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Adoption of Computer-Aided-Instructional Systems in the Teaching of Automobile Technology in Vocational/Technical Institutions: An Improvised Alternative to Practicals

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Abstract

The impact of science and technology has being felt in almost all facets of human endeavor globally. These impacts have resulted in major changes in most production lines. While some feasible reduction is observed in time and cost needs of stakeholders, there are also challenges in attempt toward the attainment of quality standards. This paper examines the adoption of computer-aided-instructional systems as an improvised alternative for the effective teaching of automobile technology in vocational/technical institutions. Apart from the practical exposure of the reviewer in the field for over 12 years in automotive industrial firms at various positions of responsibility, the review effectively considered relevant literature on computer application particularly computer–aided instructional systems and its associated gains, the reasons to justify the adoption of CAI in automobile technology. It further reviewed the impacts of CAI on Automobile Technology. The paper provided specific areas considered significance in the teaching of automobile technology where students must be trained for skills acquisition and sustainability. Additionally, the paper provided measures to enhance the adoption of CAI for the actualization VTE provisions regarding automobile technology. Valid recommendations have been made for teachers, students, administrators in various segments of education and others stakeholders in vocational/technical spheres in justification of the objective of this paper.

Keywords: *Adoption, automobile technology, computer-aided-instruction system, teaching, technological advancement, vocational/technical education*

Introduction

The development of any nation is usually barometered by the degree and extent of the socio-cultural, socioeconomic, and political improvement that are brought to bear through the enterprises of science, technology and mathematics (Nwabueze and Ozioko, 2011). Bajah and Fariwantan in Olorundare (2007) noted that sustainable development leads to fulfillment of societal ideals such as exploration, invention and utilization which are considered relevant to the needs and aspirations of the society. Currently, the world is witnessing rapid increase in scientific and technological innovations specifically in mechanical and electronic spheres.

These developments in science and technology have brought into limelight the indispensable roles of computer which is regarded as an electronic component that process meaningful information for learning more rapidly and accurately.

Computers are seen to be an effective device for presenting an instructional programme through their multifarious aids specifically in teaching and learning globally. A study by Haddad (2003) revealed that ICT can change the teaching process and it is especially useful in supporting student centered approaches to instruction by developing the higher order skills and promoting collaborative activities. Corroborating, Kara and Yakar (2009) observed that, Computer-Assisted Teaching do not only improve success but also develop higher level thinking abilities in students' learning. Uko and Ebute (2013) showcased the important of computer in educational setting where several efforts have been made by many countries to train teachers on effective use of computer as a tool to enhance teaching and learning. In order to achieve the demands of the global world and also meeting the obligations expected in technology education, teachers must first x-ray skills needs of the learners through innovative approach such as the application CAI in updating the missing link between theory and actual practical scenarios.

CAI and associated gains

Computer-assisted instruction (CAI) is a narrower term and most often refers to drill-and-practice, tutorial, or simulation activities**.** CAI, according to Ukoha and Eneogwe (1996) is a learning process whereby a learner interacts with and is directed by computer through a course of study or learning task aimed at achieving specific instructional objectives particularly skill development. It can be described as a self-learning interactive instructional technique for tutorials, drill and practice, simulation, and problem solving approaches which could be offline/online, involving interaction of the student with programmed instructional materials such as text, graphics, sound and video in enhancing the learning process through monitoring and doing in an organized environment.

In vocational trades such as automobile technology, skill development is a learned sequence of movements that combines to produce a smooth, efficient action in order to master a particular task. New applications are being developed resulting in new teaching and training technology (Harum, 2003). Thus the exploration and manipulation of simulated

environments can be accomplished with CAI-ranging from virtual laboratory experiments that may be too difficult, expensive, or dangerous to perform in a school environment to complex virtual worlds like those used in airplane flight simulators (Arnold, 1997). Stressing further that, CAI is uniquely diverse and rapidly expanding the spectrum of computer technologies that assist the teaching and learning process in the form of text or in multimedia formats, which include photographs, videos, animation, speech, and music.

Justification for the Adoption of CAI in Teaching Automobile Technology

Automobile today is controlled by various electronics sensors, circuits and computers making it mandatory for personnel to have sound knowledge of electrical principles and trouble-shooting procedures to diagnose and service many of the electrical problems found in automobile (Usman, 2009). But one of the problems of teaching and learning in automobile technology is the method of imparting knowledge to learners where subjects are customarily taught without regards to instructional materials by unprofessional, unqualified and uncommitted teachers. Besides, the inadequate and unqualified technical teachers or experts who have not updated their knowledge and skills, outdated or obsolete tools/equipment/machines, poor allocation of practical duration as observed by (Okebukola and Jegede, 1997; Udofia, Hadikusumo, and Santoso, 2015). Ogunneye (1982) found out that in this era of technological advancement, technology is still having minimum impact on education as about 80% of teachers are using the chalkboard and textbook method (traditional method), even as most schools do not have modern instructional equipment and media.

In developed economies, highly skilled automobile teachers keep abreast of continuous changes in the sector, whether these are to do with performance, safety or green energy sources. For instance, in cases where practical operations are considered significant, they showcase their deep understand of vehicles' electrical and electronic systems and their integration; have physical stamina, coordination and kinaesthetic skills, and being versatile. Such personnel are adaptive to more complex diagnostic tasks, the most advanced vehicles, and together with those incorporating the latest technologies. Currently, most of the Hi-tech and hybrid vehicles are entirely new products are posing operational and maintenance challenges in the developing economies especially the fuel and electrical systems which are connected to the Electrical Control Unit (ECU) also called 'brain box' and other auxiliary

units. A good number of modern vehicles are fitted with computerized systems, sensors, circuits and computers unit that utilize data in form of letters or numerals which is highly configured in terms of duration of operations, method of operation, servicing modes, and other related functions attached to each set buttons and keys. These modern functions are link to the network of computer-related components whether in whole or part in automobiles which demand sound technical proficiencies. Evidently, in most developing countries such as Nigeria, these realities are quite far from reach in terms of skills in basic operations, repairs and maintenance of these products due to data applications, data interpretations and the meanings these data represent in modern vehicles, hence the need for the integration and adoption of the change in meeting valid electromechanical requirements in automobile technology.

The current advancement in science and technology triggers the use of information and communication technology in the sustenance of the desired automobile technology output specifically, it is absolutely pertinent to support superior forms of learning. These prompted Oyebolu and Lemo (2013) to opine that many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy. These scenarios propel the utilization of CAI, which is considered a sectional arm of ICT in updating the traditional teaching method of automobile technology to fully integrate computer applications as guides.

Impacts of CAI on Automobile Technology Practices

A reasonable number of crashes involve driver error, automakers have created a range of safety systems that aid drivers for brief periods to help avoid accidents. Such a range of driver-assist systems which strongly utilizes sensors, buttons and other mini computers which are included in the lane departure and blind spot warnings, adaptive cruise control, automatic braking, telematics control systems and more. Researchers have shown that it's possible to take away driver control of a moving vehicle by remotely hacking into relatively insecure computer systems common in modern automobiles. Such device could also be use to kill the engine temporary, apply or disable the brakes and even converge choice data or message to the dash board panel. The height of safety devices, efficiency and performance improvements seen in today's automobiles is recorded based on the numerous computerized systems in monitoring and controlling various aspects on the composition of hi-tech and hybrid

automobiles. For instance, most cars are now fitted with mini-computers, infrared laser sensor, and standard collision-avoidance feature called City Safety for automatic co-ordination of information as data for speed controls, crash warning detectors

In 2005, Murray established T.25 - an innovative city car with a central driving position and a unique door opening system. Furthermore, the T.27 City Car is a pure electric drive vehicle with an innovative fully integrated electric motor, control system and battery designed to ensure maximum efficiency. While hardly qualifying as a car in the traditional sense, the little midget claims to be the most efficient electric car in the world and is a product of real innovation. Reuters reported millions of lines of computer code control important auto operations, from braking to air conditioning. These new technologies in automobile are fitted with the sensitive facilities adequately powered through switches, sensors and buttons that are functionally displayed as numerals or letters in the vehicle dashboard. Some of these devices are listed below: Rear-mounted radar; Night vision with pedestrian detection; Automatic high-beam control; Parental control; GPS vehicle tracking; Cameras; Driver capability and In-car Internet.

Concluding, partially-autonomous functions in vehicles is becoming more common, the leap to achieving fully driverless cars becomes ever smaller in modern time based on user's demand and change process. Today's emerging technology — sensors able to read road signs and traffic signals, while also employing vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) systems to navigate roadways, traffic and pedestrian hazards — will be available widespread in the future.

Automobile Technology and the Adoption Measures

Automotive technology addresses issues relating to engine construction, fuel and ignition systems, power trains, brakes, transmissions, electronic and diagnostic equipment among others. Courses such as brake systems, ignition, charging, etc as course offered in automobile technology leading to the award of certificate or a degree (NPE, 2004). These courses also require certain level of skills and competencies in the use tools and equipment in the repair and diagnoses. Most Hi-tech and hybrid vehicles with Electrical Control Unit (ECU) are complex and often challenging the technical competencies of the developing

economies particularly fault findings. In alliance with the standards outlined by WSC2015_WSSS33-worldskills.org, the student's needs to know basic functions and applications of CAI and appropriately adopting same in automobile practical courses as shown in Tables 1-4.

Table 1. Adoption of CAI in the Teaching of Automobile Technology Course on Electrical and Mechanical Systems and Their Integration Sub-Systems

Specific objectives of teaching automobile technology on electrical and mechanical systems and their integration sub-systems	Improvised Alternative
The students need to know and understand the principles and characteristics of: 1. Spark ignition engine management systems 2. Compression ignition engine management systems 3. Forced induction, emission and exhaust systems 4. Body electrical and electronic systems 5. Braking and stability control systems 6. Suspension and steering systems 7. Drive line/ HV systems 8. Air bag and safety restraint systems (SRS) 9. How each system is interconnected and can have an effect on other systems 10. How sensors and information are shared between various management systems	Timely adoption of scheduled CAI relevant to electrical and mechanical systems and their integration objectives

Table 2. Adoption of CAI in the Teaching of Automobile Technology Course on the Inspection and Diagnoses

Specific objectives of teaching automobile technology on the inspection and diagnosis	Improvised Alternative
a). The students need to know and understand the inspection and diagnosis on: 1. The correct use and interpretation of relevant measuring devices and equipment 2. The principles and applications of all relevant numerical and mathematical calculations 3. The principles and applications of advanced diagnostic procedures on tooling and equipment 4. Calibrate and use all measuring devices and equipment (mechanical and electrical) for diagnosis 5. Determine the precise location of component faults within a range of light vehicle systems b. The students need to know and understand when to select and apply the appropriate devices and equipment to make inspections and diagnose deficiencies and faults to: 1. Spark ignition systems 2. Compression ignition systems 3. Forced induction, emission and exhaust systems 4. Body electrical/electronic systems 5. Braking and stability control systems 6. Suspension and steering systems 7. Drive line systems 8. Calculate, check and interpret results as required 9. Review the options for repair or replacement	Timely adoption of scheduled CAI relevant to the inspection and diagnosis objectives

Table 3. Adoption of CAI in the Teaching Of Automobile Technology Course on the Repair, Overhaul and Service

Specific objectives of teaching automobile technology on the repair, overhaul and service	Improvised Alternative
a). The students need to know and understand the inspection and diagnosis on: 1. The options for repair or replacement 2. Repair methods/procedures, special tool requirements 3. effects on other vehicle systems and associated repair work b). The students need to know and understand: 1. Use manufacturers' and component suppliers' specification as require 2. Construct, justify and communicate appropriate proposals and decisions regarding repair or replacement 3. Use correct procedures for securing replacement parts 4. Repair vehicle electrical systems and electrical circuits, repair/overhaul charging and starting systems 5. Repair/overhaul hydraulic braking systems (disc and drum) and/or associated components, including hand or parking brake 6. Repair electronically controlled antilock brakes and stability control systems 7. Remove/overhaul driveline components 8. Repair/overhaul steering systems/components, including mechanical, electrical and hydraulic power assisted steering systems 9. Repair suspension systems and associated components 10. Carry out steering wheel alignment operations 11. Repair/overhaul four stroke engines and associated engine components 12. Repair/overhaul manual/automatic transaxles/transmissions and components 13. Repair diesel fuel systems including electronic compression ignition engine management systems and associated components	Timely adoption of scheduled CAI relevant to the repair, overhaul and service

Table 4. Adoption of CAI in the Teaching Of Automobile Technology Course on Hybrid and New Technologies

Specific objectives of teaching automobile technology on the Hybrid and new technologies	Improvised Alternative
The students need to know and understand and specifically with recommended tools/equipment carry out service, repair and diagnostic procedures according to manufacturers' requirements on Hybrid and new technologies: 1. Specialized equipment readings and procedures for working on high voltage electric vehicles 2. Specialized equipment readings and principles of operation for hybrid/electric and alternative powered vehicles 3. Specialized equipment readings and operations of consumer electronics (entertainment systems, etc).	Timely adoption of scheduled CAI relevant to Hybrid and new technologies

Conclusion

The development and usage of computers in education started in the 1960s which gave rise to the convenient microcomputers in the 1970s projected computer application at all levels of education which has facilitated the teaching-learning process. The use of computer (1) increases the time of learners devote to learning, (2) enhance the speed of availability of data and information, (3) provide immediate feed-back, (4) assist less qualified teachers and (5) increase teachers efficiently and effectiveness. Technical personnel in automobile must have extensive knowledge of mechanical, electronic and computer technology, and this knowledge must be updated constantly to keep pace with rapid changes particularly in trouble-shooting. In addition, personnel must understand not only parts, nomenclature and operation, but also understand the diagnosis and service procedures for each system in the vehicle. Gross (2004) had earlier mentioned that high-tech nature of today's vehicle mandates the need for regular personnel training for the acquisition and adoption CAI applications on

tools and vehicles. The review strongly showcased that conscious adoption of CAI in the teaching learning of automobile technology by professionally qualified teachers and other assisted personnel will significantly facilitate the achieving of targeted automobile technology and VTE at large.

Recommendations

This study considered necessary the adoption of the listed improvised alternatives as recommendations in the teaching of automobile technology:

1. Teachers and instructors must be computer literate in basic programme applications involving operation, maintenance schedules, and procedures as specified by the vehicle manufacturers
2. Provision of functional and sophisticated teaching aids, tools/equipment necessary for teaching and diagnosing of faults.
3. Allocation of adequate time for practical activities by the government departments
4. Effective funding of the specialized section practical activities by the government
5. Effective partnering with tools/equipment suppliers in order to meet the challenging needs
6. Establishment of effective warranty/guarantee on tools/equipment and other components parts.
7. Supply of instructional guides in local or language of the user.

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Educational technology (commonly abbreviated as Edutech, EduTech, or EdTech) is the combined use of computer hardware, software, and educational theory and practice to facilitate learning. Educational technology creates, uses, and manages technological processes and educational resources to help improve user academic performance. The field has been described as a persisting initiative that seeks to bring learners, teacher, and technical means together in an effective way. This technology has saved thousands of lives since its mass adoption in the automobile industry. Airbags can trace their origin to air-filled bladders used as early as the 1950s. Their invention is widely credited to John W. Hetrick, who registered his patent in 1951.Â Gear changes are controlled by a series of computers. The concept was initially devised by a Frenchman, Adolphe Kegresse, before WWII, but he never made a working model. DCT was first introduced in racing cars in the 1980s and was first brought to the general public by Volkswagen.Â The addition of radar to cruise control in the early 2000s has taken the technology to the next level. It has also paved the way for the advent of driverless cars. 21. The blindspot mirror helped drivers spot each other with ease.