Asia-Africa Journal of Academic Research and Review ISSN: 2814-0400 Vol. 4(1), 2024
doi:10.5281/zenodo.11357496Available online at: www.journals.iapaar.com/index.php/aajarr

Comparative Effect of Brain-Based Learning and Collaborative Instructional Models on Students' Skills Performance in Motor Vehicle Technology in Public Technical Colleges in Akwa Ibom State, Nigeria

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Abstract
This study was conducted to determine the comparative effect of brain-based learning and collaborative instructional models on students' skills performance in Motor Vehicle Technology (MVT) in Public Technical Colleges in Akwa Ibom State, South-South Nigeria. The selected skills for the purpose of this study include partial engine overhaul, schedule vehicle maintenance, and maintenance of epicyclic gearing systems. Three specific objectives, three research questions and three corresponding null hypotheses were raised to guide the study. The study adopted quasi-experimental design (pre-test - post-test group design). The study was conducted in the nine public technical colleges in Akwa Iborn State. The population for the study comprised 297 Senior Technical Two (ST2) students offering motor vehicle technology as a vocation in the nine Public technical colleges. Simple random sampling technique was used to select two out of the nine public technical colleges. The sample that actually participated in the study consisted of 100 ST2 students from the two selected technical colleges at intact class level. A researcher-developed instrument tagged Motor Vehicle Skills Performance Test (MVSPT) was used to gather data for the study. The data obtained from the instrument were analysed using mean to answer research questions and analysis of Covariance (ANCOVA) to test the null hypotheses at 0.005 level of significance. The findings revealed that students exposed to brain-based learning and collaborative instructional models significantly differed in their performance in MVT. Based on the findings of this study, it was concluded that efficient acquisition of creativity and psychoproductive skills in MVT skills programme could certainly be improved by the use of brain-based learning instructional model. On the bases of the conclusion of the study, it is recommended among others that MVT instructors and teachers should adopt brain-based learning model of instruction in conjunction with collaborative instructional model in the teaching of MVT skills programme.

Keywords: brain-based learning, collaborative, instructional model, skills, motor vehicle technology

Introduction

Currently, researches are on-going globally in order to determine the best teaching models, methods, approaches and strategies for the teaching of skills-based or workshop-based programmes under Technical, Vocational Education and Training (TVET). These researches are geared towards assisting students with students' centred-teaching/learning approach that would help to develop students' intellectual achievement and motivation to succeed academically as well as acquire the needed psycho-productive skills in workshop-based programme such as

Motor Vehicle Technology (MVT). MVT is one of the programme under TVET, design to exposed students to both theory and practical skills in order to prepare them for future employment in the world of work or be self-reliance. In MVT skills programme, students are expected to have thorough knowledge of vehicles, from tyres and headlights to the working components of petrol and diesel powered engines. They are required to have good analytical and troubleshooting skills to help in isolating problems with assemblies, components and parts of an engine. Basic computer skills and the ability to keep up with the changing technology are crucial because as technicians or technologists they should be able to solve problems of both ancient and modern vehicles.

Motor Vehicle Technology (MVT) is one of the mechanical engineering trade subjects offered as a career in public technical colleges in Akwa Ibom State and other states of the federation. It is a very exciting and distinctive occupation. As a career, it is very challenging but also rewarding in terms of economic benefits. The main objective of MVT is to provide employment at the technical college level and to augment labour for creative development (Nduononwi, 2016). It is the type of education designed to provide its graduates with creativity and psychoproductive skills. Creativity and psychoproductive skills are MVTs' required work behaviours demanded by employers of labour in auto and allied industries. Creativity and psychoproductive skill is expertness in doing job excellently and skilfully, like being able to drive a vehicle, diagnosing a vehicle problem accurately, carrying out routine servicing on an engine, overhauling an engine to serviceable condition and being able to loosen and recoupled an engine back successfully.

MVT is one of the few occupations in which about 95 percent of its students are expected to be self- employed at graduation. Due to advancement in technology, MVT now has over 400 sub-occupations under it, and these sub-occupations are interconnected to each other. However, it is important to note that the breakdown of these sub-occupations yields so many tasks or skills, and these skills are related to each other. For example: in motor vehicle engine repairs, where an engine is to be completely overhauled, the procedure for rebuilding the engine to a functional condition is interrelated to other MVT sub-careers in the profession: MVT spare parts merchandise will supply the parts for re-assembling of the engine, the cylinder block will be re-bored by an expert. A specialist will cut the crankshaft to specification (i. e. 010 mm. 020 mm. and or 030 mm): proficient MVT technician will pulverize the cylinder head valve seat. Different MVT technicians do all these before the engine is re-assembled to a functional condition by a proficient mechanic. This is what makes MVT a capitalist occupation and a unique training programme for the eradication of poverty.

MVT students are expected to acquire psychoproductive skills that would enable them carryout several services and repairs on the vehicle body and the engine. In this study, maintenance services and repairs such as partial engine overhaul, schedule vehicle maintenance and maintenance of epicyclic gearing system among others would be considered. The term "Overhaul" according to Nduononwi (2016), involves (a) partial or complete dis-assembling of the engine or machine; (b) inspection of the engine to detect damage, defective or worn parts (c)

repair or replacement of such parts, and (d) re-assembling, testing, and trial-run prior to returning the engine or machine to its full operating condition.

The reasons for engine overhaul are loss of compression, excessive oil consumption, and excessive oil clearance. The symptoms of loss of compression are extended cranking which results in hard starting, engine misfiring that make the engine run rough. Lack of power is the symptoms that can cause engine overhauling (Nduononwi (2016). However, loss of compression can be cause by other factors, therefore, before an engine is overhaul, it should be diagnosed by performing a compression test. Disregarding fuel system and ignition troubles, causes of loss of power and bad engine performance can usually be traced back to poor compression on one or more cylinders. Loss of compression can be checked in two ways. (a) by manually cranking the engine, it can be felt whether one or more cylinder have poor compression; and (b) by means of a compression gauge, applied to the spark plug holes in the cylinder head. The gauge indicates the compression in meter and kilometre, which should be above a certain limit set by the makers of the engine (Reyat, 2003 & Dolan (1999 cited in Nduononwi, 2016).

Schedule vehicle maintenance is one of the over 400 skills in Motor Vehicle Technology (MVT). It is a process carried out base on engine mileage (Carsdirect.com, 2016). Routine vehicle maintenance is mandatory processes perform in order to keep the vehicle in operational condition. There are guidelines for approximate intervals of maintenance suggested by vehicle manufacturers' on how vehicle maintenance service should be carried out (Nduononwi, 2022). On the other hand, it is always safer to refer to the manufacturer's manual or authorized service expert for intervals required. An organisation known as 'The Car Care Council" has developed a vehicle maintenance schedule/checklist to provide general guidelines for the regular schedule vehicle maintenance of passenger cars, mini vans, pickups and suburban utility vehicles (SUVs). The intervals of maintenance are built around an oil change of every 3,000 miles, which is an accepted recommendation for the majority of motorists who are rigorous service drivers. It is advisable to always consult this manual for specific recommendations by the car care council. By adhering to this car maintenance checklist, funds will be saved in the end and a better engine performance sustained. Competent and skilled technicians should be able to perform scheduled maintenance as outlined above and advice customers on work performed, general vehicle conditioning and future repair requirements.

The term "epicyclic gear also known as planetary gear" is a gear train that composed of the annulus. sun, and a sun pinion, It is possible to obtain from this single train six speeds, four of which are forward and two of which reverse (Dolan, 1999 cited in Nduononwi, 2016). In epicyclic gearing reverse direction is obtained only when the planet carrier is held stationary. The direction of the sun, annulus, or planet carrier always moves in the same direction as the driven member. When two members of an epicyclic train are locked, the unit revolves as a solid mass (Dolan, 1999). The operation of epicyclic gearing system, according Dolan (1999), is as follows:

Neutral and Park. Front and rear clutch are disengaged. no power is transmitted from the converter to the gear set, and front and rear bands are released.

Reverse. The rear clutch is applied, connecting the converter to the reverse sun gear. The rear band is applied holding the planet carrier stationary, providing a reduction in the reverse direction.

First Gear Lock-Up. The front clutch is applied, connecting the converter to the forward sun gear. 'The rear band is applied, holding the planet carrier stationary. The reverse sun gear rotates freely in the opposite direction to the forward gear sun gear.

First Gear D2. The front clutch is applied, connecting the converter to the forward sun gear. The one-way clutch prevents the planet carrier from rotating anti- clockwise. On the over-run, the one-way clutch and the gear set freewheel.

Second Gear. The front clutch is applied, connecting the converter to the forward sun gear. The front band is applied, holding the reverse gear set stationary.

Third Gear. Front clutch is applied, connecting the converter to the forward sun gear. The rear clutch is applied, converting to the reverse sun gear. Both sun gears rotate at the same speed, and the gear set rotates as a unit, providing a direct drive ratio.

Epicyclic or planetary gear system is found in many variation and arrangements to meet a broad range of speed-ratio in the design requirements. Epicyclic gearing system is use, apart from motor vehicle, in varied applications such as, lathe machine, clocks, lunar calendar, car mirror, toys, gear head motor, turbine engine, driven equipment, electric motors, hydro-turbine, driven machineries such as pumps, electrical generators, compressors, water jets and many more. Epicyclic gears have the following advantages: very compact construction, distribution of torque on several gears; provide high power density in comparison to standard parallel axis gear trains; provide a reduction in volume; multiple kinematic combinations; purely torsional reactions, and coaxial shafting. Disadvantages include high bearing loads, constant lubrication requirements, inaccessibility, and design complexity (Lynwander, 1983 and Smith, 1983 all cited in Nduononwi, 2016).

However, according to NABTFB (2008), there are deficiencies in MVT practical skills by students in Akwa Iborn State technical colleges and these have given rise to serious debates about the quality of technical education offered to learners in Nigeria for a decade now. Practical work performances in external examinations such as NABTFB and NECO by MVT students in most technical colleges have fallen short of the public expectations and are apparently at variance with the goals and objectives of the National Policy on Education (FGN, 2013). Considering these students' poor performances in examinations, what easily comes to mind is the method of imparting skills to these students. In view of the students' poor performances in public examination, it has become necessary to search for a better instructional model, strategy or method that would be ideal for the teaching of MVT skills or other workshop-based skills.

Instructional models used by teachers in the teaching of skills in MVT classroom/workshop includes collaborative instructional model. Collaborative instructional model takes place whenever students interact in pairs or in groups to share knowledge and experiences (Tochonites, 2000 cited in Nduononwi, 2016). In collaborative instructional model,

the teacher systematically organizes students into groups to work and learn together during practical work periods. The application of collaborative instructional model in the teaching of Motor Vehicle Technology skills has not yielded good results. The consequence of this instructional model is that MVT student's performance in both internal and external examinations are below expectations while MVT graduates are unable to retain the skills they acquired and apply it to novel situations.

Collaborative instructional model have been used in the teaching of MVT skills for decades without much success in terms of acquisition of practical skills, attitudes and right values required of MVT graduates by the world of work. Moreover, in spite of the application of this instructional model in the teaching of MVT skills, deficiencies in students' skills acquisition still abound; this is indicative of the students' poor performances in both internal and public examinations. It is, therefore, necessary to search for an alternative instructional model that could increase and improve MVT students' theoretical performance in both internal and external examinations in technical colleges and also address the deficiencies in practical skills and work habits in Motor Vehicle Technology.

Fortunately investigation by neuroscientists and other related disciplines has led to a novel instructional approach such as brain-based learning model. According to Wilson & Conyers (2013), Brain-based learning is a comprehensive model to instruction using current researches from researchers in educational neuroscience, social neuroscience, psycho immunology, behavioural genetics, psycho-biology, cognitive science, neuroscience and physiology. These researchers investigated the neural mechanisms of reading, numerical cognition, attention and attendant difficulties including dyslexia and dyscalculia as they relate to the pedagogical system. Their findings affirmed the human brain as the centre of all learning; that for learning to take place the instruction should be design in the way the brain learns: and that different models, techniques or strategies should be used to engage the brain for effective learning to take place. Brain-based learning, therefore, is the persistent engagement of different models based on philosophy derived from firm scientific researches.

Brain-based learning model comprises of strategies that are brain-friendly. These strategies contains important element of best teaching in brain- based learning which are meant to promote analytical skill, problem-solving skill, problem- identification skill, adaptability skill, critical thinking skill, creativity skill as well as self- management skill (AFT, 2000 Caine & Caine, 2002; Gulpinar, 2005; Jensen, 2008 all cited in Nduononwi, 2016); and all these brain-based learning related skills would lead to creativity and psychoproductive skills which is very essential to MVT students and graduates. This study, therefore, is conducted to determine the differences in students' skills performance in Motor Vehicle Technology (MVT) when taught using brain-based learning and collaborative instructional models.

Problem Statement/Justification

Many Motor Vehicle Technology graduates are roaming the streets of Akwa Ibom State and other state of the federation in search of employment, while some are being employed as

local security personnel, bar attendants and other odd jobs. Some of MVT graduates who were lucky to find employment in the state civil or federal public service are in the messenger positions. According to the Federal Republic of Nigeria (FRN, 2013), MVT programme was designed to equip the Nigerian youths with balanced work behaviour which are creativity, psychoproductive, Cognitive, affective and perceptual skills that will enable them to be enterprising and or be self-employed. Incidentally, the programme has been implemented for many years without much success in terms of acquisition of practical skills, attitudes and right values required by the world of work (Nduononwi. 2016).

One of the major observations from this study is that the students were rich in cognitive knowledge, but deficient in practical skills and work habits that are expected of prospective technicians/technologists by potential employers. The questions to ask now are: what is responsible for the spate of unemployment among MVT Graduates? Is there any problem with collaborative instructional models adopted in the teaching of MVT skills in Technical Colleges? Can brain-based learning instructional model influence students' performance in Motor Vehicle Technology? Does creating a brain-based learning classroom/workshop lead to greater performance by students in Motor Vehicle Technology? There are no ready answers to the foregoing questions, because brain-based learning instructional model have not been mentioned or discussed in technical and vocational education literature nor tested pedagogically to ascertain evidence of its usefulness in teaching MVT skills or any other skills-based subjects in Akwa Ibom State technical colleges. In the above regard, literature evidence would be too limited or inappropriate to satisfy researchers' expectation. The problem of this study, therefore, was to find out if brain-based learning instructional model would significantly enhance students' practical skills performance in motor vehicle technology (MVT).

Objectives of the study

The main objective of this study was to determine the differences in students' skills performance in Motor Vehicle Technology (MVT) when taught using brain-based learning and collaborative instructional models. Specifically, the study sought:

1. to determine the difference in students' skills performance in partial engine overhaul when taught using brain-based learning and collaborative instructional models.
2. to determine the difference in students' skills performance in schedule vehicle maintenance when taught using brain-based learning and collaborative instructional models..
3. to determine the difference in students' skills performance in maintenance of epicyclic gearing system when taught using brain-based learning and collaborative instructional models.

Research Questions

This study is design to provided answers to the following research questions.

1. What is the difference in students' skills performance in partial engine overhaul when taught using brain-based learning and collaborative instructional models?
2. What is the difference in students' skills performance in schedule vehicle maintenance when taught using brain-based learning and collaborative instructional models?

3. What is the difference in students' skills performance in the maintenance of epicyclic gearing system when taught using brain-based learning and collaborative instructional models?

Research Hypotheses

The following research hypotheses were formulated to guide the study and were tested at .05 alpha level.

1. There is no significant difference in students' skills performance in partial engine overhaul when taught using brain-based learning and collaborative instructional models.
2. There is no significant difference in students' skills performance in schedule vehicle maintenance when taught using brain-based learning and collaborative instructional models.
3. There is no significant difference in students' skills performance in the maintenance of epicyclic gearing system when taught using brain-based learning and collaborative instructional models.

Literature Review

Models for delivering lessons in the pedagogical setting are crucially important. This is because the progress of academic performance of students depends solely on how lessons are delivered and received. Brain-based learning instructional model is all about purposeful engagement of different techniques and strategies that relate to how the brain works in the pedagogical context. Jensen (1998, cited in Nduononwi, 2016), opined that the brain is intimately involved in, and connects with, everything teachers and students do at school. Any disconnect from the brain is a recipe for frustration and potential disaster. Jensen further asserted that brain- based education could only be understood in three words; namely engagement, strategies (models) and principles.

This indicates that MVT's instructors and teachers who adopt brain- based learning instructional model in their teaching should always engage their students with instructional approaches and models that are based on research findings from neuroscience. Research findings have revealed various instructional models that engage the brain, which MVT's instructors and teachers should exploit to maximize their students' academic performances. These various instructional models falls under authentic learning activities that is brain friendly. In a bid to take full benefit of brain-based teaching effectiveness, teachers should have a fundamental understanding of key memory concepts and functions in the brain and how these functions relate to teaching and learning of skills in the classroom/workshop settings.

To make instructional delivery effective, the teacher must tailored it to reflect what research reports have established as effective practice for brain-related learning. Understanding both the foundational practices and the reasons behind each practice would allow teachers to provide the highest quality of education possible to help students actualize their potential for achievement. There are ample researches on memory and how the brain preserves and effectively remembers information. It is very important to study these key points relating to the essential functions of working memory, long-term memory, as well as sensory register and how they can be used to improve teachers' effectiveness in skills-based classroom.

The brain consists of many cells; the type, which is basic to teaching/learning, is the neuron. Learning takes place when two neurons communicate. When the neuron gathers information, it grows appendages called dendrites. Dendrites constantly scan for information because the brain continually wants to learn (i. e. the brain is always searching for meaning from gathered information and stimuli). A synapse transmits messages between neurons via the axon (Sprenger, 2002 in Nduononwi, 2016). A synapse is a gap between the cells, an invisible bridge that allows the neurons to communicate as information travels through the brain (Stevens & Goldberg, 2001 in Nduononwi, 2016). When neurons repetitively communicate with each other, a neural network is formed and a pattern is repeated. The underlying rationale behind the value of brain-based learning instructional model is that neural connections in the brain, those connections that represent the formation of knowledge, are vigorously created and modified throughout a person's lifetime. This potential for continual growth in response to new information is critical to the efforts of modern educators to advance the concept and value of lifelong learning.

Theoretical Framework

This study is based on the theory of educational neuroscience or Neuro-education theory by American Federation of Teachers (AFT) (2000). The theory of educational neuroscience is all about the integration and application to education of what we know about the brain through researches by neuroscientists and other related disciplines. The concept of how the brain learns was reinforced in 2000 when the American Federation of Teachers (AFT) stated: *'It is vital that we identify what science tells us about how people learn in order to improve the education curriculum'* Therefore, Educational neuroscience is an emerging scientific field of study that combines researches in cognitive neuroscience, developmental cognitive neuroscience, educational psychology, educational technology, educational theory and other related disciplines to explore the connections between biology processes and education.

These researchers in educational neuroscience and other related discipline investigated the neural mechanisms of reading, numerical cognition, attention and attendant difficulties including, dyslexia (learning disability in which a person finds it difficult to read and write), and dyscalculia (difficulty with numbers and in doing arithmetic) as they relate to education. The aim of educational neuroscience, therefore, is to generate basic and applied researches that will provide a new "Trans-disciplinary" account of learning and teaching, which is capable of informing the pedagogy. Furthermore, educational neuroscience seeks to analyse the biological changes that take place in the brain as new information is processed. It is the study of the human nervous system, the brain, and the biological basis of consciousness, perception and learning. The nervous system and the brain are the physical foundation of the human learning process. Neuroscience links observations about cognitive behaviour with the actual physical processes that support such behaviour. This theory is still young. It is undergoing rapid, controversial development. Some of the important findings by the field of neuroscience include the followings: (a) the brain has a triad (a grouping of three) structure; (b) Human brain actually contains three

brains: cerebrum, cerebellum, and the brain stem or reptilian brain that controls the basic (see appendix). The theory of Educational Neuroscience strongly relates to this study because it seeks to analyze the biological changes in the human brain as new information is processed and link an understanding of the brain processes with classroom instruction and experiences. It looks at how environmental, emotional and social situations can be maintained so that new information learns in the classroom can be retained and stored in the brain.

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Methodology

The study was conducted in the nine public technical colleges in Akwa Ibom State. The study employed quasi-experimental design (that is pre-test — post-test group design). This implies that intact classes were used for the study. This design was employed because it was not possible to randomly sample the subjects and assign them to groups without raising the students' curiosity and or disrupting the academic programmes of the schools used for the exercise. The structure of the design process is presented as follows:

Experimental	01		02
Control	03	X	04

Where

X_1	.....	treatment (teaching) administered to the experimental group
0_1	……	pre-test administered to experimental group
0_2	…….	Post-test administered to the experimental group
03	…….	Pre-test administered to the control group
04	……	post-test administered to the control group.

The population for the study consist of all the 297 Senior Technical Two (ST2) students offering motor vehicle technology (MVT) as a career in the nine public technical colleges in Akwa Ibom State. This level of students was considered suitable for the study because the variables of the study are part of their curriculum. By experimenting with these groups of students at that level, the effect was useful as the skills acquired assisted them to be proficient in their chosen career.

The study was carried out through simple random sampling technique. The sample that actually participated in the study was 100 ST2 students at intact class level. A researcher-

developed 100 multi-choice instrument tagged "Motor Vehicle Skills Performance Test" (MVSPT) was use to gather data for the study. The instrument was given to three validates for face and content validation. Their suggestions led to adjustment in the instrument, especially in terms of ambiguous questions, excessive wordiness, difficult vocabulary, numbers of items and construct. The validates also examined the contents of the instrument with respect to their clarity, appropriateness of language, ability to elicit accurate information and suitability in line with the objectives of the study, research questions and hypotheses.

The validates' comments, corrections and modifications were incorporated into the final instrument. The instrument was pretested to sample of 60 MVT students at two weeks interval in one of the colleges that met the criteria for sampling but was not used for the study. The two sets of scores obtained were analysed with Cronbach's Alpha Analysis coefficient which yielded the Cronbach alpha reliability indices between 0.78 and 0.82. The following experimental conditions were observed to ensure success and to avoid experimental bias. *Pre-Experimental Activities: Experimental Bias*: In order to avoid any experimental bias, the regular class teachers in the participating colleges taught their own students. The researcher was not directly involved in the administration of the research instrument. *Teacher Unpredictability***:** in order to control differences that could be caused by teachers' variables and to ensure uniform standard in the conduct of the research, the researcher prepared the lesson for use by the teachers. However, the subject teachers carry out the teaching effectively through the guidance of the researcher. *Teachers' Training***:** two weeks intensive training programme was organized for participating teachers with the express permission of the head teachers in the participating colleges. At the end of the training, the researcher organized a question and answer session for the participating teachers to ensure their mastery of the methods of instruction.

Mean 'statistic was used to answer research questions while analysis of covariance (ANCOVA) was used to test the null hypotheses raised in the study. When F-calculated was greater than F- critical, the null hypothesis was rejected, indicating that there was a significant difference. Also when F-calculated was less than or equal to critical F-value, the null hypothesis was accepted. When answering the research questions, the group with the highest mean gain was considered as performing better than the other group, which has a lower mean gain.

Results

Research Question One

What is the difference in students' performance in partial engine overhaul when taught using brain-based learning and collaborative instructional models?

Table 1: Comparative effects of brain-based learning and collaborative instructional models on students' skills performance in partial engine overhaul.

Instructional Models	Sample Size	Pre-test Mean	Post-test Mean	Mean Gains	Mean Gain Difference
Brain-based	43	12.51	51.07	38.56	23.71
Collaborative	57	16.61	31.46	14.85	

Data presented in Table 1 showed that for students taught partial engine overhaul using brain-based learning instructional model, the mean increases from 12.51 in pre-test to 51.07 in post-test. The mean gain is 38.56. For students taught partial engine overhaul using collaborative instructional model, the mean increases from 16.61 in pre-test to 31.46 in posttest, giving mean gain of 14.85. The difference in mean gain for students taught with brain-based learning instructional model exceeds the mean gain for students taught using collaborative instructional model by 23.71. It is, therefore, inferred that brain-based learning model of instruction enhances students' performance in partial engine overhaul more than collaborative instructional model.

Research Question Two

What is the difference in students' skills performance in schedule vehicle maintenance when taught using brain-based learning and collaborative instructional models?

Table 2: Comparative Effect of Brain-Based Learning/Collaborative Instructional Models on Students' Performance in the Schedule Vehicle Maintenance

Instructional Models	Sample Size	Pre-test Mean	Post-test Mean	Mean Gains	Mean Gain Difference
Brain-based	43	18.47	67.63	49.16	
					36.46
Collaborative	57	17.67	30.37	12.7	

In Table 2, data presented indicate that for students taught schedule vehicle maintenance using brain-based learning instructional model, the mean increases from 18.47 in pre-test to 67.63 in post-test. The mean gain is 49.16. For students taught schedule vehicle maintenance using collaborative instructional model, the mean increases from 17.67 in pre-test to 30.37 in post-test, giving mean gain of 12.7. The difference in mean gain for students taught with brain-based learning instructional model exceeds the mean gain for students using collaborative instructional model by 36.46. It is, therefore, inferred that brain-based learning model of instruction enhances students' performance in schedule vehicle maintenance more than collaborative instructional model.

Research Question 3

What is the difference in students' performance in maintenance of epicyc1ic gearing system when taught using brain-based learning and collaborative instructional models?

Table 3: Comparative effect of brain-based learning and collaborative instructional models on students' performance in maintenance of epicyc1ic gearing system

Instructional Models	Sample Size	Pre-test Mean	Posttest Mean	Mean Gains	Mean Gain Difference
Brain-based	43	13.28	72.61	59.33	
					44.97
Collaborative	57	14.40	28.76	14.36	

Data presented in Table 3 indicate that for students taught maintenance of epicyc1ic gearing system using brain-based learning instructional model, the mean increases from 13.28 in pre-test to 72.61 in post-test. The mean gain is 59.33. For students taught maintenance of epicyc1ic gearing system using collaborative instructional model, the mean increases from 14.40 in pre-test to 28.76 in post-test, giving mean gain of

14.36. The difference in mean gain for students taught with brain-based learning instructional model exceeds the mean gain for students using collaborative instructional model by 44.97. It is, therefore, inferred that brain-based learning model of instruction enhances students' performance in maintenance of epicyc1ic gearing system more than collaborative instructional model.

Findings

The results of the study showed that:

1. Students taught partial engine overhaul using brain-based learning instructional model performed better than those taught with collaborative instructional model.
2. Students taught schedule vehicle maintenance using brain-based learning instructional model performed better than those taught with collaborative instructional model.
3. Students taught maintenance of epicyclic gearing systems using brain-based learning instructional model performed better than those taught with collaborative instructional model.
4. There is a significant difference in students' performance in partial engine overhaul when taught using brain-based learning and collaborative instructional models.
5. There is a significant difference in students' performance in schedule vehicle maintenance when taught using brain-based learning and collaborative instructional models.
6. There is a significant difference in students' performance in maintenance of epicyclic gearing system when taught using brain-based learning and collaborative instructional models.

Discussion of Findings

Comparative Effect of Brain-Based Learning and Collaborative Instructional Models on Students' Performance in Partial Engine Overhaul

The two instructional models clearly differed in their effects on students' performance in partial engine overhaul (see Tables I and 4). The finding regarding the Research Question 1 shows that the post-test mean for students in the experimental group, which was exposed to brain-based learning instructional model, was greater than the post-test mean for students in the control group that was exposed to collaborative instructional model. Differences in mean gains between the two instructional models were in favour of brain-based learning instructional model. This result clearly showed that brain-based learning model of instruction was more effective in facilitating students' performance in partial engine overhaul. In this finding, collaborative instructional model was observed to be the least model in facilitating students' performance in partial engine overhaul.

Moreover, findings show the rejection of Null Hypothesis 1 on the basis that the analysis of covariance (ANCOVA) presented computed F-ratio, which was greater than critical F ratio. This means that there is a significant difference in students' performance in partial engine overhaul when taught using brain-based learning and collaborative instructional models. This research finding is supported by earlier studies by Denton (2010); Montgomery and Whitting

(2000); Kiesinger (2011); and McNarnee (2011). These researchers unanimously agreed that brain-based learning instructional model facilitates students' performance in the pedagogical setting. This finding has revealed the ineffectiveness of collaborative instructional model in the teaching of partial engine overhaul in MVT workshop/classroom situation.

The implication of this finding is that, students' poor performance in partial engine overhaul in both internal and external examinations is observe to have been caused by the inefficiency of collaborative instructional model in enhancing acquisition of psychoproductive skills in theoretical as well as practical aspect of MVT skill such as partial engine overhaul. It is the opinion of the researcher that collaborative instructional model seems not to have sufficiently equipped MVT graduates with contemporary skills required to make them to be self-employed or be employable in the world of work. This is indicative of MVT graduates roaming the streets of Akwa Ibom State in search of jobs different from their occupation.

This observation is line with Johnson and Johnson (1994), who opined that collaborative instructional model involved some disadvantages such as lack of participation of some team members and the dominant attitude of some members, especially self-confident students. These negative tendencies might have been responsible for the ineffectiveness of collaborative instructional model in enhancing students' performance in partial engine overhaul. It is also the opinion of the researcher that the possible solutions to the problem of skills acquisition in partial engine overhaul rest in the adoption of brain-based learning instructional model as the medium of instruction in the teaching of partial engine overhaul skills and training teachers/instructors on the use of brain-based learning model of instruction in the classroom/workshop.

Comparative Effect of Brain-Based Learning and Collaborative Instructional Models on Students' Performance in schedule vehicle maintenance

The finding of the study revealed that the two instructional models significantly vary in their effect on students' performance in schedule vehicle maintenance. (see Table 2 and 5). The finding regarding Research Question 2 shows that the post-test mean for students in the experimental group, which was exposed to brain-based learning instructional model, was superior to the post-test mean for students in the control group that was exposed to collaborative instructional model. Differences in mean gains between the two instructional models were in favour of brain-based learning instructional model. This result undoubtedly showed that brain-based learning model of instruction was more effective in facilitating students' performance in schedule vehicle maintenance.

However, this finding has shown collaborative instructional model as the' least instructional model in facilitating students' performance in schedule vehicle maintenance. Moreover, findings show the rejection of Null Hypothesis 2 on the basis that the analysis of covariance (ANCOVA) presented computed F-ratio, which was higher than critical F - ratio. This means that there is a significant difference in students' performance in schedule vehicle maintenance when taught using brain-based learning and collaborative instructional models. This research finding supported by earlier studies by Kiesinger (2011); McNamee (2011) Denton (2010) and Saleh (2012). These researchers jointly agreed that brain-based learning instructional

model improve students' performance in classroom setting. This finding has exposed the ineffectiveness of collaborative instructional model in the teaching of schedule vehicle maintenance skills. The implication of this finding is that, students' poor performance in schedule vehicle maintenance in both internal and external examinations is observed to have been caused by the inefficiency of collaborative instructional model in enhancing acquisition of creativity and psychoproductive skills in both theoretical as well as practical component aspect of MVT skills such as schedule vehicle maintenance.

It is the view of the researcher that collaborative instructional model seems not to have adequately equipped MVT graduates with mandatory skills required to make them to be employable in the world of work. This is indicative of MVT graduates roaming the streets of Akwa Ibom State in search of jobs different from their profession. One of the greatest challenges of collaborative instructional model is its reliance on a positive group full of life to function at its highest regard. Disagreement between individuals students usually halt a collaborative group's capacity to work mutually, which bring up a significant problem when group members lack conflict resolution skills. Every so often students find it difficult to trust the other team members, and sometime several students prefer to work individually and are not motivated to work as a team (Kiraly, 2003, cited in Nduononwi, 2016).

These problems may have made collaborative instructional model not an effective teaching model for MVT skills such as schedule vehicle maintenance. It is the belief of the researcher that the possible solutions to the problem of skills acquisition in schedule vehicle maintenance lies in embracing brain- based learning instructional model as a medium of imparting skills to the students and training teachers on the application of brain-based learning in the teaching of skills.

Comparative Effect of Brain-Based Learning and Collaborative Instructional Models on Students' Performance in Maintenance of Epicyclic Gearing System

The two instructional models evidently vary in their effects on students' performance in maintenance of epicyclic gearing system (see Table 3 and 6). The finding regarding Research Question 3 showed that the post-test mean for students in the experimental group that was exposed to brain-based learning instructional model, was greater than the post-test mean for students in the control group that was exposed to collaborative instructional model. Differences in mean gains between the two instructional models were in favour of brain - based learning instructional model. This result undoubtedly showed that brain-based learning model of instruction was more effective in facilitating students' performance in maintenance of epicyclic gearing system. In this finding, collaborative instructional model was observed to be the least model in facilitating students' performance in maintenance of epicyclic gearing system.

Moreover, findings show the rejection of Null Hypothesis 3 on the basis that the analysis of covariance (ANCOVA) presented computed F-ratio, which was greater than critical F - ratio. This means that there is a significant difference in students' performance in the maintenance of epicyclic gearing system when taught using brain-based learning and collaborative instructional models, These finding is supported by earlier studies carried out by Shetty (2008); Sprenger (2002) Kiesinger (2011); and Mary (2004). These researchers unanimously affirmed that brain-

based learning model of instruction enhances students' performance in all situations. This finding .has revealed the ineffectiveness of collaborative instructional model in teaching maintenance of epicyclic gearing system in MVT workshop/classroom setting.

The implication of this finding is that, students' poor performance in maintenance of epicyclic gearing system in both internal and external examinations is observed to have been' caused by the inefficiency of collaborative instructional model in enhancing acquisition of psychoproductive skills in theoretical as well as practical aspect of MVT skills such as maintenance of epicyclic gearing system. It is the opinion of the researcher that collaborative instructional model seems not to have amply equipped MVT graduates with contemporary creativity skills required to make them become self-employed or be employable in the world of work. This is indicative of MVT graduates roaming the streets of Akwa Ibom State in search of jobs different from their career. Collaborative classroom/workshop call for all students to be actively involved, participate in the activity, and help their team members work towards the achievement of the set goals. Sometimes this is not always possible due to bullying and off-topic discussions by close friend in the team. Under such conditions, learning may not take place; and this may renders the objective of the project unachievable.

However, in the brain-based classroom/workshop, students are well coordinated because the instructors/teachers are part of the team or group, playing the role of a guide or a facilitator. It is the opinion of the researcher that the possible solutions to the problem of skills acquisition in maintenance of epicyclic gearing system rest in the adoption of brain-based learning instructional model as the medium of imparting skills as well as training the instructors/teachers to apply brain-based learning a the medium of instruction.

Conclusion

The findings of this study serve as the basis for making the following conclusions. Efficient acquisition of creativity and psychoproductive skills in MVT could certainly be improved by the use of brain-based learning instructional model. It is also a solution for raising career technicians/craftsmen in MVT for the world of work. Brain-based learning instructional model is useful, efficient and effective tool for the training of engineers, technologists, technicians and artisans irrespective of the topic and ability levels of students in motor vehicle technology programme and other workshop-based programmes.

Educational Implications of the Study's Findings

Findings of the study show that there is a significant difference in students' performance in the 3 variables of the study when taught using brain-based learning and collaborative instructional models. The findings also provide useful insight into the effects of the two instructional models. It is important to note that the findings suggest brain-based learning model to be a very useful model that significantly facilitate students' performance in the 3 variables of the study. On the other hand, these findings have also exposed the ineffectiveness of collaborative instructional model in the teaching of the 3 variables. It is the belief of the

researcher that students' poor skills performances in both internal and external examinations regarding the 3 variables is observed to have been caused by the inefficiency of collaborative instructional model in enhancing acquisition of creativity and psychoproductive skills in theoretical as well as practical aspect of MVT skills. It is also the opinion of the researcher that collaborative instructional model seems not to have sufficiently prepared MVT graduates with contemporary skills required in MVT to make them to be self-employed or be employable in the world of work. The educational implications of these findings are that MVT students can acquire the necessary creativity and psychoproductive skills that would make them to perform better in both internal and national examinations, be self-employed and or gainfully employed, if instructors and teachers adopt brain-based learning instructional model as the medium of instruction.

Recommendations

In recognition of the discussion outline in the study, the following recommendations are hereby suggested:

1. MVT instructors and teachers should adopt brain-based learning model of instruction to enhance effective instructional delivery that would facilitate the acquisition of creativity and psychoproductive skills in MVT subjects;
2. Collaborative instructional model should be used in conjunction with a more effective, motivating and rewarding model such as brain-based learning instructional model in the teaching of MVT subjects;
3. MVT instructors and teachers should be trained and retrained to enable them acquire brain-based learning teaching skills fir effective and efficient training of MVT students for the world of work.

References

American Federation of Teachers (ATF) (2000). *Building a profession: Strengthening teacher preparation and induction.* Report of the K-16 Teacher Education Task Force. Washington, D. C.: Author Diane Rigden.

Caine. R. N. and Caine, G. (2002). Making connections: teaching and the brain (G. Ulgen trans.) Nobel Yayinlari.

Cardirect .com (2015). A routine car maintenance schedule based on engine mileage. Accessed on 20/08/2015 from: http ://www. carsdirect. corn/car-maintenance/a-routine- car-maintenance schedule-based-on-engine-mileage.

Denton, B. T. (2010). *Handbook of healthcare operations management: Methods and application. International series in operational research and management science*. Sprenger.

Dolan, J. A. (1999). *Motor Vehicle Technology And Practical Work*. Parts 1 and 2. London: Heinemann Education Books Limited.

Federal Republic of Nigeria (2013). *National policy on education*. 4th Ed., NERDC Press.

Gulpinar, M. A. (2005). The principles of brain-based learning and constructivist models in education. *Education Science: Theory and Practice*, 5 (2), 299 — 307.

Jensen, E. (1998) *Teaching with the brain in mind.* Alexandria, Association for Supervision and Curriculum Development.

Jensen, E. P. (2008). A fresh look at brain - based education. *Phi Delta Kappan, 89* (6), 408 - 417. http://dx.doi.org/10.1177/00317217080900605.

Johnson, D. W., Holubec, E. J. & Johnson, R. T (1994). *Cooperative learning in the classroom.* (G. Vitale Trans.), Paidos.

Kiesinger, R. (2011). Brain-based learning and its effects on reading outcome in elementary aged students. (MSc Dissertation, University of Wisconsin-Stout). Menmonie, Wisconsin.

Kiraly, D. (2003). Summary of discussion on collaborative teamwork and group work. In Pym, et al (Eds). *Innovative and c-learning in translation training. Reports on online symposia*. (pp. 51-57). Universitat Rovivra I Virgili.

Lynwander, P. (1983). Gear drive systems: Design and application. New York: Marcel Dekker.

Mary, P. T. (2004). *The effect of information processing models in the teaching of geography in secondary schools of Kerala*. (Unpublished Doctoral Thesis, School of Pedagogical Science). Mahatma Gandhi University, India.

McNamee, M. M. (2011). *The impact of brain-based instruction on reading achievement in a second grade classroom.* (Doctoral dissertation. Walden University). Minnesota. ProOuest.

Montgomery, L. & Whiting, D. (2000). Teachers under construction—incorporating principles of engaged and brain based learning into a constructivist technology in education program. In D. Willis, J. Price & J. Willis (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (PP. 795-800). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/p/15661.

National Business and Technical Education Board (NBTEB) (2008; 2012 - 2014). Practical work exarniners' report. Ekpoma, Benin City, Edo State.

Nduononwi, A. A. (20160). *Comparative Effects of Brain-based Learning and collaborative instructional models on students' performance in motor vehicle technology in technical colleges in Akwa Ibom State.* (PhD Thesis, University of Uyo, Uyo, Nigeria.

Nduononwi, A. A.; Umoh, I. W.; Umanah, N. P. & Akpan, V. M. (2022). Security education and implementation of technical education programme for national development. *Journal of Education.* Vol. 13 No. 2. PP. 87 – 95.

Reyat, H. S. (2003). The Automobile. A textbook for students and those who want to know what an automobile is and how ii works. Ram Nagar. New Delhi: . Chand & Company Ltd.

Saleh, S. (2012). The effectiveness of brain-based teaching approach in enhancing scientific understanding of Newtonian physics among form four students. *International Journal of Environmental and Science Education.* 7 (1), 107-122.

Shetty, G. (2008). A study of the metacognition levels of student teachers on the basis of their learning styles. *Journal of Research & Method in Education*, 4 (1), 43-51.

Sprenger, M. B. (2002). *Becoming a "wiz" at brain-based teaching: How to make every year your best year*. Corwin Press.

Stevens, J. & Goldberg, D. (2001). *For the Learners 'Sake*. Zephyr Press.

Tochonites, 0. L. (2000). Creating an Effective Foreign Language Classroom. http//www.wisc.edu/step/ep301/fal12000/tochonites/stucen.html

Wilson, D. L., & Conyers, M. A. (2013). *Five big ideas for effective teaching: Connecting mind, brain, and education research to classroom practice*. Teachers College Press.