Effects of collaborative learning and framing on psychomotor achievement and interest of automechanics students in the technical colleges in Lagos state, Nigeria

Owoso Joseph Oluropo
Department of Automobile Technology, Adeniran Ogunsanya College of Education,
Otto-Ijanikin, Lagos State, Nigeria
Email: owosoropo@yahoo.com

Abstract
This study was designed to determine the effects of combine use of collaborative learning and framing on psychomotor achievement and interest of automechanics students in the technical colleges in Lagos State, Nigeria. The study was a pretest, posttest; non-equivalent control group quasi-experiment which involved groups of students in their intact classes assigned to experimental and control groups. 28 students constituted the students in the experimental group and 27 students constituted the students in the control group. Three research questions and three null hypotheses, tested at 0.05 level of significance, guided the study. The instruments used for data collection were Automobile Psychomotor Achievement Test (APAT) and Automechanics Interest Inventory (AII). Mean and ANCOVA were used to analyzed the data collected. The study revealed that students taught automechanics using the collaborative learning and framing had a higher mean score than students taught using the conventional teaching method in psychomotor achievement test. The high mean scores were found to be significant. The study also found out that the collaborative learning and framing improved students' interest in automechanics than the conventional methods and the high mean score was found to be significant. Consequently, the researcher recommended that the National Board for Technical Education (NBTE) should consider a review of Motor Vehicle Mechanics Work curriculum for Technical Colleges with a view to incorporating the collaborative learning and framing into the teaching of automechanics. Technical colleges' teachers should adopt the use of the collaborative learning and framing for the teaching of automechanics.

Key words: Technical College; Constructivist Instructional; Approach. Psychomotor Achievement;

Introduction

Automechanics is one of the mechanical trades (Federal Republic of Nigeria (FRN), 2004) offered as Motor vehicle mechanics work in Nigeria Technical Colleges. The programme for Motor vehicle mechanics work in Nigeria Technical Colleges is designed to produce competent craftsmen. According to National Board for Technical Education (NBTE, 2001) a craftsman is expected to test, diagnose, service and completely repair any fault relating to the automobile assembly main units and systems to the manufacturers'

specification as indicated in the Technical College curriculum for Motor vehicle mechanics work. A national curriculum is adopted in all the Technical Colleges accredited by NBTE. The programmes in Technical Colleges are offered at two levels leading to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) for craftsmen and master craftsmen respectively (Federal Ministry of Education, 2000). The curriculum for Motor vehicle mechanics work in the Technical Colleges is developed to offer a complete secondary education in general education subject in addition to occupational area. The Federal Republic of Nigeria (FRN, 2004) pointed out that the main feature of the curricular activities for technical colleges is structured in foundation and trade modules; the curriculum for each trade consists of general education, theory and related courses, workshop practice, industrial training components and small business management and entrepreneurial training. The trade theory and workshop practice cover the major automobile assembly main units and systems, their functions and principles of operation. This curriculum if adequately implemented is expected to produce competent automechanics craftsmen for industrial and technological development in Nigeria.

Technology the world over is dynamic. With advancement in technology, petrol engine automobiles that are imported or assembled in automobile industries in Nigeria are coming with new devices. For instance, the fuel supply system of petrol engines of vehicles in the past, operate with carburetors. Nowadays, most petrol engine automobiles use electronic fuel injection system. Thus, technological development in the automobile industries is in a constant state of flux and change. The influence of technological developments in automobile industries has rendered traditional skills inadequate for work in the automobile industries while creating the need for new and often sophisticated skills. Obviously, the automobile industries need the service of craftsmen who can adapt to the changes in technology in the industries. Greater stress should therefore be placed on providing students with broad learning and problem-solving skills in order to prepare them for a wide range of challenges posed by technological advancement (Szczurkwska, 1997).

According to Ogwo and Oranu (2006), with technological advancement and globalization in workplaces employers are seeking employees who are able to flexibly acquire, adapt, apply and transfer their knowledge to different contexts and under varying technological conditions and to respond independently and creatively. The increasing effect of rapid rate of technological changes on work places and globalization have informed the recommendation by United Nation Educational, Social, and Cultural Organization (UNESCO) and International Labour Organization (ILO) (2002) that all technical and vocational education system in the twenty-first century should be geared towards lifelong learning. Within this context, Rojewski, (2002) remarked that to prepare students in a technologically advanced global 21st century workplace requires that educational institutions should in addition to academic skill inculcate a broad set of workplace basic skills which include learning to learn, both technical and interpersonal/communication skills, higher order thinking skills such as decision making and problem-solving as well as flexibility, creative thinking and ability to work in team which make the students adaptable to the present and

future changes. A complete education of students in the contemporary world of work thus, must focus on developing basic workplace skills that will enable students to be responsible and be effective problem solvers (Moore, 1998).

The challenge for preparing students for the 21st century, workplace basic skills therefore has necessitated a shift from instructional approaches based on the behavioural learning theories to those rooted in cognitive psychological learning theories for which the constructivist instructional approach is one (Ogwo and Oranu, 2006; Brooks and Brooks, 1996). Constructivism is a theory of learning based on the idea that knowledge is constructed by the learner based on mental activity. According to Epstein and Ryan (2002) the constructivist instructional approach is based on the idea that learning is a constructive process in which the learner is building an internal illustration of knowledge on a personal interpretation of experience. It is therefore, a model of instruction and learning, and interactive process in social settings; it is problem solving oriented, allow students to explore and work in groups, making meaning of task and setting out to solving problems that are perplexing to them. Some of the constructivist instructional approaches which can be used to facilitate learning in the classroom are; collaborative leaning and framing

Collaborative learning is an instructional method in which students work in group toward achieving common goal. According to Song, Koszaika and Grabowski (2005) students working together are engaged in the learning process instead of passively listening to the teacher. Pairs of students working together represent the most effective form of interaction (Schwart, Black, and Strange, 1991). When students work in group, valuable problem solving skills are developed by formulating ideas, discussing the ideas, receiving immediate feedback and responding to questions and comments by their partners. Framing as a constructivist instructional strategy can be used for sequencing and synthesizing information. According to Minsky (1994) teacher using framing instructional technique provides instruction that make students identify and list major ideas, concepts and principles; examine such lists and point out relationships between concepts or ideas, such as comparison/contrast, simple causes/effects forms/functions and advantages/disadvantages; and arrange such information in rows and columns having such relationship as headings. Framing, as a strategy, engenders meaningful learning through helping students organize incoming information and building mental bridges between prior knowledge and new knowledge (Barlett, 2002). The obvious implication of the use of these collaborative learning and framing in a classroom is to improve students' thinking skills and problem solving abilities so as to improve students' achievement.

Achievement connotes performance in a school subject as symbolized by a score or mark on an achievement test. Students' Achievement in vocational and technical education according Epunnam, (1999) is defined as the learning outcomes of the student which include the knowledge, skills, and ideas acquired and retained through his course of studies within and outside the classroom situation. According to Ogwo (2004) functional technical and vocational education is defined relative to the objective of students' skill acquisition, securing and retention of employment at sub-professional level. Ogwo maintained that

unless the training is conducted to the extent that these objectives are attained, the technical and vocational programme cannot be deemed to be effective.

Over the years, the achievement of the students in Motor Vehicle Mechanics work has never been encouraging. The Federal Ministry of Education (FME, 2000) noted that NABTEB results of students in the last five years indicate high failure rate in the trades courses. In the same vein, Aina (2000) remarked that in the NABTEB certificate examinations conducted in May 2000 the average failure rate F9 were: Electrical 25%, Construction trade 41% and Engineering trades which includes Motor Vehicle Mechanics Work 49%. In Lagos State specifically, NABTEB results showed that average failure rate in Motor vehicle Mechanic Work in the year 2008, 2009 and 2010 were 14.5%, 44.4% and 17.4% respectively. The high failure rate in the NABTEB examinations has resulted into many of the students' inability to secure employment in the industries or be self-employed. The prevalent high rate of unemployment among technical college automechanics graduates, no doubt, defeats the very fundamental objective of acquisition of skills for self-reliance emphasized in the National Policy on Education. The Federal ministry of Education (FME, 2000) has observed that some of the factors responsible for the high failure rate of technical colleges' students in the NABTEB examinations particularly in the main trades include poor teaching in the technical colleges. Oranu (2003) commenting on the issue of poor quality of teaching observed that the teaching methods such as lecture and demonstration methods which are teacher-centred are the main teaching methods employed by technical teachers for implementing the curriculum in the technical colleges in Nigeria. These methods emphasize knowledge transmission from the teacher to passive students, encourage rote memorization of fact (Boyle, Duffy and Dunleavy, 2003) and make students apathetic and repulsive to learning due to lack of engagement of students in the classroom activities to sustain students' interest in learning. Besides, teaching methods which are based on behavioural learning theories are directed towards isolating the learner from social interaction and towards seeing education as a one-on-one relationship between the learner and the objective material being learned (Epistein and Ryan 2002).

The preparation of workers for entry-level jobs and advancement in the workplace requires technical colleges to provide not only job skills, in automechanics students but also higher-order thinking, problem solving, and collaborative work skills. Doolittle and Camp (1999) indicated that traditional learning-teaching approaches based on behavioural learning theory do not adequately equip students with higher-order thinking skills, collaborative and problem solving skills, but learning approaches based on constructivist theory does. Perhaps, if collaborative learning and framing as constructivist instructional approach are combined during instruction to teach automechanics in technical colleges, it will assist in developing students' thinking skills and problem solving abilities which in turn may help them improve their performance in automechanics. This study is therefore designed to determine effects of the collaborative learning and framing on psychomotor achievement and interest of automechanics students in the technical colleges in Lagos State, Nigeria.

Purpose of the Study

The major purpose of this study was to determine effects of the collaborative learning and framing on psychomotor achievement and interest of automechanics students in the technical colleges. Specifically, this study determines the effects of combine use of collaborative learning and framing on psychomotor achievement and interest of automechanics students in the technical colleges.

Research Questions

The following are the research questions formulated for this study;

1. What are the mean psychomotor achievement scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods?
2. What are the mean interest scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods?

Research Hypotheses

The following null-hypotheses tested at .05 level of significance guided this study;

HO_1: There is no significant difference between the mean psychomotor achievement scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods

HO_2: There is no significant difference between the mean interest scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods

The Theoretical Assumption of the Constructivist learning approach

The constructivist theory according to Mandor (2002) holds the view that scientific knowledge are personally constructed and reconstructed by the leaner based on his prior knowledge or experience. In this context Gray (2005) defined constructivism by reference to four principles; learning, in an important way, depends on what we already know; new ideas occurs as we adapt and change our old ideas; learning involves inventing ideas rather than mechanically accumulating facts; meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas.

According to Kozloff (1998) a constructivist framework challenges teachers to create environments in which the teacher and student are encouraged to think and explore. Kozloff emphasized that but to do otherwise is to perpetuate the ever-present behaviour teacher-centered approach to teaching and learning. From this perspective constructivist classroom then, consists of learner centered, active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, and manipulate object, pose questions, research, investigate, imagine, and invent (Gray 2005).

Kim (2005) identified three fundamental differences between constructivist teaching and other teachings as follows: learning is an active constructive process rather than the process of knowledge acquisition; teaching is supporting the learner's constructive processing of understanding rather than delivering the information to the learner and; teaching is a learning-teaching concept rather than a teaching-learning concept. These according to Kim mean putting the learner first and teaching is second so that the learner is the center of learning.

Jonassen (1990) in his own view highlighted the following as the as some of the assumptions of constructivist teaching: Firstly, knowledge is constructed out of sensual and perceptive experiences of the learner in which learning is internalize through the learner's constructive process in nature. Secondly, knowledge is the personal understanding of the outside world through personal experience rather than the experiences of others. Thirdly, this internally represented knowledge becomes the basis of other structures of knowledge and a new cognitive structure of the person. Fourthly, learning is an active process of developing meaning based on individual personal experiences. In other words, learning is a developing process by the learner's understanding of the real world. Fifthly, it comes from the premise that personal understandings result in various perspectives. The perspectives constructed within the individual cognitive conceptual structure attempt to share all possible various perspectives. Sixthly, learning creates knowledge in the context of a situational reality. Knowledge is the understanding of meaning through situational contexts, not objective reality.From the foregoing, the learner is seen as the owner of his ideas and that understanding can only be created in the learner from experiences and discussions among peers, fellow students and teachers (Stofflet 1994, Solomon 1991). There is therefore, the need to link the existing memory with the present experiences in classroom setting, which would lead to reinforcing a successful learning.

Method

This study was a pretest, posttest, non-equivalent control group quasi-experiment which involved groups of students in their intact classes assigned to treatment groups. The study was conducted in NBTE accredited technical colleges offering automechanics in Lagos State, Nigeria. The study was a pretest, posttest; non-equivalent control group quasi-experiment which involved groups of students in their intact classes assigned to experimental and control groups. The sample size was 55 students. 28 students constituted the students in the experimental group and 27 students constituted the students in the control group. The instruments used for data collection were Automobile Psychomotor Achievement Test (APAT) and Automechanics Interest Inventory (AII). The APAT is an NABTEB standard test for practical examination. The test was adopted for the study. The APAT contained a list of practical tasks students carried out. The practical tasks were based on Petrol Engine Maintenance work - module CMV 11 in the technical college syllabus (Appendix A). A scoring guide was also developed for the APAT which was used by the examiner to rate the students' performance of the practical tasks. The AII which was used to

test the students' interest in Automechanics was also developed by the researcher. The items of the interest inventory were based on five point Likert scale type of Strongly Agreed (SA), Agreed (A), Undecided (UD), Disagree (D) and strongly Disagree (SD) (Appendix B). The APAT and AII were subjected to face validation and content validation. Scorer reliability technique was used to establish the reliability coefficient of the APAT. In using this technique, two raters used the scoring guide of the APAT to score the students' psychomotor achievement. The inter-rater reliability obtained was 0.72 using Kendall's coefficient of concordance. Cronbach Alpha was used to determine the internal consistency of the Automechanics Interest Inventory (AII) items. The interest inventory was administered on equivalent sample of automechanics students. The reliability coefficient computed for the automechanics Interest inventory was found to be 0.83. The data collected with the APAT and AII were analyzed using Mean, to answer the research questions while ANCOVA was used to test the two null-hypotheses formulated to guide this study at 0.05 level of significance.

Control of Extraneous Variables

Experimental Bias

To reduce experimental bias, the regular class teachers in the participating schools taught their own students. Hence, the researcher was not directly involved in administering the research instruments

Lesson Plan Development

To control invalidity that could be caused by teachers' variability in the development of the lesson plan and to ensure uniform standard in the conduct of the research, the researcher personally prepared the lesson plans for both groups.

Training of Teachers for the Experimental Groups

A training programme was organized for the teachers. The teachers were given detailed explanations on the use of the collaborative learning and framing

Experimental Procedure

The pretest was first conducted before the commencement of the treatment. The pre-test featured the administration of the APAT and AII to the students in both experimental and control groups to determine their psychomotor skill performance and interest before the experiment.

The pre-test was immediately followed by the treatment. During the treatment, the experimental group was taught with constructivist lesson plan. The Constructivist lesson plan incorporated the use of collaborative learning and framing. These instructional strategies to a greater extent emphasized students' active participation in their learning process, group learning, connectedness of the lesson to real-world situation and practical hand-on activities. In using the collaborative learning and framing, students were asked to form themselves into groups at the beginning of each class. No criteria were used in this

process of forming the group as the students were able to choose their group mates as they like. Also, within each group, each group member was assigned a role to perform by consensus amongst the group members. No particular thought was given to structure the groups or the roles within the groups other than the generally-acknowledged importance of group work in constructivist learning environments. After the formation of groups, the groups were introduced to the tasks they were to undertake. In designing the tasks, an attempt was made to present the tasks in an authentic manner, situated in the real world context in the working environment. To achieve that, each group was presented with a model of petrol engine and a real engine to work with. Each group member viewed the working model then, dismantled engine parts and re-assembled them after examination of the working principles of the model. In the process, group members discussed issues and clarified ideas about the task performed. At the same time, in each task performed, students identified and listed major ideas, concepts and principles; and point out relationships between concepts, such as comparison/contrast, simple causes/effects forms/functions and advantages/disadvantages; and arrange such information in rows and columns to form frames under the guidance of the teacher. Subsequently, groups were required to create an oral presentation on the task performed for delivery to the class.

The control group was taught with conventional lesson plans. The conventional lesson plan incorporated the use of demonstration and lecture methods. In each class, teacher performed the task in the presence of the students and explained the concepts to the students while the students listen and take notes.

The experimental group was taught 10 lessons with the constructivist lesson plans while the control group was also taught 10 lessons. Each lesson lasted for 90 minutes and the treatment lasted for 10 weeks. At the end of the treatment, a post-test was administered on both groups with the APAT and AII to determine their psychomotor skill performance and interest after the treatment.

Results

Research Question 1

What are the mean psychomotor achievement scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods?

Table 1:

Mean of Pretest and Posttest Scores of Experimental and Control Groups in the Psychomotor Achievement Test

Group	N	Pre-test $\overline{X}$	Post-test $\overline{X}$	Mean Gain
Experimental	28	2.50	41.57	39.07
Control	27	2.55	23.11	20.56

The data presented in Table 1 show that the experimental group had a mean score of 2.50 in the pretest and a mean score of 41.57 in the posttest making a pretest, posttest gain in experimental group to be 39.07. The control group had a mean score of 2.55 in the pretest and a posttest mean of 23.11 with a pretest, posttest gain of 20.56. With this result, the students in the experimental group performed better in the Automobile Psychomotor test than the students in the control group

Research Question 2

What are the mean interest scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods?

Table 2:

Mean of Pretest and Posttest Scores of Experimental and Control Groups in the Automechanics Interest Inventory

Group	**N**	**Pre-test** $\overline{X}$	**Post-test** $\overline{X}$	**Mean Gain**
Experimental	28	69.85	95.21	25.36
Control	27	70.70	87.29	16.59

Table 2 shows that the experimental group had a mean score of 69.85 in the pretest and a mean score of 95.21 in the posttest making a pretest, posttest gain in experimental group to be 25.36. The control group had a mean score of 70.70 in the pretest and a posttest mean of 87.29 with a pretest, posttest gain of 16.59. With this result, the interest of the students in the experimental group improved better than the interest of the students in the control group

Research Hypotheses

HO_1: There is no significant difference between the mean psychomotor achievement scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods

Table 4:

Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of Experimental and Control groups in the Psychomotor Achievement Test

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4692.427[a]	2	2346.213	207.024	.000
Intercept	3027.067	1	3027.067	267.101	.000
Pretest	8.205	1	8.205	.724	.399
Group	4692.400	1	4692.400	414.046*	.000
Error	589.319	52	11.333		
Total	63408.000	55			
Corrected Total	5281.745	54			

***Significant at sig of F<.05**

The data presented in Table 4 indicate that the F-value for group is 414.046 with significance of F at .000, which is less than .05. Hence, the null-hypothesis is rejected at.05 level of significance. This result shows that there is significant difference between the mean scores of students taught automechanics with collaborative learning and framing and those taught using conventional teaching method in psychomotor achievement test. Hence, the difference in the mean of the psychomotor achievement of students taught with the collaborative learning and framing and those taught with conventional teaching method is significant

HO_2: There is no significant difference between the mean interest scores of students taught automechanics with the collaborative learning and framing and those taught using the conventional teaching methods

Table 5:

Summary of Analysis of Covariance (ANCOVA) for Test of Significance Between the Mean Interest Scores of Experimental and Control groups in the Automechanics Interest Inventory

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	867.924[a]	2	433.962	42.886	.000
Intercept	1242.822	1	1242.822	122.821	.000
Pretest	6.159	1	6.159	.609	.439
Group	867.461	1	867.461	85.726*	.000
Error	526.185	52	10.119		
Total	460131.000	55			
Corrected Total	1394.109	54			

***Significant at sig of F<.05**

Table 5 shows that the F-value for group stood at 85.726 with significance of F at .000, which is less than .05. Hence, the null-hypothesis is rejected at.05 level of significance.

This result shows that there is significant difference between the mean scores of students taught automechanics with collaborative learning and framing and those taught using conventional teaching method in Automechanics Interest Inventory. Therefore, the difference in the mean interest scores of students taught with the collaborative learning and framing and those taught with conventional teaching method is significant

Discussion

This study revealed that students taught with collaborative learning and framing had a higher mean score than those students taught using the conventional teaching method in psychomotor achievement test. The analysis of covariance presented in Table 4 confirmed that the difference between the mean scores of students taught with collaborative learning and framing and those taught with conventional teaching method was found to be significant. The significant difference was attributed to the treatment given to the experimental group. This finding indicated that the collaborative learning and framing have positive effect on students' skill performance in automechanics. The obvious implication of this is that the use of collaborative learning and framing as constructivist instructional approach are more effective than the conventional teaching method (Lecture and demonstration methods) in enhancing students' psychomotor achievement in automechanics. This finding is similar to the findings of Tabago (2010) who found out that The Constructivist Approach of laboratory teaching using Constructivist Approach-based experiments is effective in enhancing student's achievement and in developing a more positive attitude towards physics than the traditional experiments. Becker and Maunsaiyat (2004), found out that the adoption of constructivist instructional approach in the teaching of Thailand vocational electronics students improved the students' achievement in electronics than the students taught with traditional instructional method.

Engagements in learning have consistently been linked to increased levels of students' success (Kushman, Sieber, and Harold, 2000). The need to get students engaged in the classroom learning activities has called for the need for teacher to use teaching methods which are students-centred to minimize rote learning and memorization of fact in the classroom. The finding of this study revealed that the difference in the mean interest scores of students taught with the collaborative learning and framing and those taught with conventional teaching method was found significant. Hence, the use of collaborative learning and framing improved students interest that the use of conventional teaching methods. This finding shows that The students' skill performance and interest towards automechanics can be enhanced when they work cooperatively as they learn; providing them with more opportunities to apply their own skills and make their own decisions, and taking into consideration as well as overcoming their misconceptions on the subject.

Conclusions and Recommendations

This study found that the combine use of collaborative learning and framing is effective more that the conventional teaching methods (lecture and demonstration

methods) on psychomotor achievement and interest of automechanics students in the technical colleges. If the collaborative learning and framing as constructivist instructional approach is used for teaching of automechanics in the technical colleges, the students' psychomotor achievement will be improved. It is therefore recommended that technical college teachers should adopt the use of the collaborative learning and framing to the teaching of automechanics. National Board for Technical Education (NBTE) should consider review of curriculum for Motor vehicle mechanics work programme with a view to incorporating the collaborative learning and framing into the teaching of automechanics.

References

Aina, O. (2000). Nigeria technical and vocational education in the near future. In Federal Ministry of Education (2001), *The National Master-plan for Technical and Vocational Development in Nigeria in the 21st Century with the Blue Print for the Decade 2010*. Abuja: Federal Ministry of Education

Barlett, F. C. (2002). *Remembering*. London: The Cambridge University Press

Becker, K. H., & Maunsaiyat, S. (2004). A comparison of students' achievement and attitudes between constructivist and traditional classroom environments in Thailand vocational electronics programs. Retrieved November 15, 2006 from http*://www. scholar.lib.vt.edu/ejournals/JVER/v29n2/becker.html*

Boyaci, O. I. (2006). Situation and authentic learning Experience in certain appropriate social context. http*://www. scholar.lib.vt.edu/ejournals/JVER/v29n2/boyaci.html*

Boyle, E. A., Duffy, T, & Dunleavy, K. (2003). Learning styles and academic outcome: The validity and utility of vermants inventory of learning style in a British higher education setting. *British Journal of Educational Psychology*. 73(2), 267 – 290.

Brooks, J.G., & Brooks, M. G. (1996). In search of understanding: *The case for constructivist classroom*. United States of America: Association for Supervision and Curriculum Development.

Doolittle, P. E. & Camp, W. G. (1999). Constructivism: the career and technical education perspective. Journal of vocational and technical education, 16(1). Retrieved March 25, 2005, from *http://scholar.lib.vt.edu/ejournals/JVTE/v16n1/doolittle.html*

Epistein, M., & Ryan, T. (2002). Constructivism. Retrieved March 18, 2004, from http*//:www.scholar/lib.vt.odu/ejournals/jje/jte-v7ni/epistein.jte-v19n1.htm*

Epunnam, A. D. (1999).Influence of school environmental variables on academic performance as perceived by students. *Unpublished M.Ed thesis*. University of Nigeria, Nsukka

Federal Ministry of Education (2000). *Technical and vocational education development in Nigeria in the 21st century with the blue-print for the Decade 2001 – 2010.* Abuja; Federal Ministry of Education

Federal Republic of Nigeria (2004). *National policy on education*. Lagos: NERDC.

Gray, R. E (2005). Globalization, education and the education revolution. Retrieved August 4, 2005, from *http//:www.elca.org/2005cdprogramplanner*

Jonassen, D. H. (1990). Thinking technology: Chaos in Instructional Design. *Educational Technology*. 30(2), 32-34

Karakirik, N., & Dumus, S. (2005). Collaborative learning. Retrieved March 2, 2003 from http//:www.cal.org/ncle.htm

Kim, J. S. (2005). The effects of a constructivist teaching approach on student academic achievement, self-concept, and learning strategies. *Asia Pacific Education Review*, 6(1)., 7-19

Kozloff, M. A. (1998). Constructivist in education: sophistry for a new age. Retrieved June 12, 2006, from *http//:www.edexcellence.net/library/epciv.html*

Kushman, J. W., Sieber, C., & Harold, K. P. (2000). This isn't the place for me: School dropout. In D. Capuzzi & D. R. Gross (Eds.), *Youth at risk: A prevention resource for counselors, teachers, and parents (3rd Ed)*. Alexandria, VA: American Counseling Association.

Lave, J. (1988). Cognition in Practice: Mind, mathematics, and culture in everyday life. Cambridge, UK: Cambridge University Press. In Lave, J., & Wenger, E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge, UK: Cambridge University Press.

Mandor, A. K. (2002). Effect of constructivist based instructional model on acquisition of science based skills among Juniors school students. Unpublished M.Ed. Thesis. Department of Science Education, *University of Nigeria, Nsukka*

Minsky, M. (1994). A frame work for presenting knowledge. In P.H. Wilston (Ed.) The psychology of computer vision. New York McGraw-Hill.

Moore, D. K. (1998). *Classroom teaching skills*. New York: McGraw Hill Companies

National Board for Technical Education (NBTE), (2001). *National technical certificate examination (craft level) syllabus for engineering trades based on the NBTE modular curricular*. Kaduna: NBTE

Ogwo, B. A. (2004). Functionality vocational education in Nigeria public schools: examining some policy paradigms. In Uzodimma, C.U. (Ed). *Functionality of Education in Nigeria: Issues, Problems and Concern*. Enugu. The academic Forum for the Inter-disciplinary Discuss (TAFID)

Ogwo, B. A., & Oranu, R. N. (2006*).. Methodology in informal and nonformal technical /vocational education*. Nsukka: University of Nigeria press

Oranu, R. N (2003). Vocational and technical education in Nigeria. Retrieved on July 18, 2005 from *http://www.ibe.co.org/curriculum/Africapdf/lago2ora.pdf*

Rusbult, C. (2005). Thinking skills in education: comparing for frameworks. . Retrieved April 21, 2006 from *http//:www.accd.edu/spc/master/adjunctmini-thinkingskills.pdf*

Schwart, g., Black, S., & Strang, H. (1991). Active learning: Creating excitement in the classroom. Retrieved June 2, 2003 from *http//:www.gwu.edu/-htm*

Solomon, J. (1991). Teaching about the nature of science. British National Curriculum Research in Science Education. 2(75), 95-103.

Song, N. Koszaiks, F., & Grabowski, D. (2005). Science and the structure of knowledge in P.L. Gardner (Ed). *The Structure of Science Education*: Hawthoon: Longman

Stoflet, R. (1994). *The accommodation of science pedagogical knowledge: the application of conceptual change constraints to teacher education*. National Association for Research in Science Teaching. New York. John Wiley and Sons Inc.

Szczurkwaska, S. D. (1997). Training of teachers/trainers in technical and vocational education. Retrieved march 20, 2006 from *http//:www.unevoc.unesco.org/publications/studies/studies-11e*

Tabago, L. C. (2010). The effectiveness of constructivist approach-based experiments in teaching selected physics concepts. Retrieved September 12, 2012 from *http://www.auamii.com/proceedings_Phuket_2012/tabago.pdf*

UNESCO., & ILO, (2002). Technical and vocational education system for the twenty-first century. Retrieved June 20, 2005, from http://www.unesdoc.org/images/0012/001295/129533epdf

APPENDIX A

Instruction: Answer all questions Time: 2 hrs

All necessary tools, equipment and materials are provided.

1. On the vehicle provided, carry out the following specific tasks and report to the examiner at the end of each exercise:
   a. Remove the cylinder head
   b. Check cylinder head , valve seat for damages
   c. Clean cylinder ridges and decarbonizes piston head
   d. Refit cylinder head and adjust valve clearance
2. On the vehicle provided
   a. Check radiator hoses for leakage and report to the examiner
   b. Remove radiator hose and report to the examiner
   c. Refit radiator hose and report to the examiner
   d. Carry out visual inspection of the fan belt to the examiner
   e. Remove fan belt and report to the examiner
   f. Refit and adjust fan belt and report to the examiner

Scoring Guide for Psychomotor Achievement Test (PAT)

S/N	SKILLS/TASKS TO BE RATED IN THE PRACTICAL EXAMINATION	EXCELENT 4	GOOD 3	FAIR 2	POOR 1
1	Interpretation of task	Fully and immediate within 1-5mins	Fully after 5mins	Averagely with/without support	Unable to perform task successfully
2	Selection of tools	All tools	¾ of the tools	1/2of the tools	Less than ½ of the tools
3	Use of tools	Use of all tools for the right jobs	Using 3/4 of the tool for the right jobs	Using ½ of the tools for the right jobs	Using less than ½ of the tools for the right jobs
4	Correct removal of cylinder head	All steps in the correct order	missing 1 step	missing 2 steps	missing more than 2 steps
5	Identification of damages a	Correctly without support	Correctly with support	Average with support	Cannot identify
6	Clearing of carbon deposits	Completely without trace	With light trace	With average trace	With heavy trace
7	Refitting skill	Successfully with clips in place	With 1-2 misses	With more than 2 misses	With more than 3 misses
8	Correct adjustment with feeler gauge to the give clearance	Correct to manufacturer's specification of at least 0.05mm	With mistakes to less or more than 0.05	Gap averagely tight or loose	Gap too wide or tight
Q.2.1	Selection and use of tools	All tools	¾ of the tools	1/2of the tools	Less than ½ of the tools
2	Correct examination of hose for leakage	Correctly with no leakage	With 1 point leakage	With 2 point leakage	With more than 2 point leakage
3	Correct removal of radiator hose	In the correct order	Missing 1 step	Missing 2 steps	Missing more than 2 steps
4	Correct inspection of fan belt	Handling and identification of all faults	Handling missing 1 faults	Handling and missing 2 faults	Handling and missing more than 2 faults
5	Correct removal of fan belt	In the correct order	Missing 1 step	Missing 2 steps	Missing more than 2 steps
6	Correct adjustment of fan belt	Adjust to correct tension	Moderately tightened but move with light force	Move with heavy force	Move freely
7	Refitting skill	In the correct order and tightened	Missing 1 step but tightened appropriately	Missing 2 steps but tightened	Missing more than 2 steps

		appropriately		appropriately	

APPENDIX B

AUTOMECHANICS INTEREST INVENTORY

I**nstitution**……..

Registration Number……

Instruction: Below is a list of statements to ascertain your disposition towards automechanics. Please, check (√) to indicate the degree to which you agree or disagree with the statements.

Note: Strongly Agree (SA); Agree (A); Undecided (UD); Disagree (D); Strongly Disagree (SD)

S/N	Items	SA	A	UD	D	SD
1	I do not like answering questions in classes involving construction of petrol engines					
2	I do not like staying with automobile technicians whenever they are working on engines					
3	If I were an automechanics teacher, I will not like to teach a class involving cars repairs					
4	I do not like to involve myself in construction activities					
5	Whenever I hear the word engine repairs, I have a feeling of dislike					
6	I compete with other students for high scores in automechanics exercises and tests					
7	I do not feel at ease in automechanics classes					
8	Car repairs is a waste of time					
9	I am always late to automechanics classes					
10	I used to be afraid whenever I am called upon to answer questions in a class involving working principles of engines					
11	I like being taught construction work					
12	I like to be involved in design activities					
13	I always think about how machines like car engine is constructed					
14	I like to picture the way engine works in my head					
15	I do not like studying in the automobile workshop					
16	I found construction activities very fascinating					
17	I always encourage others to attend classes involving learning about working principles of automobile					

	engines					
18	I do not like taking part in discussion based on properties of automobile engines					
19	I believe that there is prospects in being an automobile craftsmen					
20	I like to visualize how cars work from different perspectives					