



## Effects of challenge-based and activity-based learning approaches on technical college students' achievement, interest and retention in woodwork technology



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### ABSTRACT

*This study examines the effects of challenge-based and activity-based learning approaches on technical college students' achievement, interest and retention in woodwork technology. A quasi-experimental research design was adopted. The study constituted a total number of 122 subjects, 63 for Challenge-based learning, while 59 were for activity-based learning. The study revealed that students taught woodwork using the challenge-based learning instructional approach had a higher mean score than students taught using the activity-based learning teaching method in cognitive achievement tests, psychomotor achievement tests and tests for retention of learning. Consequently, the research recommended that the National Board for Technical Education (NBTE) should consider a review of Woodwork work curriculum for Technical Colleges with a view to incorporating the challenge-based learning instructional approach into the teaching of woodwork.*

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## Introduction

Woodwork technology is one of the vocational subjects studied in technical colleges in Nigeria. The goal of Woodwork technology in technical colleges according to National Board for Technical Education (NBTE, 2007) is to produce skilled craftsmen for self or paid employment in the world of work. The skill areas for employment in woodwork include: machine Operations, Furniture Making, Upholstery Design and Construction, Carpentry and Joinery. All these areas of woodwork technology are changing rapidly and as such it demands that practitioners should have flexible skills that can easily adapt to changes.

The rapid changes in technology have necessitated the need to equip technical college students with workplace basic and thinking skills which will make them flexible and adaptable to the present and envisaged future changes (Olelewe et al., 2021; Zhang et al., 2020). Technology, the world over is dynamic and work organizations are getting increasingly flexible, process-based and multi-tasking. This apparently is to suit demands of the prevalent knowledge society and ample use of innovations and inventions in work places and changes in the organization of work (Ogwo and Oranu, 2006). In this context, there is need for educational institutions to adjust their curriculum to accommodate changes in work places so as to produce students with work place basic skills required to thrive in the 21<sup>st</sup> century knowledge-based economy and society (Boyle, Duffy & Dunleavy, 2011). The changes in the curriculum of Woodwork technology are also necessary to accommodate changes in the sector.

Employers in woodwork industries engage the services of employees with workplace skills who are able to flexibly acquire, adapt, apply and transfer their knowledge to different contexts and under varying technological conditions. The challenge of preparing

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technical college students for the 21<sup>st</sup> century woodwork workplace therefore necessitates a shift in the instructional delivery system used in the teaching of Woodwork technology in technical colleges. The traditional instructional methods especially lecture and demonstration teaching methods though used for so many years in the teaching of Woodwork technology seem today inadequate for equipping students with skills such as creative skills, higher order thinking skills and problem-solving skills needed by the students to thrive as craftsmen in the 21<sup>st</sup> century Woodwork workplace. This is because the teaching methods are executed by teacher centred activities; hence most students are not always given enough opportunity to participate actively in the teaching/learning process (Orji, 2015; Orji & Ogbuanya, 2018). These teaching/learning methods emphasize knowledge transmission from the teacher to passive students and encourage rote memorization of facts (Boyle, Duffy & Dunleavy, 2011). The consequence of the use of these methods in teaching vocational subject such as woodwork technology in the technical colleges is that students are unable to acquire workplace skills as well as retain their learning and apply it in new situations. Moreover, Ukoha and Eneogwe (1996) maintained that lecture and demonstration methods are inappropriate for teaching and encouraging students to think for themselves in practical related subjects including woodwork technology. This could therefore, be partly responsible for the low achievement of technical college students' in woodwork technology examinations and at the workplace when eventually employed after graduation.

This study examines the effects of challenge-based and activity-based learning approaches on technical college students' achievement, interest and retention in woodwork technology. A quasi-experimental research design was adopted. The study constituted a total number of 122 subjects, 63 for Challenge-based learning, while 59 were for activity-based learning. Eight research questions and twelve null hypotheses, tested at 0.05 level of significance, guided the study. The instruments used for data collection were Woodwork Cognitive Achievement Test (WCAT), Woodwork Psychomotor Achievement Test (WPAT) and Woodwork Interest Inventory (WII) items. The instruments were face validation by five experts. The trial test for determining the coefficient of stability of the WCAT was carried out using the test re-test reliability method. Pearson product-moment correlation coefficient of WCAT was found to be .78. In addition, Kuder Richardson 21 (K-R 21) was used to test the internal consistency of the WCAT.

## Literature Review

### Empirical Review and Hypothesis Development

The achievement of Woodwork technology students in National Business and Technical Examinations Board (NABTEB) especially that of 2011/2012, 2012/2013, 2013/2014 has not been encouraging. In the year 2011/2012, out of 634 students that sat for NABTEB (woodwork) in all the technical colleges in Niger State, only 213 students made a good pass of A1 – C6 grade (33.60%), while 421 students representing 66.40% had grades ranging from P7 – F9. Also in the year 2012/2013, out of the 806 students that sat for the same NABTEB (woodwork) examination, only 234 students made A1 – C6 grade (29.03%) while 572 students representing (70.97%) had P7 – F9 grades. Again, out of the 803 students that sat for NABTEB (woodwork), 599 (74.60%) of overall students had poor results with only 204 (25.40%) students making A1 – C6 grades in the academic year 2013/2014 (Niger State Science and Technical School Board NSSTSB, 2014). These can be seen in the distribution of students' academic achievement by years of study in the colleges within the area under study.

This continuous poor academic achievement most often reduces students' interest and can lead to poor knowledge retention in woodwork technology as well as other adverse effects on the entire programme objectives of woodwork technology. Students sometimes hate a subject which records high rate of failure in examination and retention of knowledge is seriously dependent on achievement and interest. Considering this poor achievement of students in woodwork technology subject, one is bound to be worried. Teaching and learning in Woodwork technology however, might be enhanced by the adoption of teaching/learning approaches rooted in problem-based learning approach.

Problem based learning (PBL) is one of the constructivists learning strategy which posits significant contextualized real-world situation, providing resources, guidance and instruction to learning as the students develop content knowledge and problem-solving skills. PBL is a student-centered, self-directed integrated and contextual mode of learning (Orji & Ogbuanya, 2018, 2020). Problem based learning requires learners to actively explore information resources other than the teacher, including primary documents, reference materials and community members, and to draw on knowledge from diverse subject areas. Hence, Ogbuanya (2008) recommended that students should take responsibility for their own learning and the teachers should be looked at more as mentors and less as presenters of information. Therefore, instructional methods rooted in PBL could be a sure way of teaching both theory and practical in woodwork. It helps the students to learn how to learn and reduces the teacher's instruction, since the learners are actively involved.

Prominent among teaching and learning approaches that are rooted on problem-based learning are challenge-based and activity-based learning approaches. Challenge-based learning (CBL) is an engaging multidisciplinary approach to teaching and learning that encourages students to leverage the technology they use in their daily lives to solve real-world problems (Johnson and Adams, 2011). The authors maintained that challenge based learning begins with a big idea and cascades to the following: the essential question; the challenge; guiding questions, activities, and resources; determining and articulating the solution; taking action by implementing the solution. Further, Abubakar (2013) stressed that Challenge – Based learning builds on the practice of problem-based learning, in which students work on real-world problems in collaborative teams, but with key distinctions that add a great deal of relevancy for students. At the center of Challenge – Based learning is a call to action that inherently requires students to make

something happen. They are compelled to research on their topic, brainstorm strategies and solutions that are both credible and realistic in light of time and resources, and then develop and execute one of those solutions that address the challenge in ways both they themselves and others can see and measure.

Although teacher involvement throughout challenge-based learning process is crucial, its nature changes as students' progress through its stages. Early on when the teacher introduces Challenge – Based learning to students and set up the challenge, the teacher is making decisions, communicating information, teaching skills, and answering questions about how the process works and what is expected of students. In the middle stages, students take charge of planning and researching their own work and the teacher serves primarily as a project manager and mentor working alongside the students, helping them through the rough spots and keeping them on track. In the later stages, students are deeply engaged in their own work while the teacher ensures that they have mastered the required knowledge and skills through appropriate assessments. Finally, the teacher will transit into the role of product manager supporting the students as they implement, evaluate, and publish their solutions and results. Challenge based teaching/learning approach like Activity – Based teaching/learning is geared towards improving students' achievement in the 21<sup>st</sup> century classrooms. Though, this is yet to be verified in wood work technology.

The idea of Activity – Based learning follows the constructivist educational theory and is learner-centered pedagogy. Activity – Based learning may be defined as a method of instruction, where activities of different types, suitable and relevant to specific subjects are integrated seamlessly into the regular instructional materials and methods to involve students in the teaching – learning or instructional processes and engage them fruitfully (Auta, 2012). An Activity – Based learning approach requires students to become active participants instead of passive learners. According to Haury and Rilero (2004) an Activity – Based learning approach involves three components: (i) hands-on; students are actually allowed to physically perform tasks as they construct meaning and acquire understanding;(ii) minds-on; the activities focus on the core concepts, allowing students to develop thinking processes and encouraging them to question and seek answers that enhance their knowledge, and thereby acquire an understanding of the real world; and (iii) authentic; students are presented with problem-solving that incorporates real-life questions and issues in the format that encourages collaborative effort, dialogue with teachers or experts and generalization to broader ideas and application. In Activity – Based-teaching, students not only interact with materials or make observations but, involved in developing thinking processes and construction of meaning in order to acquire understanding. The assumption is that direct experiences with natural phenomena will provide curiosity and thinking (Lumpe & Oliver, 2011).

In Activity – Based-teaching approach, the textbook is replaced by cards. These cards are prepared from units in textbooks. There are cards for introducing the topic, learning it, reinforcing it and testing it. These cards include activities, both individual and group (Shuptrine, 2013). The cards are arranged in card boxes in order of steps on a ladder. Each step and each activity within it are represented by icons. A ladder for the subject is displayed on a chart in every classroom. Students are expected to know which card they are on and get the appropriate cards from the card boxes, which are systematically arranged with the relevant icon labels, in the classroom. Students work either individually or in groups. Sometimes, students in higher levels help students at lower levels. The teacher-student ratio is reduced to 1:1 where the teacher attends to only one child at a time. Activity – Based and Challenge – Based learning approach earlier discussed seems capable of improving students' academic achievement and retention of learning in woodwork technology since both are learner centered. However, it is not yet known which of these teaching methods will be better in improving students' achievement in wood work technology.

Academic achievement has been described as a view on how well an individual has done his cognitive tasks. It may also be regarded as the general ability of students concerning their offered subjects compared to a specified standard called Pass Marks' (Abubakar, 2013). Abubakar, (2013), maintained that pass mark is relative and can be arbitrarily defined as 40% or 50%. This may also be referred to as the criterion of excellence (Aremu & Adika, 2000). The term as well means the attainment of success of a student in his school work among his classmates. Achievement in Woodwork technology connotes performance in the school subject as symbolized by a score or mark on Woodwork achievement test. Students' achievement in vocational and technical education according to Beesley (2012) is defined as the learning outcomes of student which include the knowledge, skills and ideas acquired and retained through his course of studies within and outside the classroom situation.

Psychomotor achievement simply relates to students' achievement in practical tasks. Therefore, in this study, psychomotor achievement refers to achievement of students in Woodwork technology practical task which is usually represented by a score or mark obtained in a performance test. Okoro (2009) explained that performance test involves the use of tools and equipment in a direct assessment of the amount of practical skills possessed by the student. However, it is also observed that students' cognitive and psychomotor achievement may also be influenced by gender of the student.

Gender refers to the characteristics, whether biological or socially influenced, by which people define male and female (Myers, 2002). Gender may also be explained as the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for men and women. Disparities according to Okoro (2009) usually exist in the levels of performance between males and females. This study will therefore, ascertain if students' achievement, retention of learning and interest in studying Woodwork technology will reflect students' gender after being exposed to challenge-based learning teaching approach and Activity-Based learning teaching approach. Students' achievement and retention of learning is most often dependent upon several factors among which are learning environment and instructional method. Instructional method rooted in challenge-based learning teaching

approach or Activity – Based learning teaching approach seem to provide a learning environment that gives students deeper engagement in the learning process which may influence students' retention of learning in Woodwork technology.

Retention of learning is the repeat performance by a learner of the behaviour earlier acquired, elicited after an interval of time (Uba, 2014). It is affected by the degree of original learning, the method of learning and the learner's memory capacity among other factors (Demmert, 2014). Retention simply refers to how much a person remembers after an interval of time without practice and that it is the difference between what is initially learnt and what is later forgotten. Retention of learning can equally refer to learning which lasts beyond the initial testing and it is assessed with test administered two or more weeks after the information has been taught and tested. Haynie (2012) explained that retention of learning is measured with two tests: the initial test and the delayed retention test. The initial test is the test employed at the time of instruction or immediately thereafter while the delayed retention tests are those administered two or more weeks after instruction and initial testing to measure retained knowledge. Retention is the preservative factor of the mind (Kundu and Tootoo, 2007). Whatever touches consciousness leaves trace or impression and is retained in the mind in form of images. Boyle, Duffy and Dunleavy (2003) posited that students' retention in learning is determined by factors such as teachers' ability, motivation, meaningfulness of subject matter, methods of instruction, memory capacity of the learner and the learner's interest in learning.

Interest is an important factor in learning, it is viewed as the feeling that an individual has when he or she wants to know or learn more about something such as Woodwork technology. Obodo (2004) contended that interest is the attraction, which forces or compels a child to respond to a particular stimulus. In other words, a child develops interest if a particular stimulus (e.g. teaching method or school subject) is attractive and arousing or stimulating. This means that the child is bound to pay attention as a lesson goes on if he is interested in that particular lesson. Bayraktar (2014) maintained that interest comes as a result of eagerness or curiosity to learn not by force. Interest is an important variable in learning because if a student has positive interest towards a particular subject, he or she not only enjoys studying the subject but would also derive satisfaction from the knowledge of the subject. Interest is perceived in relation to internal state of mind or reactions to external environment or predisposition to experience. Interest may also be viewed as the readiness to react towards or against a situation, person or things in a particular manner, e.g. with love or hate fear or resentment to a particular degree or intensity. That is to say that, interest is that internal state that influences the individual's personal actions. This definition assumes that students' interest in woodwork technology implies the reactions, impressions and feelings the student has in Woodwork technology and its related tasks.

The abilities of a woodwork craftsman in the area of construction and repair of woodwork products may therefore be enhanced through teaching and learning approaches such as Challenge – Based or Activity – Based learning approach. Hence, this study will attempt to find out which of these teaching/learning approaches will be more effective in improving students' achievement, retention and interest in wood work technology.

### ***Hypotheses***

The following null hypotheses guided the study and were tested at 0.05 level of significance:

**HO<sub>1</sub>:** There is no significant difference between the mean effect of Challenge – Based and Activity – Based learning approach on students' academic achievement in Woodwork technology.

**HO<sub>2</sub>:** There is no significant difference between the mean effect of gender on Woodwork technology cognitive achievement of students (male and female) when taught using Challenge – Based and Activity – Based learning approach.

**HO<sub>3</sub>:** There is no significant interaction effect of treatment given to students taught using Challenge – Based and Activity – Based learning approach on gender (male and female) with respect to their mean scores in Woodwork technology cognitive achievement test.

**HO<sub>4</sub>:** There is no significant difference in the mean retention scores of students taught woodwork technology using Challenge – Based and Activity – Based learning approach.

**HO<sub>5</sub>:** There is no significant difference in the mean retention scores of male and female woodwork students on Woodwork technology cognitive achievement test when exposed to Challenge – Based and Activity – Based learning approach.

**HO<sub>6</sub>:** There is no significant interaction effect of treatment given to students and their gender with respect to their retention scores in Woodwork technology.

**HO<sub>7</sub>:** There is no significant difference between the mean effect of Challenge – Based and Activity – Based learning approach on students' psychomotor achievement in Woodwork technology.

**HO<sub>8</sub>:** There is no significant difference between the mean effect of gender on Woodwork technology psychomotor achievement of students (male and female) when taught using Challenge – Based and Activity – Based learning approach.

**HO<sub>9</sub>:** There is no significant interaction effect of treatment and gender on students psychomotor achievement taught using Challenge – Based and Activity – Based learning approach in woodwork technology.

**HO<sub>10</sub>:** There is no significant difference between the mean effect of Challenge – Based and Activity – Based learning approach on students' interest in studying woodwork technology.

**HO<sub>11</sub>:** There is no significant difference between the mean effect of gender (male and female) on students' interest in woodwork technology.

**HO<sub>12</sub>:** There is no significant interaction mean effect of treatments given to students taught using Challenge – Based and Activity – Based learning approach and their gender (male and female) with respect to their mean scores in woodwork technology inventory.

## **Research and Methodology**

### **Design of the Study**

The research study adopted quasi – experimental research design in which precisely, the pre-test posttest non- equivalent control group design was used. The design is adopted because it is not possible to randomize the subjects of the study without disrupting the school setting, class arrangement, routine time table and school programmes (Bakare & Orji, 2019).

### **Area of the Study**

The study was conducted in Niger state because the state is one of the states where students' poor performance in woodwork was reported by National Board for Technical Education (NBTE) 2011- 2014. Niger State was created out of the defunct North Western State in 1976. Niger State shares its borders with the Republic of Benin (West), Zamfara State (North), Kebbi State (North-West), Kogi (South), Kwara (South-West), Kaduna (North-East) and the Federal Capital Territory. The State comprises 25 local government areas grouped into seven education zones namely; Minna, Suleja, Bida, Kutigi, New Bussa, Rijau and Kontagora. The State is the largest State in Nigeria in terms of land mass. It covers about 86,000 sq km<sup>2</sup> (8.6million hectares) representing about 9.3% of the land area of the Country (Source; Niger State Development Action Plan (DAP 2012).

Niger State has seven NBTE accredited Technical Colleges but only four are offering Woodwork technology. The Technical Colleges include: Government Technical College Kontagora; Government Technical College, New Bussa; Suleman Barau Technical College Suleja, Government Technical College Pandogari, Government Technical College Eyagi-Bida, Government Technical College Minna and Federal Science and Technical College Shiroro–Kuta. Niger State has a wide spread distribution of industries such as Woodwork industries which need the services of well – trained craftsmen produced in technical colleges and the schools that were used for the study are: Government Technical College, Minna, Sulaiman Barau Technical College Suleja, Government Technical College Eyagi-Bida, and Government Technical College New-Bussa. These schools are equipped with facilities and equipment required to conduct this study.

### **Population for the Study**

The population for this study consists of all 122 second year students of Woodwork technology in the four technical colleges offering woodwork technology in Niger State. The data was obtained from the students who registered in each school. Simple random sampling was used to select the sample. NTC II students were used because they have studied Woodwork technology in their first year and should have had basic understanding of Woodwork technology terms, materials and tools of the trade. The distribution of the population according to schools is shown in.

### **Sample and Sampling Techniques**

Simple random sampling technique (balloting) was used to assign two schools to challenge based learning approach group and two schools to Activity – Based learning approach group. Two intact classes of year II students were assigned to each of the groups. Each intact class comprises of male and female students as shown in the entire population of 122 was used for the study.

### **Instruments for Data Collection**

The instruments used for data collection for this study consists of woodwork technology cognitive achievement test (WTCAT), woodwork technology psychomotor achievement test (WTPAT) and woodwork technology interest inventory (WTII). The WTCAT and WTPAT were developed by the researcher based on NBTE NTC II woodwork technology trade curriculum and course specifications. A scoring guide was also developed for the WTCAT while a rating scale was developed for WTPAT which was used by the examiners to score the cognitive achievement test and rate the students' performance of the practical tasks respectively. The woodwork interest inventory (WTII) was also developed by the researcher. The items developed were those that could elicit interest in wood work activities which are appropriate to the vocational and technical nature of wood wok. More so the items emphasized work activities that are related to skilled jobs. The items of the interest inventory were also based on a four-point scale of Strongly Agreed (4), Agreed (3), Disagreed (2) and Strongly Disagreed (1).

### **Validation of the Instruments**

Both content and face validation were carried on WTCAT. A table of specification was built for the WTCAT in order to ensure their content validity. Based on the table of specification, a total of 82 multiple choice items were drawn for the WTCAT. Three questions were also drawn for the WTPAT. The WTCAT, WTPAT and WTII and lesson plans were validated by three experts from the department of Industrial and Technology Education, Federal University of Technology Minna and two Woodwork technology teachers from technical colleges in Niger State. The experts were given the table of specification to enable them carry out content validity. The face validation involved checking the items of the instruments for appropriateness in arrangements and logical sequence of the test items and teaching plans. Based on the experts' suggestions, a revision was carried out on the instruments.

The psychometric test analysis on the WTCAT was conducted as part of the validation exercise. Its reliability was determined using 40 sampled NTCII students in Government Technical College, Patigi, Kwara State. GTC, Patigi was used because it did not form part of the study institutions but uses the same entry requirement as the study groups. The answer sheets were marked and the scores used for computing the difficulty index, discrimination index and distracter index of the test items. In line with Nworgu (1992), an item is good if it has difficulty index ranging from 0.30 to 0.70, discrimination index ranging from +0.30 to 1.0 as well as having the distracter index from 0.02 to 0.17 in positive decimal. In all, 40-items that had good difficulty, discrimination and distracter indices were chosen.

### **Reliability of the Instruments**

The WTCAT was trial-tested on 40 NTCII students in Government Technical College, Patigi, Kwara State using test-retest reliability technique. GTC, Patigi was used because it did not form part of the study institutions but uses the same entry requirement as the study groups. The reliability of the WTCAT was determined using Pearson Product Moment Correlation Coefficient and was found to be .78 while its internal consistency was established using Kuder – Richardson 20 (KR20) approach. The result of the internal consistency was calculated to be .76. The stability of the WTPAT was determined using four raters. The inter-rater reliability was calculated using Kendall's Coefficient of Concordance and the result yielded .82. Cronbach Alpha method was used to determine the internal consistency of the WTII items and was found to be a reliability coefficient of .89.

### **Training (Briefing) of Woodwork Teachers as Research Assistant for the Study**

A three -day intensive briefing was organized for the teachers that were used as research assistants. The teachers that used Challenge based learning (CBL) lesson plans were given detailed explanation on the use of CBL instructional method and other research expectation while the teachers that used Activity – Based learning (ABL) lesson plans were given detailed explanation on the application of the Activity – Based learning teaching plans. At the end of the briefing a micro teaching session was organized to ensure that the teachers have mastered the application of the teaching plans and have also understood the general requirement of the research.

### **Experimental Procedure**

Pre-test was first administered to the two groups using WTCAT, WTPAT and WTII before the treatment exercise to determine the equivalence of the subjects assigned to challenge based learning group and Activity – Based learning group. Then treatment commenced in all the groups. Challenge based learning group was taught woodwork technology with CBL lesson plans while the Activity – Based learning group was taught woodwork technology using the ABL teaching plans. This lasted for 8 weeks. Thereafter, posttest was administered to the two groups and after an interval of about two weeks a retention test was administered. The scores of the two groups on pre-test, post-test and retention test was computed and analysed.

### **Method of Data Analysis**

The data collected from the pre-test, post-test, interest and retention test were analyzed using Analysis of Covariance (ANCOVA) to test the null hypotheses at 0.05 level of significance. ANCOVA was chosen based on the fact that it is a parametric technique which adjusts for initial differences on relevant variables (Uzoagulu, 2011). Analyses were carried out using the Statistical Packages for Social Sciences (SPSS).

## **Results**

### **Hypotheses**

**HO<sub>1</sub>:** There is no significant difference between the mean effect of challenge-based and activity – based learning approach on students' academic achievement in Woodwork technology.

**HO<sub>2</sub>:** There is no significant difference between the mean effect of gender on Woodwork technology cognitive achievement of students (male and female) when taught using challenge-based and activity – based learning approach.

**HO<sub>3</sub>:** There is no significant mean interaction effect of treatment given to students taught using challenge-based and activity – based learning approach and their gender (male and female) with respect to their mean scores in Woodwork technology cognitive achievement test.

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 1, 2 & 3 are presented in table 1 below.

**Table 1:** Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (CBL and ABL), their Gender and Interaction Effect with Respect to their Mean Scores on Woodwork Technology Cognitive Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6019.303 <sup>a</sup>	14	429.950	9.284	.000
Intercept	116029.049	1	116029.049	2505.394	.000
Method	3963.837	8	495.480	10.699	.000
Gender	7.731	1	7.731	.167	.684
Gender * method	82.602	5	16.520	.357	.877
Error	4955.352	107	46.312		
Total	336096.000	122			
Corrected total	10974.656	121			

The data presented in Table 1 shows F-calculated values for three effects: treatment, gender and interaction effect of treatments and gender on students cognitive achievement in woodwork Technology. The F-calculated value for treatment is 10.699 with a significance of F at .000 which is less than 0.05. Hence, the null-hypothesis of no significant mean difference between the effect of CBL approach and ABL approach on students’ cognitive achievement in woodwork technology is therefore rejected at .05 level of significance. The result implies that the mean difference between the effect of CBL approach and ABL approach was significant. The F-calculated value for gender as shown in Table 9 is .167 with a significance of F at .684 which is greater than .05. Therefore, the null hypothesis of no significant difference between the mean effect of gender (male and female) on students’ cognitive achievement in woodwork Technology is accepted at .05 level of significance. This means that there was no significant mean difference between the effects of gender on students’ cognitive achievement in woodwork Technology. The interaction of treatments and gender has F-calculated value of .357 with a significance of F at .877 which is greater than .05. Therefore, the null hypothesis of no significant interaction effect of treatments and gender is accepted. This means that there was no significant interaction effect of treatments given to students taught with CBL approach and ABL learning approach and their gender with respect to their mean scores on woodwork Technology cognitive achievement test.

**HO4:** There is no significant difference in the mean retention scores of students taught woodwork technology using challenge-based and activity – based learning approach.

**HO5:** There is no significant difference in the mean retention scores of male and female woodwork students on Woodwork technology cognitive achievement test when exposed to challenge-based and activity – based learning approach.

**HO6:** There is no significant mean interaction effect of treatment given to students and their gender with respect to their retention scores in Woodwork technology.

Summary of Analysis of Covariance (ANCOVA) test for hypothesis 4, 5 and 6 are presented in table 2 below.

**Table 2:** Summary of Analysis of Covariance (ANCOVA) for test of significance of Effects of Treatment (CBL, ABL), their gender and interaction Effect with respect to their mean scores on woodwork technology cognitive retention test.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7015.737 <sup>a</sup>	26	269.836	5.081	.000
Intercept	24113.370	1	24113.370	454.075	.000
Retention	5404.216	16	337.764	6.360	.000
Gender	2.441	1	2.441	.046	.831
Retention * gender	173.679	8	21.710	.409	.913
Error	5044.919	95	53.104		
Total	490500.000	122			
Corrected total	12060.656	121			

The data presented in table 2 shows that F-calculated value for the groups (CBL and ABL) is 6.360 with a significance of F at .000 which is less than .05. Hence the null hypothesis was rejected at .05 level of significance. The result means that there was a significant difference between the mean score of student taught Woodwork technology using CBL and those taught using ABLA in cognitive retention test. The F-calculated value for gender (male and female) as shown in table 10 is .046 with a significance of F at .831 which is greater than .05. Hence, the null hypothesis was not rejected at .05 level of significance. This means that there was no significant mean difference between the effect of gender on cognitive retention learning of student taught Woodwork technology using CBL and those taught using ABL.

The interaction of treatment and gender has F-calculated value of .409 with significance of F at .913 which is greater than .05. Therefore, the null hypothesis of no significant interaction effect of treatment and gender is accepted. This means that there was no significant interaction effect of treatment given to students taught CBL and ABL and their gender with respect to their mean scores on Woodwork technology Cognitive retention test.

**HO7:** There is no significant difference between the mean effect of challenge-based and activity – based learning approach on students’ psychomotor achievement in Woodwork technology.

**HO8:** There is no significant difference between the mean effect of gender on Woodwork technology psychomotor achievement of students (male and female) when taught using challenge-based and activity – based learning approach.

**HO9:** There is no significant mean interaction effect of treatment given to students taught using challenge-based and activity – based learning approach and their gender (male and female) with respect to their mean scores in woodwork technology psychomotor achievement test

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 7, 8 & 9 are presented in table 3 below.

**Table 3:** Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (CBL, ABL), their Gender and Interaction Effect with Respect to their Mean Scores on Woodwork Technology Psychomotor Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8067.097 <sup>a</sup>	17	474.535	17.619	.000
Intercept	195187.985	1	195187.985	7246.973	.000
Method	5593.886	9	621.543	23.077	.000
Gender	13.708	1	13.708	.509	.017
Gender * method	337.642	7	48.235	1.791	.097
Error	2801.108	104	26.934		
Total	373893.000	122			
Corrected total	10868.205	121			

Table 3 shows F-calculated values for three effects: treatment (CBL and ABL), gender and interaction of treatment and gender on students’ psychomotor achievement in wood work technology. The F-calculated value for treatment is 23.079 with a significance of F at .000 which is less than .05. Hence, the null hypothesis of no significant difference between the effect of treatments (CBL approach and ABL approach) on students’ psychomotor achievement in woodwork technology is therefore, not accepted at .05 level of significance. This means that there was significant mean difference between the effect of CBL approach and ABL approach on students’ psychomotor achievement in woodwork technology.

The F-calculated value for gender is .509 with a significance of F at .017. Since the F-calculated value is less than the Significant F-value, the null hypothesis is, therefore, rejected at .05 level of significance. This result means that there was significant effect of gender in favour of females on students’ psychomotor achievement in woodwork Technology.

The interaction effect of treatment and gender has F-calculated value of 1.791 with significance of F of .097 which is higher than .05. Therefore, the null hypothesis of no significant interaction effect of treatments given to students taught with CBL approach and ABL approach and their gender with respect to their mean scores on woodwork Technology psychomotor achievement test is accepted at .05 level of significance. This, therefore, means that there is no significant interaction effect of treatments given to taught with CBL approach and ABL approach and their gender with respect to their mean scores on woodwork Technology psychomotor achievement test.

**HO10:** There is no significant difference between the mean effect of challenge-based and activity – based learning approach on students’ interest in studying woodwork technology.

**HO11:** There is no significant difference between the mean effect of gender (male and female) on students’ interest in woodwork technology.

**HO12:** There is no significant interaction mean effect of treatments given to students taught using challenge-based and activity – based learning approach and their gender (male and female) with respect to their mean scores in woodwork technology inventory.

Summary of Analysis of Covariance (ANCOVA).test for hypotheses 10, 11&12 are presented in table 4 below.



**Table 4:** Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments, Gender and Interaction Effect of Treatments Given to Students Taught with CBL And ABL and their Gender with Respect to their Mean Scores on Woodwork Technology Interest inventory

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8209.418 <sup>a</sup>	47	174.668	2.387	.000
Intercept	221425.386	1	221425.386	3025.494	.000
Gender	174.744	1	174.744	2.388	.127
Interest	6469.004	34	190.265	2.600	.000
Gender * postinterest	783.867	12	65.322	.893	.558
Error	5415.804	74	73.187		
Total	518599.000	122			
Corrected Total	13625.221	121			

The data presented in Table 4 shows F-calculated for three effects: treatment, gender and interaction of treatment and gender on students' interest in woodwork Technology. The F-calculated value for treatment is 2.600 with a significance of F at .000 which is less than .05. Therefore, the null hypothesis of no significant difference between the mean effect of treatments (CBL approach and ABL approach) on students' interest in studying woodwork Technology is not accepted at .05 level of significance. The result means that the mean difference between the effect of CBL approach and ABL approach on students' interest in studying woodwork Technology is statistically significant. F-calculated value for gender as shown in Table 12 is 2.388 with a significance of F at .127 which is greater than .05. Hence, the null hypothesis of no significant difference between the mean effect of gender (male and female) on students' interest in woodwork Technology was retained at .05 level of significance.

With this result it shows that gender has no significant effect on students' interest in woodwork Technology. The interaction effect of treatment and gender has F-calculated value of .893 with significance of F of .558 which is higher than .05. This means that there is no significant interaction mean effect of treatments given to students taught using CBL approach and ABL approach and their gender with respect to their mean scores in woodwork Technology Interest Inventory.

## Discussion

This study determined the effects of challenge-based and activity-based learning approaches on technical college students' achievement, interest and retention in woodwork technology as well as their effect on gender. The data presented in Table 1 revealed that the mean difference between the effect of activity-based learning approach and challenge-based learning approach in woodwork Technology cognitive achievement was statistically significant. This means that CBL is more effective than ABL approach in improving students' cognitive achievement in woodwork Technology. The above findings are consistent with the findings of Kabiru (2010), Ade (2013), Johnson and Adams (2011) and Umar (2012) who, in their separate studies in other subjects found that the CBL instructions had significant effect upon the students' cognitive achievement than other instructional formats. The findings of this study also support some literature evidence such as Araz (2007) who stated that when learners are exposed to new ideas that are presented through different intelligences, they will have a better chance to learn, remember the information and apply their learning experiences to other situations which can lead to higher achievement. Therefore, the result of this study with regard to students' cognitive achievement is attributed to the treatment given to students in CBL group. However, analysis of covariance revealed that the null hypothesis of no significant effect of gender on students' cognitive achievement in woodwork Technology was accepted since the F-calculated value is greater than the significant F-value. This means that the difference between the mean scores of male and female students in woodwork Technology cognitive achievement test, is at variance with the findings of Usoro (2009), and Owoso (2010) who reported a significant difference in the cognitive achievement test mean scores of male and female students taught by the constructivist method in favour of male students. Also, the finding of this study in respect of male and female students' achievement in woodwork Technology does not support the writings of Samuel (2001) who concluded that girls and women perform far below the level of boys and men in science and technology and the allied fields.

The data presented in table 2 revealed that the difference in the retention mean score of the students taught with the CBL approach and those taught with ABL is significant. This showed that the CBL approach have positive effect on the student's retention of learning in woodwork technology. The provision of active learning environment where students can be engaged and participate actively in class discussion increase the students' ability to explore issues and articulate their own ideas. This affirms Shri-Krishna & Badri (2013) views that active learning approach facilitate active knowledge construction, develops higher order thinking skills, improves memory and enhance transfer of learning to another situation. Bayraktar (2014) was of the opinion that by teaching students to think, they will gradually begin to realize that conscious reflection secretes understanding. He maintained that when students learn to think, they will be able to tackle all sort of new problem creatively and will have acquired some confidence. The analysis of covariance of the mean score of male and female in the test for cognitive retention of learning revealed that there was significant difference in the mean retention scores of male and female woodwork students on woodwork technology cognitive achievement test

when exposed to CB and AB learning approaches. The mean score of female was higher than the mean score of male. This finding is in contrary to the views of Ozden & Gultlain (2008), that retention of learning is not affected by gender but by the degree of original learning, time at which retention is measured and the individual's working memory capacity among other factors. Thus, since male and female were taught with the same method, they acquired the same degree of original learning hence their retention of learning was not significantly different.

The data presented in Table 3 revealed that the mean difference between the effect of CBL and ABL on students' psychomotor achievement in woodwork Technology was not statistically significant. Hence, the null hypothesis of no significant mean difference was accepted. The result of this study regarding students' psychomotor achievement could be explained by the fact that teachers' adoption of authentic instructional technique in learning group, where visual aids engaged the students in higher order thinking tasks such as analysis synthesis and evaluation. Burries (2014) noted that authentic instruction fosters higher order thinking skills in students. He explained that higher order thinking requires students to manipulate ideas in ways that transform their meaning and applications. The manipulation of information and ideas allows students to discover solution to problems (Afolabi and Akinbobola 2009).

The data presented in Table 4 revealed that the null hypothesis of no significant mean difference between the effect of CBL and ABL in the woodwork Technology interest inventory was not accepted. This means that there was significant mean difference between the effect of CBL and ABL on students' interest in woodwork Technology. This result, particularly that CBL is effective in stimulating students' interest in studying woodwork Technology, tends to support the writings of Charif (2014) who wrote that using learning in the classroom makes lessons more interesting, which causes students to pay more attention to what is taught and then learned. As Anandalakshmi (2014) also explained, using multiple entry points to introduce new material in activity-Based learning classroom will allow teachers to specifically target several intelligences. This will activate students' interest and get them involved in the learning process and also give them more exposure to the lesson content, and more opportunities to connect with the material. The results could, therefore, be explained by the fact that teaching to students' strengths (intelligences/learning styles) engages the students in the learning process. This, consequently, increased their self-esteem and enthusiasm in studying woodwork Technology. The analysis of covariance results also revealed that the null hypothesis of no significant difference between the mean effects of gender on students' interest in woodwork Technology was retained. This implies that the observed differences in the mean interest scores of male and female students was not statistically significant. However, the finding of this study with regard to the influence of gender on students' interest in woodwork Technology unparallel the findings of Okorieocha (2010) who found a significant gender influence on students' interest towards basic electricity in favour of male students in Technical Colleges of Rivers State.

## Conclusions

This study determined the effects of challenge-based and activity-based learning approaches on technical college students' achievement, interest and retention in woodwork technology. The challenge-based learning approach used in this study greatly affected the students learning of woodwork technology. This was reflected in the students' cognitive, psychomotor achievements and retention of learning. In other words, students learnt woodwork technology and psychomotor skills better because they were allowed to participate actively in the classroom teaching and learning by interacting with teacher, learning environment and their colleagues, work and learn together in groups. Also students retained their learning for a longer time when they were allowed to think on possible solutions to a problem while engaging in practical activities with real objects, tools and machines collaboratively. It is hoped therefore, that if the challenge-based learning approach is taken into consideration in the teaching of woodwork technology in the Technical Colleges, craftsmen trained will graduate from the Technical Colleges with knowledge, psychomotor skills, strong problem solving skills, creative thinking, collaborative work and independent decision making skills will make them adaptable to the present and envisaged changes in the woodwork technology industries occasioned by technological advancement. Consequently, the craftsmen will be able to Improve on their learning and pass NABTEB examinations with better grades, contribute their quota to industrial development of this nation, and become employers of labour instead of hoping solely on paid employment.

Based on the findings of this study, the following recommendations are made;

- i. Technical College teachers should adopt the use of challenge-based learning approach to the teaching of woodwork technology.
- ii. National Board for Technical Education (NBTE) should consider review of curriculum for woodwork technology programme with a view to incorporating the challenge-based learning approach into the teaching of woodwork technology.
- iii. Government should provide tools and equipment needed to teach the state-of-the-art of woodwork technology in the Technical Colleges.
- iv. Ministry of education and administrators of Technical Colleges should always organize seminar, conferences and workshops to sensitize technical teachers on the use of the challenge-based learning approach.

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