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# **Effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges**

**Ogundola I. Peter<sup>1\*</sup>, A. Popoola Abiodun<sup>1</sup> and O. Oke Jonathan<sup>2</sup>**

<sup>1</sup>Department of Curriculum Studies, Faculty of Education, University of Ado-Ekiti, Ekiti State, Nigeria.

<sup>2</sup>Department of Applied Science, University of Education, Ikere-Ekiti, Ekiti State, Nigeria.

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**The study assessed the effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in Western Nigeria technical colleges. Elements of constructivism assessed include concept mapping, cooperative work skills and cognitive apprenticeship. Pretest, posttest experimental design with a non-equivalent control group was adopted for the study. A total of one hundred and six randomly selected year two students in mechanical related trades were drawn from four technical colleges spread across the south western Nigeria States. Forty six of these numbers were placed in the experimental group while sixty were placed in the control group. The research instruments developed, validated and used for data collection were the constructivism lesson plan, conventional lesson plan and the general metalwork achievement test (GMWAT). The GMWAT which was a 30 item objective questions with four options was administered on all the groups before the commencement of teaching (pretest). This was later administered as posttest on the students after the experiment. Three research questions were raised while two hypotheses tested at 0.05 level of significant were used for the study. Frequency counts, mean and standard deviation were employed to answer the research questions while t-test and analysis of covariance (ANCOVA) were used to test the hypotheses. Preliminary results of findings showed a significant difference between the students taught with constructivism teaching approach and those in the control group. Significant difference does not exist between male and female students exposed to the constructivism approach. Recommendations and suggestions for further studies were advanced.**

**Key words:** Constructivism, technical college, students, mechanical trades.

## **INTRODUCTION**

Technical/Vocational education is the foundation of nation's wealth and development. It is a type of education that is meant to produce semi-skilled, skilled and technical manpower necessary to restore, revitalize, energize, operate and sustain the national economy and substantially reduce unemployment (Federal Government of Nigeria, 2000). It is a form of education involving, in addition to general education, the study of technologies

and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life (FGN, 2004). This specialized education is offered in technical institutions saddled with training of lower and middle level manpower, including technical colleges. Technical Colleges in Nigeria are established to produce craftsmen at the craft (secondary) level and master craftsmen at the advance craft (post secondary) level (Federal Ministry of Education, 2000). The courses offered at the technical colleges leads to the award of National Technical Certificate (NTC) and Advance

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\*Corresponding author. E-mail: peterdolas@yahoo.com.

National Technical Certificate (ANTC). The curriculum programmes of technical colleges according to Federal Government of Nigeria (2004) are grouped into related trades. These includes, the computer trades, electrical/electronics trades, building trades, wood trades, hospitality trade, textile trades, printing trades, beauty culture trades, business trades and mechanical trades.

Mechanical trades is a general name used in describing trades that have direct bearing with metal welding/forming and or servicing/repairs of machines or machine related equipment and appliances. The trades in this group include agricultural implement and equipment mechanics work, auto body repair and spray painting, auto electrical work, auto body mechanics works, auto mechanics works, auto body building, auto parts-merchandising, air-conditioning and refrigeration mechanics works, mechanical engineering craft practice, welding and fabrication engineering craft practice, foundry craft practice, instruments mechanics work and marine engineering craft. Based on the high rate of industrialization in Nigeria, the aspiration of the mechanical related trade students in technical college are very high. They have very high hope of being employed by the industries, at the same time, advancing in their academic pursuit.

## STATEMENT OF THE PROBLEM

Technical college graduates upon graduation are supposed to have three options. These options according to the National Policy on Education (FGN, 2004) is to either secure employment in the industries, pursue further education in advance craft in a higher technical institutions or set up their own business and become self-employed. Unfortunately, despite all effort by the government to ensure qualitative education at the technical colleges and bring about high quality products both in academic and employability, there have been persistent reports of high failure rate among graduates of the colleges (FGN, 2001; NABTEB, 2006). One probable cause of the high failure of students in recent years according to NABTEB (2002) chief examiners' report is partly due to teaching methods employed by instructors to teach the students. In most technical colleges, Oranu (2003) observed that the teaching methods used in teaching are mostly lecture and the demonstration methods. According to Sofolahan (1991) the continue use of these traditional teaching method to teach in our schools reduces the ability of students to grasp relevant concepts than when exposed to lessons involving hand on experience. The methods are based on the learning theory of behaviorism. They thus encourage students to be passive, direction followers and product oriented. On this same vain, the Federal Ministry of Education (1993) in her reports on technical colleges revealed that student in technical colleges are always put-off or not been interested in vocational education because of the non

motivating and unchallenging methods and approach used by their teachers. As technology is changing, the mechanical related trade students must change with it so that their level of thinking on diagnoses, repairs and maintenance should be commensurate with maintenance need of today's industrial need, in other words, only teaching methods that equip students with the higher order thinking skills for easy adaptability and flexibility. Such as the constructivism instructional teaching approach is one viable option in the present globalize economy.

## RESEARCH QUESTIONS

As a result of the problem stated above the following research questions were formulated to guide the study:

- (1) What are the mean score and standard deviation of experimental and control groups on concept mapping in the general metal work practical skill test?
- (2) What are the mean score and standard deviation of experimental and control groups on cooperative work skills items in the general metal work achievement test?
- (3) What are the mean score and standard deviation of experimental and control groups on cognitive apprenticeship items in the general metal work achievement test?

## HYPOTHESES

The following null hypotheses which were tested at 05 level of significance, guided the study.

HO<sub>1</sub>: There is no significant difference between the mean scores of students taught with the constructivist methods and those taught with the conventional methods in the general metal work achievement test

HO<sub>2</sub>: There is no significant difference between the mean scores of male and female students exposed to the constructivist instructional approach.

## LITERATURE REVIEW

Constructivism is first of all a theory of learning based on the idea that knowledge is constructed by the knower based on mental activity. Learners are considered to be active organisms seeking meaning. Constructivism is founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world consciously we live in. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences. Constructions of meaning may initially bear little relationship to reality (as in the naïve theories of children), but will become increasing more

complex, differentiated and realistic as time goes on.

Constructivist learning theory says that all knowledge is constructed from a base of prior knowledge. Children are not a blank slate and knowledge cannot be imparted without the child making sense of it according to his or her current conceptions. Therefore, children learn best when they are allowed to construct a personal understanding based on experiencing things and reflecting on those experiences. Dougiamas (1998) describes the major "faces of constructivism" to include trivial, radical, social, cultural and critical constructivism. The trivial constructivism which is the simplest idea in constructivism is the root of all the other shades of constructivism. In this principle, knowledge is actively constructed by the learner, not passively received from the environment.

Radical constructivism adds a second principle to trivial constructivism. According to Glasersfeld (1990), coming to know is a process of dynamic adaptation towards viable interpretations of experience. The knower does not necessarily construct knowledge of a "real" world.

Social constructivism or Socio Constructivism assumes that the social world of learner includes the people that directly affect that person, including teachers, friends, students, administrators and participants in all forms of activity. This takes into account the social nature of both the local processes in collaborative learning and in the discussion of wider social collaboration in a given subject, such as science.

The cultural constructivism transcends beyond the immediate social environment of a learning situation. It refers to the wider context of cultural influences, including custom, religion, biology, tools and language. For example, the format of books can affect learning, by promoting views about the organization, accessibility and status of the information they contain.

Critical constructivism is a type of constructivism that looks at constructivism within a social and cultural environment, but adds a critical dimension aimed at reforming these environments in order to improve the success of constructivism applied as a referent. The guiding principles of constructivism are that (1) knowledge is constructed, not transmitted. (2) Prior knowledge impacts the learning process. (3) Initial understanding is local, not global. And (4) Building useful knowledge structures require effortful and purposeful activity. One of the primary goals of using constructivist teaching is that students learn how to learn by giving them the training to take initiative for their own learning experiences. According to Audrey Gray, the characteristics of a constructivist classroom are that the learners are actively involved, the environment is democratic and the activities are interactive and student-centered and that the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous.

Further more, in the constructivist classroom, students work primarily in groups and that learning and knowledge

are interactive and dynamic. There is a great focus and emphasis on social and communication skills, as well as collaboration and exchange of ideas. This is contrary to the traditional classroom in which students work primarily alone, where learning is achieved through repetition and where subjects are strictly adhered to and guided by textbooks.

The teacher's role in a constructivism classroom is to prompt and facilitate discussion. Thus, the teacher's main focus should be on guiding students by asking questions that will lead them to develop their own conclusions on the subject. David Janssen identified three major roles for facilitators to support students in constructivist learning environments to include modeling, coaching, and scaffolding. For the potentials of constructivism instructional teaching technique to be fully annexed, important key elements or tools of the teaching method that enhances effective teaching/learning process need be adapted in a constructivism classroom. Three of such important elements include concept mapping, cooperative works skills and cognitive apprenticeship.

A concept map according to Olaitan et al. (1999) is an approach to represent sets of words graphically in an attempt to systematically deduce all aspects of the characteristics of those set of words. Nwanchukwu (2001) explains that the concept map instructional approach differs from traditional teaching methodology in that, it is far less teacher-centered; instead the student is helped to direct his/her own learning. Nwanchukwu sees a concept as a thinking tool, highlighting the abstract intellectual representation of an object. To ensure that learners understand the meaning of the word concept in the classroom situation, he proposes that the teacher should carry learners thinking along with his through making a drawing of a familiar object on the board, describing the object briefly to the learners including telling them the characteristics of the object, telling the students to close their eyes for a short time and think of what has been said and what they could imagine about the object and then make them understand that those mental images represent their individual concepts of the object, thus clarifying to them the full meaning of a concept. Concept map represents the relationships among a set of connected concepts and ideas. It is a tangible way to display how your mind "sees" a particular topic. Kreger (nd) maintained that, construction of concept maps helps us pull together information we already know about a subject and understand new information as we learn. Cooperative work skills also known as collaborative learning/work skill, are a mode of teaching with a set of common attributes and features (Conway, 1997). It is cognitive in nature. It also has several variations. The following are its essential features: Students work in teams to master academic materials, teams are made up of high, average and low achievers and are racially and sexually mixed and reward systems are group-oriented rather than individually oriented.

Perkins (1991) finds that collaborative learning demonstrates the notion of distributive intelligence, which states that accomplishment is not a function of one person, but rather a group in which each contributes to the achievement of desired goals. Cooperative learning is an ideal way for students to learn the skills that extend beyond the classroom of sharing responsibility and working together toward common goals. According to Karagiorgi and Symeou (2005) collaborative learning does not just entail sharing a workload or coming to a consensus, but allows learners to develop, compare and understand multiple perspectives on an issue. Driscoll (2000) argues that collaboration also provides students with a way to understand point of view outside their own. When students collaborate, they articulate their goals and plans which encourage a kind of reflection which can lead to learning. When other students read the goals and plans a cycle of critiquing, revision and review is set up which can lead to improved understanding.

Cognitive apprenticeship is an instructional strategy that provides authentic 'indexed' and 'situated' or 'anchoring' experiences for extended exploration (Karagiorgi and Symeou, 2005). Cognitive apprenticeship can be used in a classroom as an instructional design or learning technique, in which students learn through help and guidance of a teacher or expert. In cognitive apprenticeship, one needs to deliberately bring the thinking to the surface, to make it visible, whether it's in reading, writing, problem solving (Collins et al., 1991). The teacher's thinking must be made visible to the students and the student's thinking must be made visible to the teacher. Constructivism represents one of the great ideas in education. Its implications on how teachers teach and how learners learn are enormous. If the efforts in reforming education are to succeed, then a focus on student-centered learning may well be the most important contribution of constructivism.

The main purpose of this study is to assess the effect of the constructivism instructional approach on teaching practical skills in general metal work to mechanical related trade students in South western Nigeria technical colleges.

## **METHODOLOGY**

### **Research design**

The design adopted for the study was the quasi-experimental pre-test, post-test experimental non equivalent control group. The two groups (made up of four technical colleges) experimental and control groups were randomly assigned to the methods of teaching. Intact classes were also randomly assigned to different treatment conditions.

### **Research instrument**

The instruments used for the study were the constructivism lesson plans, conventional lesson plans, consumables and equipment for the practical exercise and thirty objective questions for the pre test

post test tagged general metal work achievement test (GMWAT)

### **The population**

The population of the study consisted of all year two students in all the thirty four technical colleges in six of the south western states in Nigeria. The states are; Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states.

### **Samples and sampling techniques**

A multi stage random sampling technique was used for the study; this involves randomly selecting four technical colleges from the list of thirty four government owned technical colleges in the south west Nigeria. A total of one hundred and six year two mechanical related trade technical college students constituted the subjects for the study. Two of the technical colleges were assigned to experimental group and the other two were assigned to the control group. The assignment of schools to the groups is presented in Table 1.

### **Validation of research instruments**

The constructivist lesson plans, the conventional lesson plans and the general metal work achievement test were face and content validated by three test and measurement experts in the Department of Curriculum Studies, University of Ado Ekiti, Nigeria. This is done by the experts to confirm the suitability of the items with the table of specification and also to juxtapose each GMWAT items against constructivist instructional approach it sought to evaluate.

The validators focused on adequacy of content, logical sequence and suitability of the technical term used. Their comments and suggestions were used to restructure the final instrument.

### **Reliability of the instruments**

To ensure high reliability of the GMWAT, it was trial tested by administering it on 20 randomly selected mechanical related trade students in Government Technical College, OWO, Ondo State (an area different from the sample area of the study). The test - retest reliability technique was adopted. The Pearson product moment correlation coefficient of the GMWAT was 0.70. This was considered suitable enough for the study.

### **Data collection and analyses**

The research involved two main stages, which were the administration of pre-test and post-test that contained the same questions arranged in different order. The study was conducted for a period of six weeks during which two topics; vis screw/thread cutting and production of simple engineering components on the bench were covered. The pre-test was administered in the first week of the research exercise to the whole students before both the experiment and control groups were subjected to the treatments. All the practical sessions were held in the college metal work workshop, with the materials provided by the school. After the administration of the pre-test, students in the experimental group were thought using the constructivism instructional approach.

The second group comprised of students in the control group. They were thought with the use of the traditional teaching method. Both groups were taught by their regular teachers.

Prior to the teaching exercise, the experimental group teachers have been trained on the use of the constructivism teaching

**Table 1.** Subject group distribution according to name of school, type, trade and number of student.

S/N	Name of school	Group	Type of group	No. of student/trade
1	Government Technical College, Ado Ekiti, Ekiti State	A	Experimental	21 (Motor vehicle mechanics)
2	Government Technical College, Ijebu Ode, Ogun State.	B	Control	30 (Mechanical eng. craft practice)
3	Government Technical College, Ibadan, Oyo State	C	Experimental	25 (Air conditioning and refrigeration mechanics works)
4	Government Technical College, Epe, Lagos State.	D	Control	30 (welding and fabrication eng. craft practice)
TOTAL				106

approach. The teaching process lasted for 4 weeks and a post-test was administered to all the students. The data collected were analyzed using t-test analysis to test the significance difference between male and female students exposed to the experimental method and analysis of covariance (ANCOVA) was used to test for significant difference between the teaching methods at 0.05 level of significance.

## RESULTS

The results of data analysed in this study are as follows:

### Research question 1

What are the mean score and standard deviation of experimental and control groups on concept mapping in the service station mechanic work and vehicle system maintenance practical skill test?

The data presented in Table 2 indicated that the experimental group had a mean of 24.50 and a standard deviation of 2.75 in the pre-test and a mean score of 28.59 and standard deviation of 1.26 in the post-test making a pre-test post-test gain in experimental group to be 4.09. The control group had a mean score of 7.20 and a standard deviation of 5.27 in the pre-test and a mean of 9.37 and a standard deviation of 6.36 with the post-test with a pre-test with a pre-test post-test gain of 2.17. This implies that the experimental group performs in achievement test better than the control group.

### Research question 2

What are the mean score and standard deviation of experimental and control groups on cooperative work skills items in the general metal work achievement test?

The data presented in Table 3 indicated that the experimental group had a mean of 13.40 and a standard deviation of 6.17 in the pretest and a mean score of 28.59 and standard deviation of 1.45 in the post-test making a pretest post-test gain in experimental group to be 15.19. The control group had a mean of 6.63 and a standard deviation of 4.89 in the pretest and a mean of 8.53 and

standard deviation of 6.10 in the post-test making pretest gain of 1.9. This implies that the experimental group performed in achievement test better than the control group.

### Research question 3

What are the mean score and standard deviation of experimental and control groups on cognitive apprenticeship in auto-electricity practical skills test? The data on Table 4 shows that the experimental group had a mean score of 12.30 and a standard deviation of 5.97 in the pre-test and a mean score of 28.43 and standard deviation of 1.44 in the post-test with a pretest post-test gain of 16.13. The data in the same Table 4 also shows that the control group had a mean score of 6.67 and a standard deviation of 4.85 in the pretest and a mean score of 8.52 and standard deviation of 4.82 in the post-test with a pretest post-test gain of 1.85. This implies that the experimental group performed better than the control group.

### Hypothesis 1

There is no significant difference between the mean scores of students taught with the constructivist methods and those taught with the conventional methods in the general metal work achievement test.

The data presented in Table 5 shows that since the F-cal (406.80) computed is greater than the critical value of F (3.92) at 0.05 level significance, null hypothesis is rejected. It therefore means that there is significant difference between the mean scores of students taught with the constructivist method and those taught with the conventional methods in the achievement test.

The analysis of covariance reveals that there is significant difference between the mean scores of the experimental and control groups in the achievement test in favour of the experimental group. This further implies that the different method of teaching practical skills to automobile technology students does give a significant difference.

**Table 2.** Mean and Standard deviation of pre-test and post-test scores of experimental and control group in the general metal work achievement test (GMWAT).

Group	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental	46	24.50	2.75	28.59	1.26
Control	60	7.20	5.27	9.37	6.36

**Table 3.** Mean and standard deviation of pretest and post-test scores of experimental and control group in AMAT.

Group	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental	46	13.40	6.17	28.59	1.45
Control	60	6.63	4.89	8.53	6.10

**Table 4.** Mean and standard deviation of pretest and post-test scores of experimental and control group in auto-mechanics achievement test.

Group	N	Pre-test		Post-test	
		$\bar{x}$	SD	$\bar{x}$	SD
Experimental	46	12.30	5.97	28.43	1.44
Control	60	6.67	4.85	8.52	4.82

**Table 5.** Analysis of covariance of the scores of experimental and control group in the GMWAT.

Sources of variation	df	Sum of squares	Mean square	F-Cal	F-Crit
Between groups	1	9618.85	9618.85	406.80	3.92
Within groups	104	2459.09	23.65		
Total	105	12077.94			

**Table 6.** t-test analysis of mean score of male and female students exposed to experimental condition.

Influencing factors	n	X	SD	df	Std. error	t-cal	t-table	Decision
Male	37	50.35	4.38	44	0.819	1.38	1.67	*NS
Female	09	49.22	4.96					

P = 0.05, t cal < t critical, \*NS = not significant.

## Hypothesis 2

There is no significant difference between the mean scores of male and female students exposed to the constructivist instructional approach.

Table 6 reveals that there is no significant difference between the mean scores of male and female students exposed to the constructivism instructional approach as revealed by their performances in the post test achievement test. Thus t cal (1.38) < t critical (1.67).

## Findings

On the basis of the data collected and analysed for this study, the following findings were made.

(1) Students taught with constructivism instructional approach scored higher in the post-test than those taught with conventional method. This signifies that the components of constructivism instructional approach such as concept mapping, cooperative work skills and cognitive apprenticeship lead to higher academic achievement in general metal work than the conventional method.

(2) There was no significant difference in the mean scores of male and female students taught with the constructivism instructional approach. This implies that constructivism instructional approach is not gender sensitive.

## DISCUSSION OF FINDINGS

The analyses and results of this study showed that the experimental group had higher mean scores than the control group in the post-test. This finding indicates that the constructivism instructional approach has a positive effect on students' academic achievement in general metal work. This implies that the key components found in constructivism instructional approach when used collectively are more effective than the conventional teaching method in enhancing student academic achievement.

This finding is in line with the works of Mayer (1992); Hendry (1996) in Karagiorgi and Symeou (2005), who in their separate studies found that the adoption of constructivism instructional approach and its components greatly organises the individuals experiential world. This finding has actually given meaning to the feeling expressed about knowledge by Von Glasersfeld (1995) that no matter how it is defined, it is in the heads of persons and that the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience. The key components found in constructivism instructional approach when used collectively are more effective than conventional teaching method in enhancing student academic achievement in general metal work. This means that constructivism instructional approach is more effective than the conventional method when it comes to developing students in handling complex tasks such as the principle of screw and thread cutting, production of simple engineering components etc. This finding is also in line with the work of Copley (1992) in Tam (2000) in which it was discovered that constructivism instructional approach greatly improves students academic achievement and helps them become active participants in their learning and make meaningful connections between prior

knowledge, new knowledge and the processes involved in learning. According to Ogwo (2005), the use of constructive principles will equip students better for the unknown. Another important revelation of the study is the fact that teaching strategy is not sex bias. This is in line with the study of Abaegbu (1999) whose research indicated that there is no significant difference in academic achievement of male and female students. It also corroborated the studies of Ochogor (1993) and Eze (1999) when in their separate studies concluded that boys and girls when taught together under the same conditions show comparatively equal performance level. All the activities and innovations in constructivism instructional approach were geared towards the teaching of practical skills in order that the performance of the technical college graduates will correspondingly meet the demands of the 21st century labour market. Having found that the constructivism instructional approach has positive effect on students performances. Teachers need to adopt this approach by incorporating the components of constructivism in order to make teaching and learning process effective. Teachers should also ensure that learning experiences incorporate problems that are important to students, not those that are primarily important to teachers and educational system.

Students learn and master skills better when they are allowed to participate actively in the class by interacting freely with teacher and their peers, work in groups and perform practical projects.

## RECOMMENDATIONS

In view of the results of these findings and conclusions reached in the study, the following recommendations are hereby offered.

- (1) Metal work teachers should always adopt the components of constructivism. This will enable them to cater for diverse learning styles of students in their classrooms and hence, improve their academic achievement and development of practical skills.
- (2) Students should always be allowed to participate actively in class by interacting freely with the teacher and their colleagues as this will improve their academic ability and performance in their trade subject.
- (3) Government should be implored to give enough grants to equip technical college workshops. Constructivism teaching cannot be effectively carried out in ill equipped workshops.
- (4) Mechanical trade related teachers in technical colleges should be given on-the-job training opportunities such as short-term courses, seminars and workshop to enable the teachers to update their knowledge; this will help them to constantly keep abreast with the ever-changing scientific knowledge and various modern methods of teaching trade subjects.

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