Integration of New Motor Vehicle Technological Innovations into the Technical College Curriculum in Nigeria

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Abstract
The increased number of new sub-systems in modern automobiles intended to improve upon their safety, economy and comfort among other things have made them more sophisticated and complex to maintain. The curriculum for the training programmes of their maintenance personnel in technical colleges has however, remained rigid. This study thus, identified the innovations perceived as important to be integrated into the curriculum to enhance its relevance and adequacy. A survey research design and structured questionnaire was used to elicit the opinions of the subject teachers in technical colleges in Niger state. Data obtained from 56 respondents were analyzed. Three null hypotheses were tested using t-test statistics at 0.05 level of significance. It was found that 32 innovations including anti-lock braking System (ABS), electronic fuel injection (EFI), variable valve timing intelligence (VVT- i), on-board detection and diagnostic system (OBD), among others were perceived as important to be integrated into appropriate modules of the curriculum. It is recommended that government should provide interventions to upgrade both human and material resources in technical colleges to facilitate the teaching and learning of skills related to these innovations. Also, new innovations identify should be included in the curriculum of technical colleges.

Introduction
The automobile (motor vehicle) is a generic term for a self-propelled, trackless, non-articulated, four-wheeled land vehicle which encompasses passenger cars, recreational vehicles, taxies and buses used to transport people in cities, on highways or across country (Anglin, 1997). Automobile has now become an indispensable means of transportation in modern societies. At the early stage of development, there were several experimental cars but the work of Karl Benz, a German Mechanic in 1885 was regarded as the first practical and reliable automobile. According to Egbuchulam (2000), the Benz car and many other early automobiles were however, simple, not very reliable, limited in speed and distance travelled and less comfortable. Technological dynamism coupled with the emergence of new technologies has however, influenced the modern automobiles. There have been continual evolutions in design intended to achieve faster, more reliable, more streamlined, cleaner and safer vehicles with enhanced comfort, fuel economy and longevity. Harnessing new technologies into the vehicles have made the modern automobiles an assemblage of a group of sophisticated technologies. The introduction of electronic controls has particularly brought even greater changes in designs and operations of many of their sub-systems. The demand for automobiles in Nigeria have continued to increase especially following the collapse of the rail transport system in the midst of undeveloped inland water ways and a very high cost of air transport which is also plagued by high rates of mishaps. Assorted brands of motor vehicles available today on the Nigerian roads used for either public convenience or luxury for personal transportation.

The motor vehicles, therefore, come in with a wide range of classical and new technologies. A national policy banning the importation of automobiles that are more than eight years from their dates of manufacture has however, restricted their importation. These vehicles when in use in Nigeria must be serviced and properly maintained to keep them in roadworthy conditions. Service personnel must therefore be equipped with the relevant knowledge and skills for these purposes to increase their capacity. The programmes for the education and training of craftsmen and master craftsmen for the maintenance of all types of motor vehicles are carried out in technical colleges at the National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) levels, respectively, (National Board for Technical Education - NBTE, 2003). Several studies conducted revealed that the products of these programmes lacked the basic skills needed for gainful employment in today's automobile industry (Elobuike, 1999; Agbata, 2000; Atsumbe, 2006 and Saba, Raymond and Tsado, 2010). The curriculum was blamed for not being adequate and relevant to offer enough of the skills needed to meet the challenges that are involved in the maintenance of modern vehicle on our roads. The incorporation of new technologies with new subsystems and system components into modern vehicle have changed their configurations and made their maintenance more complex task, though, some of the new systems make them easier to maintain.

The curriculum for the technical college programmes that train the service personnel for maintaining these vehicles has remained rigid and different from the recent technological innovation in automobiles. The gaps created between the curriculum and the new technological innovations have made the needed skills for effective maintenance of these new breed vehicle to continue to elude the products of these programmes. The result has being that, the graduates of these programmes are often unemployable or underemployed while most vehicles with these new innovations either suffer disrepair or have the new systems replaced by the classical substitute systems that the new ones were meant to improve upon. Yet some are even completely grounded just barely into their expected service lives because of lack of competent personnel for their effective maintenance. As measures to keep education and training in tune with the knowledge and skills needed in the world of work, school courses and curricula must be reviewed, enriched and updated regularly in line with changes that are taking place in the automobile industries. Thus, it was imperative to investigate the new technological innovations in motor vehicle with the view to identifying those that posed new challenges to the maintenance personnel in Nigeria for integration into the technical college curriculum.

This study was therefore designed to identify the new technological innovations used in the construction of the operative systems of modern automobiles which were not included in the curriculum for technical college motor vehicle mechanic work programmes. Specifically, the study tried to identify the new innovations in the following sub-systems of automobiles: the engine, the transmission, suspension, steering, braking systems, the electrical/electronic and auxiliary systems.

Hypotheses

The hypotheses used for the study were (Ho):

1. There is no significant difference in mean responses of automobile craftsmen (AC) and technical teachers (TT) on the new technological innovations in automobile engines.
2. There is no significant difference in mean responses of AC and TT on the new technological innovations in the automobile transmission, suspension, steering and braking systems.
3. There is no significant difference in mean responses of AC and TT on the new technological innovations in the automobile electrical/electronic and auxiliary systems.

Methods

A survey research design was adopted for this study. The area of this study is Niger state. The state has six technical colleges offering motor vehicle mechanics work programmes and some automobile service stations. The population for the study comprised of 56 subjects made up of all automobile craftsmen of the two automobile companies (Niger State Transport Authority and Peugeot Automobile Danali Motors Minna) and all the automobile teachers in Government Technical College Minna and Bida. The instrument for data collection was a structured questionnaire generated from literature. Section one of the instrument elicited information on the occupational status of the respondents. Section two, was structured on a five-point rating scale, elicited information on the opinions of the respondents about the new technological innovations in the operative systems of automobiles. The rating scale indicated the degrees of importance of each items checked by the respondents as extremely important, highly important, very important, unimportant and very unimportant. Respondents were asked to check the degrees of importance of each item to be integrated into the curriculum for the technical college programmes.

The instrument was face validated by three experts from Department of Industrial and Technology Education, Federal University of Technology, Minna. Data obtained were analyzed using mean, standard deviation and t-test. The response categories of the rating scale were assigned numerical values of 5, 4, 3, 2 and 1 respectively which was used for calculating the mean responses. While 0.05 level of significance, df of 54 and the critical-t value was used for accepting or rejecting the null hypotheses was 2.00.

Results

Data obtained from the study were presented in tables relative to the hypotheses as follows:

Table 1: mean and t-test analysis of mean responses of AC and TT on the innovations in automobile engines.

	AC		TT		TGP		
	$\bar{x}_1$	S_1	$\bar{x}_2$	S_2	$\bar{x}$	t-cal	Remark
Electronic fuel injection	4.28	0.80	3.96	1.02	4.13	1.30	HI
Gasoline direct injection	3.69	1.00	3.89	0.97	3.79	0.76	HI
Dual fuel system	3.35	0.97	3.74	0.98	3.54	1.49	HI
Electronic Ignition system	4.28	0.80	4.44	0.75	4.36	0.77	HI
Variable value timing	3.93	0.70	3.89	0.85	3.91	0.19	HI
Super charging	3.72	0.75	3.74	0.94	3.72	0.09	HI
Turbo-inter cooling	3.79	0.82	3.81	0.68	3.80	0.10	HI
Emission control systems	4.21	0.90	3.89	0.93	4.05	1.30	HI
On-board detection and diagnostic system	4.41	0.57	3.93	1.00	4.18	2.19	HI

df = 54; critical-t = 2.00; TGP = two groups pooled; HI = highly important.

Hypothesis 1

There is no significant difference in mean responses of AC and TT on new technological innovations in automobile engines. Table 1 show that the pooled mean responses for all the items are above 3.50 which indicate a highly important perception by respondents for all the new innovations to be integrated into the curriculum. The table also shows that the null hypothesis was accepted for all the items except the on-board detection and diagnostic system (OBD), which has the calculated t-value of 2.19, which is greater than the critical t-value of 2.00 at 0.05 levels of significance and so, was rejected.

Table 2: mean and t-test analysis of mean responses of AC and TT on the innovations in automobile transmission, suspension, steering and braking systems.

New innovations in transmission, suspension, steering and braking Systems	AC		TT		TGP		
	$\bar{x}_1$	S_1	$\bar{x}_2$	S_2	$\bar{x}$	t-cal	Remark
Auto-active automatic transmission	3.79	1.01	3.78	0.80	3.79	1.04	HI
Trans- axle transmission	3.31	0.76	3.48	0.94	3.39	0.74	VI
Continuously variable transmission	3.41	0.98	3.33	1.04	3.38	0.30	VI
Cruise control system	3.86	0.88	3.52	0.85	3.70	1.48	HI
Anti-lock braking system with electronic brake force distribution	4.31	0.60	4.07	0.78	4.20	1.28	VI
All wheel steering system	3.00	1.20	2.89	0.93	2.95	0.39	HI
Active suspension with electronic variable damping	3.93	0.75	3.78	0.85	3.86	0.70	HI
Electronic stability programme and traction control system	3.93	0.70	3.63	0.74	3.79	1.55	HI
Drive- by- wire systems	2.93	1.13	2.85	1.06	2.89	0.27	VI

df = 54; Critical-t = 2.00, TGP = two groups pooled; HI = highly important; VI = very important.

Hypothesis 2

There is no significant difference in mean responses of AC and TT on the new technological innovations in automobile transmission, suspension, steering and braking systems. Table 2 shows that all the items were perceived as important to be integrated into the curriculum. It also shows that there is no statistically significant difference in mean responses of automobile craftsmen and technical teachers on the indicated new innovations in the transmission, suspension, steering and braking systems. The null hypothesis was therefore accepted for all the items at 0.05 levels of significance.

Table 3: mean and t-test analysis of mean responses of AC and TT on the innovations in the electrical/electronic and auxiliary systems.

New innovations in electrical/electronic and auxiliary systems	AC		TT		TGP		
	$\bar{x}_1$	S_1	$\bar{x}_2$	S_2	$\bar{x}$	t-cal	Remark
Safety airbags and airbag curtains	3.55	0.69	3.85	1.13	4.21	2.75	HI
Power seats, doors and windows	3.62	0.86	3.56	1.22	3.59	0.21	HI
Electronic controlled air conditioning system	3.83	0.81	3.89	0.97	3.86	0.25	HI
Automatic front wind screen wiper	3.66	0.86	4.37	0.63	4.00	3.56	HI
Automatic headlight brightness switch	3.79	0.86	4.48	0.58	4.13	3.57	HI
Adaptive headlights	3.59	0.68	3.26	1.20	3.43	1.26	HI
Active rearview mirrors	3.79	0.77	3.67	0.92	3.73	0.53	HI
Speed limit alarm	3.31	0.85	4.37	0.97	3.34	0.25	HI
Rear-mounted sensor parking assistance	2.76	0.79	3.63	1.12	3.70	0.50	HI
Central power locking system (doors)	3.69	0.89	3.93	1.04	3.80	0.93	HI
Anti-theft security alarm	4.31	0.93	4.37	0.95	4.34	1.83	HI
Electrically controlled glass sunroof	3.17	0.88	3.41	0.89	3.27	1.15	VI
Electrically controlled radio antenna	3.21	0.70	4.52	1.01	3.39	1.02	VI
Hybrid automobiles	3.07	1.07	3.07	1.00	3.07	0.00	VI

df = 54; critical- t = 2.00; TGP = two groups pooled; HI = highly important; VI = very important.

Hypothesis 3

There is no significant difference in mean responses of AC and TT on the new technological innovations in automobile electrical/electronic and auxiliary systems. Table 3 shows that all the listed items were perceived as important to be integrated into the curriculum. The table also shows that there are differences in the mean responses of automobile craftsmen and technical teachers on three of the listed new innovations whose calculated t- values are more than the critical t-value of 2.00. The null hypothesis was thus rejected for these items, which include safety airbags and airbag curtains, automatic front windscreen wiper, and automatic headlight brightness switch.

Findings

A total of 32 new innovations comprising 9 in engines; 9 in transmission, suspension, steering and braking systems; and 14 in the electrical/electronic and auxiliary systems

were rated as important to be integrated into the curriculum. Prominent among these new innovations are electronic fuel injection (EFI), electronic ignition system, variable valve timing intelligence (VVT-i), supercharging, emission control system, OBD, and All Wheel Steering System (AWS). Others include Anti-lock Braking System (ABS), active suspension with electronic variable damping, safety airbags and airbag curtains.

There were significant differences in the mean responses of automobile craftsmen and technical teachers on four of the identify new technological innovations in automobile for which the null hypotheses were rejected among which are; On-board detection and diagnostics system and safety airbags and airbags curtains.

Discussion

Curriculum and instruction can be conceptualized as open systems interacting with the environment and maintaining equilibrium by transformation of energy and exchange of information among the component sub-systems. In the same viewpoint, work, skills and training can be conceptualized as sub-systems of an open system; then new innovations and changes in technology demanding new work skills being the common perturbation that often destabilize the contents of school curricula and instructional activities. Therefore, there must be a continuous interaction and exchange of information between the schools and industries where the new innovations and changes in technology are emanating from. The findings of this study showed that all the identified new technological innovations have implications for the work of today's automobile maintenance personnel. The large number of the new innovations that were yet to be integrated into the curriculum reflects the long period the curriculum has being in use without any review. Also, the large number of these new innovations also account for the findings of the empirical studies by Elobuike (1999) and Agbata (2000) that the products of the technical college motor vehicle mechanics work programmes lacked the relevant skills for gainful employment in today's automobile industry.

The areas of the new innovations in motor vehicle identified in this study correlates with the areas of students' difficulties found by Idris (2011). He identified the areas of difficulty for the final year students of NTC motor vehicle mechanics work programmes to include the engine, particularly the cooling and lubrication systems; the transmission system comprising the clutch, gearbox and final drive assembly as well as the suspension, steering and braking systems among others. These areas of difficulty identified bear most of the new innovations found in this study as shown in Tables 1 and 2, which were yet to be taught to students. In Table 3, the ratings of a large number of new innovations in the electrical/electronic and auxiliary systems are also important to be integrated into the curriculum. This trend is as a result of the increasing electronic control of more mechanical systems of modern motor vehicle whereby mechanical works cannot be distinctly separated from the electrical/electronic subsystems. The implications of the increased electronic control of mechanical systems of modern motor vehicles are that a mechanical Craftsman and electrician who were trained without adequate knowledge of the electrical/electronic subsystems of the vehicles will be grossly ineffective in their maintenance services.

Conclusion

The curriculum for motor vehicle mechanics work programmes in technical colleges can be said to have lost its validity. The technological innovations identified in this study, which are the technologies for today and future motor vehicles are so many and common to be so neglected in technical college programmes that supposed to train the workforce for the maintenance of all types of motor vehicles (Beer, 2001; Byme, 2002; Ford Motor Company, 2002) The need for their integration into the curriculum for the education and training programmes for maintenance craftsmen in technical colleges cannot be over-emphasized. A prompt intervention is now indispensable if the occupational future of the large number of the trainees of technical colleges' programmes will be guaranteed and sustained for employability.

Recommendations

Having established the need to enrich and update the curriculum for motor vehicle mechanics work programmes in technical colleges by the large number of the technological innovations in modern motor vehicle yet to be included in the national curriculum, it is recommended that:

1. New innovations identify should be incorporated into the curriculum of technical colleges.
2. The curriculum for teachers' training programmes should also be reviewed to include these innovations in order to prepare teachers who will be able to implement the curriculum in technical colleges.
3. Government should provide intervention to upgrade both human and materials resources in technical colleges to facilitate the teaching and learning of skills related to these innovations.

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