrical system
- Identify and maintain tyres

Close look at the foregoing, one would notice that, of all the (45) general practical and theoretical objectives, only items 15 and 24 of the respective theoretical and practical objectives that tend to deal with subject matters related to the multi disciplinary mechatronic units. Yet, a further consideration of these contents may not still consider two as actually dealing with real state-of-the-art cross-disciplinary units. This can be ascertained in the perspective of the specific objectives of both general objectives which read: "Describe the features of the electronic spark ignition as it replaces the contact-breaker unit" (for the theoretical general objective, item 15); "Identify the features of the electronic spark ignition as it replaces the contact breaker unit" (for the practical general objective, item 24); etc. Thus, viewing from the stand point of the state-of-the-art, such specific objectives as stated may not be considered really as emerging vehicular mechatronics. If out of 45generalobjectives of AT programme, two that try to deal with related mechatronics do not really offer the students the needed study/practice on the state-of-the-art mechatronics, where then is the place of automechatronics in AT course in Nigeria Polytechnics? Here then lies the gap. When the students are not taught the fundamental theory and skills of the mechantronics that controls the state-of-the-art vehicles today, the students graduate eventually without possessing the prerequisite skills/knowledge for self, public or industrial engagement. Such AT technicians/technologies would be incompetent perhaps - as we have them today – due to the relative absence of automechanatronics in AT education in Nigeria.

**State-of-the-art Automechatronics**

It has been stated elsewhere that the best way to explain the term, automechatronics, may be by separately viewing the salient parts of the term; namely, auto, mecha, and tronic. Auto represent automobile, mecha, a short form of mechanics, and tronic – electronics. Automobiles relate to self-propelling land vessels such as cars. Mechanics deals with motions and associated forces as relate usually to machine construction or operation. Electronics concerns the study and application of electronic units/devices. The first or former auto is large and self-existing, while the

later two are normally acts of studying and application. Bringing three together will suggest that it is the later two that are actually combined and applied in the former one. In other words, knowledge/units obtained from the combined mechanics-electronics study are usefully applied in automobiles (for their improved comfort and performance). Automechatornics are therefore study, knowledge or units of mechatronics that are related to automobiles. Studies, units and other related systems/components of mechatronics associated with the construction, control or maintenance of motor vehicles, are collectively known as automechatronics.

Automechatronics (AMT) can be said to have existed just as the basic mechatronics or electromechanical(s). Electromechanical units are units that combine electrical and mechanical influence to operate or exist. In automobiles, such units as solenoid have been there right from when automobiles started receiving major developments. Today - occasioned by recent technological innovations – these basic cross-disciplinary units are now developed, or new ones introduced to exist as AMT. Modern AMT also involves computers and other associated controls. All these exist/operate mostly in systems involving other dependent/independent units like sensors, actuators. Examples of AMT systems include the cruise control acceleration and deceleration or simply, cruise control system, electronic stability control system, etc. It is the synergistic employment of these cross-disciplinary systems in design and construction of modern vehicles that make them state-of-the-art vehicles. They are vehicles replete with, largely dependent on, and controlled by, AMT (systems and components).

**Automechatronics and Automotive Technology**

Mechatronics has been seen as the synergistic act of using related aspects of mechanics and electronics for improved performance and control. They mainly involve systems and relate components of the multi-disciplinary fields. When it relates to motor vehicles, they basically involve systems and controls with mechanic, electric, and sometimes, computer based. Integrated usually at the design and manufacturing stages of modern vehicles, all these influence in totality, the performance and control of the motor vehicles. Just like every other technology, these vehicles would require maintenance and other post-factory work to keep their functionality. These vital services are usually carried out by crop of personnel known as technicians or technologists.

In Nigeria, technicians or technologists are produced mainly by institutions of technical education such as technical colleges or those of technology education, especially the polytechnics. At the post-primary (technical) colleges, it is Motor Vehicles Mechanic work (MVM) - producing motor vehicle craft personnel. At the polytechnics, the course exists as Automotive Technology. One who has studied the course at National Diploma (ND) level is taken as an automotive technician, while those at Higher National Diploma (HND) are regarded as automotive technologists.

Thus, it is those of the technology education - polytechnics in particular - that are in better stance to handle these emerging automobile technologies, having expectedly been exposed to the fundamental design and construction of these vehicles and their new technological systems.

Regrettably however, the course with which to expose these prospective technicians/ technologists appears to be lacking these fundamental state-of-the-art provisions. The curricular specifications for automotive technology at Nigerian polytechnics have little or no room for acquiring skills/knowledge of the emerging AMT system/units. Of the 45 automotive technology general objectives for both ND and HND, only two at ND level deal somewhat with the emerging automobile technologies.

This death in subject matter means that students taking the course are likely to graduate with little or no skills/knowledge of the dominant AMT upon which modern vehicles are built and depend. It is thus vivid from here that owners of such vehicles in the country bought, handle, and maintain them at the mercy of untrained, unqualified technician/technologist or even craft personnel. From special or road side workshops of such tech/craft personnel, state-of-the-art vehicles that went are frequently worse than they went in at the first instance. Experience such as this remains the lot of many Nigerians.

As a result, a good number (of Nigerians) have had a recourse to using just simple vehicles that do not have (any) state-of-the-art accessory. Some (of these Nigerians) who can endure the "pain", bear the burden of frequently changing one major part or the other. They wastefully keep changing key components such as the engine, gear box and other AMT-based systems or units. Others (Nigerians) who can neither take or return to simple vehicle nor remain bearing the pain at the mercy of incompetent personnel, decide eventually to favour public transport, leaving their hard earned vehicles parked to occupy precious spaces and rot at home – still another form of economic waste.

This ugly trend sometimes transcends mere economic waste or leakages. It remains a common observation in Nigeria that, once an individual's technology - especially automobile - is disfunctional, (the emotional state of) an average Nigerian is usually thrown off (–relatively distressed). The social lives of the Nigerian's home, among others, are regrettably affected. This sometimes results in some unhealthy secondary experiences like home breakage, ill health, etc. These and other related negative outcomes could have been ameliorated via the availability and competent services of trained vehicle maintenance technicians/technologists in the country. It remains vivid therefore, that there is an urgent need of AMT in automotive technology education to keep paste with modern industrial, public and private automobile maintenance needs in contemporary Nigeria.

**Conclusion**

Change, they say, is exclusively permanent. Of all the changing elements in the globe, technology appears to be one most rapid. That the globe is today technology-driven is actually as a result of these technological revolutions. Prominent of the ways technology exerts this changing influence is through things used by man for whose comfort and improved living, they were also intended. One of the widely used technologies that have impacted heavily on the man's way of living is the automobile. It is therefore not supervising observing the overwhelming developments in automobile industry today. As long as man's existence endures, this man's special means of mobility may continue to experience rapid changes/improvements to meet the insatiable taste of man. There is therefore the obvious need for the maintenance personnel who should handle the emerging state-of-the-art vehicles to up-date -that continually - to be able to stand their maintenance and other post factory work challenges (Adekunle). It is hoped that the effort made in this paper will spur the relevant stake-holders to upgrade automotive technology programmes with state-of-the-art vehicle mechatronics to enable the allied institutions produce competent automotive technicians/technologists(that are able to handle state-of-the-art vehicles) in the country. Realization of this may help to eliminate much of the problems/wastages encountered by owners of modern vehicles vis-à-vis unskilled automobile maintenance personnel in Nigeria.

**Recommendation**

Based on the forgoing, the following recommendations were made.

1) There should be immediate and continuous reviewing/upgrading of curricula for technology education programmes - especially those dealing with automotive technology - based on the emerging state-of-the-art automechatronics innovations in the automobile industries.
2) Government should establish free retraining automobile centers for (practicing) automotive maintenance technicians generally, and those from the polytechnics in particular.
3) There should be regulation of brand of (modern) vehicles imported into the country by qualified Nigerian experts. This will help to screen out such vehicles that need to wait until we are (maintenance) ready to avoid further pollution and other wastages associated with such abandoned vehicles in our environment.

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