

Effect of Activity-Based Teaching Techniques on Students' Academic Achievement in Foundry Craft in Technical Colleges in Rivers State

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Abstract: *This study examined the effect of activity-based teaching techniques on academic achievement of foundry craft students of technical colleges in Rivers State. The study sought to determine the effect of activity-based teaching techniques in moulding and heat treatment process. The study adopted a quasi-experimental research design which involved a pretest, posttest, non-equivalent control group of students in their intact classes. Two research questions guided the study and two hypotheses were tested at .05 level of significance. The population of the study consisted of all the sixty-seven (67) NTC II students of foundry craft in technical colleges in Rivers State. An intact class of the schools was used with the help of some teachers who were briefed on the procedures for the study. Instrument for data collection was Foundry Craft Achievement Test (FCAT) which contains twenty (20) multiple choice items. Three (3) experts in the field of technical education validated the instrument. The reliability coefficient of the instrument Foundry Craft Achievement Test (FCAT) was carried out to determine the internal consistency using Kuder Richardson formula 20 (K – R 20) technique and a coefficient of 0.78 was established. Data collected were analyzed using mean and standard deviation and Analysis of Covariance (ANCOVA) was used to test the hypotheses at .05 level of significance through the use of SPSS Version 20. The findings of the study revealed that there is a significant difference between the students' achievement when taught moulding and heat treatment process with activity-based teaching technique. In other words, students taught moulding and heat treatment process with activity-based teaching technique score higher than those students taught moulding and heat treatment process with discussion teaching technique. Finally, the study recommended that activity-based teaching technique should be adopted for teaching foundry craft in technical colleges in Rivers State and Nigeria in general and teachers should also be trained to adopt it.*

Keywords: Activity-Based Teaching Technique, Academic achievement, Foundry Craft and Technical College

Introduction

Technical and vocational education is designed to offer training to improve individual's general proficiency in relation to their occupations. Technical and vocational education is the foundation of nations' wealth and development. Technical and vocational education is an aspect of education that leads to acquisition of practical and applied skills as well as basic scientific knowledge (Federal Republic of Nigeria, 2013). It is a type of education that is meant to produce semi-skilled, skilled and technical manpower necessary to restore, re-vitalize, energize, operate and sustain the national economy and substantially reduce unemployment (Ogundola, et al, 2010). It is the 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 the economic and social life (FRN, 2013). This implies that an individual who acquires those competencies and some psychomotor skills in Technical Vocational Education and Training (TVET) is already empowered to be self-reliant. Such individual has greater opportunities to earn a livelihood as well contribute to national development.

Technical Vocational Education and Training (TVET) is the education for those who need it, those who want it, and those who want to progress by it (Okoye, 2013). Thus, a sound practice of Technical and vocational education seemed to be the secret behind the success of most of the developed nations of the world. Lawal (2010) describe technical and vocational education as that type of education that prepares people who could apply relevant practical skill to make positive changes within their society and afford a self-dependent life. This form of education has been attested severally as an education that provides self-employment, enhances productivity and self-reliance. Technical Vocational Education and Training (TVET) give individual the skills to live, learn and work as a productive citizen in a global society. TVET encompasses programmes that provide participants with skills, knowledge and aptitudes that enable them to engage in productive work, adapt to rapidly changing labour markets and economies, and participate as responsible citizens

in their respective societies. This education is offered in technical institutions, including technical colleges, saddled with the responsibility of training low and middle level manpower.

Technical colleges in Nigeria are established to produce craftsmen and master craftsmen. Technical colleges are mainly established for the training of students to acquire practical skills, knowledge and attitudes essential for employment in various trades. Denga (2010) described technical colleges as the post-primary level as pre-vocational and vocational schools whereas technical colleges, technical teacher colleges and polytechnics are identified as post-secondary level. The courses offered at the technical colleges lead to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC). The National Policy on Education (NPE, 2013) buttressed technical college as a segment of technical and vocational education (TVE) designed to produce craftsmen at the secondary school level and master craftsmen at the advanced craft level technical colleges in Nigeria are regarded as the principal vocational institutions. According to Okorie as cited in Beako, Flagg, Okorieocha and Kooli (2018) technical colleges are established to prepare individuals to acquire practical skills and basic scientific knowledge. He further stated that technical colleges train both males and females in the areas of electrical installation and maintenance and metal work programmes, among others.

The programmes of technical colleges, according to Federal Government of Nigeria (2013) are grouped into related trades. These include construction trades, computer trades, electrical/electronic trade, textile trades, Business trades, printing trades and mechanical trades.

Foundry craft is one of the main industries prompting the development of world economy. The foundry industry is a main feeder to major manufacturing sectors that drive technological growth and most world economies usually depend on the stability of foundry and steel industries (Panchal, 2010). The importance of the foundry technology in technological development cannot be underscored and the impact on the economic development of any nation with its high value adding possibilities. According to Abioye et al, (2017) foundry is made up of process steps depending on the category of castings produced from casting design to pattern making to materials/alloy selection to sand preparation to moulding to melting to casting to fettling and to heat treatment and quality control processes that includes all the production line in foundry operations.

Foundry work as that branch of engineering in which metal is melted and poured into moulds made of sand or metal. According to Clegg in Dokadawa (2014) foundry is an aspect of metal work technology that deals with casting of metals. Casting enables components to be made easily and cheaply that would be difficult and expensive to machine from the solid or fabricate from pieces. According to Packer as cited in Miller et al (2017) foundry encompasses 16-21 process steps for each category of castings produced from casting design to pattern making to materials/alloy selection to sand preparation to moulding to melting to casting to fettling and finally to heat treatment and quality control processes that involves all the production line in foundry operations. Foundry craft works involves many processes especially in the making of patterns, cores and moulds for producing intricate shapes (Jain, 2012). Foundry craft technology is the most efficient and effective means of producing parts of machines and other parts that are difficult to produce on the lathe machine with respect to grinding, milling and shaping.

Students who offer this trade area are expected to graduate with skills that will enable them gain employment in the industry or be self-employed. Therefore, the imperativeness of teaching techniques cannot be over-emphasized. Transferring knowledge requires teachers to adopt the appropriate pedagogy techniques that best suit the learners, suit the objectives and, most especially produce the desired outcomes. Most of the teaching techniques today have embraced modern technology and this has brought tremendous changes in the field of learning. No wonder, Tebabal and Kahssay (2011) opined that most of the conventional teaching methods were teacher-centered with no activity for the learners making them passive learners towards the subject matter. This approach is least practical, but more theoretical and memorizing. It is therefore pertinent to employ teaching technique that will be more of student-centre or activity-based or project-based technique. Consequently, foundry craft teachers need to embrace new technology and appropriate teaching and learning techniques as a tool to transform the present isolated, teacher-centre and text bound classroom into rich, students-centre interactive knowledge environment in order to motivate students and help to improve students' achievement of foundry craft practices; thus the consideration of activity-based teaching technique.

Activity-based teaching technique is one of the teaching methods for the teaching adopted by teachers in various subjects. It is a means by which students develop independence, responsibility and practice behavior. Activity-based teaching technique is suitable for both large and small groups as well as individual instruction. A project method implies a practical problem which a student and the teacher plan to execute. It is a learning activity selected, planned, designed and executed by learners collectively or individually to clarify facts, acquire new knowledge, skills, appreciation and to solve identified problems under the teacher's guidance and supervision. Therefore, the role of the teacher in providing guidance and direction to students should not be completely eliminated. This is because students tend to exaggerate their power of execution and to select projects that are beyond them, thereby leading to the production of crude projects which defeat the purpose of the project method.

Activity-based teaching technique is a technique that is extensively used in skill acquisition. It is a purposeful activity or unit of expenses engaged in by students, individuals, and group or by a whole class. It is a vehicle of instruction through which certain behavioural changes can be effected. Project works bring opportunities for students to promote their achievement. Moreover, these works enable students to work together in a real- world environment by collaborating on a task (Bas, 2011). Activity-based teaching has the following advantages that make it stand out among other pedagogies; it engages learners, boosts cooperative learning skills, improves academic performance, develops high order thinking skills and builds positive relationships between students and teachers. Activity-based teaching is a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks.

The teaching method employed by the teacher could be a strong determinant of students' level of academic performance According to Akinson and Feather (2012), student's academic achievement is conceived as a latent disposition which is manifested in overt striving only when the individual perceives performance as instrumental to a sense of personal accomplishment. Krebs (2010), stated that one of the techniques used in evaluating the academic performance of learners is the achievement test and that the scores students obtained in an achievement test are supposed to be representative of the extent to which the characteristics being measured by the test are present in the test instruments. According to Okpara in Shogbesan and Faleye (2014) stated that a score in an achievement test can only be meaningful and relevant if it actually represents the level of understanding and attainment of the items.

Statement of the Problem

Technical colleges is established with the aim of developing a skill workforce in carpentry and joinery craft, brick/blocklaying and concreting craft, electrical installation and maintenance works mechanical engineering craft as well as foundry craft etc; to produce craftsmen and master craftsmen who are skilled and proficient in different area of specialization. However, it is obvious today that these noble objectives suffered many setbacks ranging from students poor academic performance in standard examination, class participation practical skills acquisition to mention but a few. This decline in students' performance has been associated to a number of factors, among which is the strategy employed in impacting knowledge to the learners (Adigun et al, 2019). In corroboration with the above, Alasi (2018) noted that the persistent poor academic performance of students in foundry craft and other technical subjects is as a result of inappropriate teaching methods adopted by the teachers. This continues poor academic achievement of student is worrisome to many well-meaning Nigerian including the researchers. Based on the foregoing, the researchers was determined to find out the effect in which activity-based teaching techniques will have on academic achievement of foundry craft students' of technical colleges in Rivers State.

Aim and Objectives of the Study

The aim of this study is to determine the effect of activity-based teaching techniques on academic achievement of foundry craft students' of technical colleges in Rivers State. Specifically, the study determined the:

1. Effect of activity-based teaching techniques on academic achievement of students' in moulding process in technical colleges in Rivers State.
2. Effect of activity-based teaching techniques on academic achievement of students' in heat treatment process in technical colleges in Rivers State

Research Questions

The following two (2) research questions were posed to guide the study

1. What is the effect of activity-based teaching techniques on academic achievement of students' in moulding process in technical colleges in Rivers State?
2. What is the effect of activity-based teaching techniques on academic achievement of students' in heat treatment process in technical colleges in Rivers State?

Hypotheses

The following two (2) hypotheses were formulated and tested at the 0.05 significance level:

HO₁: There is no significant difference between the mean achievement scores of students taught moulding process using activity-based teaching technique and those taught using discussion teaching technique in technical colleges in Rivers State.

HO₂: There is no significant difference between the mean achievement scores of students taught heat treatment process using activity-based teaching technique and those taught using discussion teaching technique in technical colleges in Rivers State.

Methodology

❖ **Design of the Study:** The study adopted a quasi-experimental design. Specifically, the pretest, posttest, non-equivalent control group design was adopted. The design is represented below.

Category A: $O_1 X_1$

Category B: $O_1 X_2$

Where; O_1 - Pre-tests for both groups

O_2 - Post-tests for both groups

X_1 - Treatment (Category A: Control group)

X_2 - Treatment (Category B: Experimental group)

- ❖ **Population for this study:** The population of the study consisted of all NTC II students of the three (3) Government Technical Colleges offering foundry craft out the four (4) Technical Colleges in the State, namely Government Technical College, Port Harcourt, Government Technical College Ele-ogu, Government Technical College Tombia and Government Technical College, Ahoada.. Thus, the total population of the study was sixty-seven (67) NTC II students of GTC Ahoada =23, GTC Ele-ogu = 8 and GTC Port Harcourt = 36. The figures were provided to the researcher in each school by the Heads of Department (HODs). The reason for chosen NTC II was because it is not an external examination class and that the selected topic for the study is in the content of NTC II curriculum.
- ❖ **Sample and Sampling Technique:** There was no sample for the study because the population was manageable in size. Hence a census was adopted.
- ❖ **Instrument for Data Collection:** The instrument used for data collection was Foundry Craft Achievement Test (FCAT) which was developed by the researcher. The instrument “Foundry Craft Achievement Test (FCAT)” which contains twenty (20) multiple choice items was developed by the researcher to assess students’ achievements in the experimental and control groups respectively. The multiple choice items were extracted from NABTEB Past Questions between 2015 and 2020 respectively. The items of FCAT were drawn in line with the six major classes of cognitive domain of Bloom’s taxonomy of educational objective: knowledge, comprehension, application, analysis, synthesis and evaluation.
- ❖ **Validity of the Instruments:** The instrument was subjected to face and content validation by three (3) experts in the field of technical education; Two (2) from Ignatius Ajuru University of Education Port Harcourt and the one from Isaac Jasper Boro College of Education Sagbama, Bayelsa State. The experts were requested to assess the language suitability of the items and its ability to measure students’ achievement in foundry craft practice. Foundry Craft Achievement Test (FCAT) was carried out to ensure that course content and its sub-sections represent items suitable for National Technical Certificate Two (NTC II) students.
- ❖ **Reliability of the Instrument:** The reliability coefficient of the instrument Foundry Craft Achievement Test (FCAT) was carried out to determine the internal consistency using Kuder Richardson formula 20 (K – R 20) technique.
- ❖ **Method of Data Analysis:** The data collected from the administration of pretest and posttest were analyzed using descriptive statistic (mean and standard deviation) to answer the research questions and inferential statistics (Analysis of Covariance) was used to test the hypotheses at .05 level of significance with the aid of Statistical Packages for Social Sciences Version 20 (SPSS 20). The pretest-posttest mean difference of each of the treatment groups were computed, decision rule based on the calculated mean was used; if f-ratio is less than .05, then “reject” the null hypothesis whereas, if f-ratio is greater than .05 “accept”.
- ❖ **Control of Extraneous Variables:** The following measures were employed to control some of the extraneous variables in this study:
 - i. Experimental bias: When researchers involve external subjects (students) in their experiment, the students become sensitized that they are being used for a study.
 - ii. Initial group difference: Randomization is one of the procedures used to control initial group differences in experimental studies.
 - iii. Teacher variable: When different teachers are involved in an experiment, the problem of teacher variable is likely to arise since different teachers possess different standards in terms of knowledge of the content, methodology and evaluation.
 - iv. Treatment bias: Experimental and control group students were not informed or made to understand anything about the research process.

Presentation of Results

Research Question 1

What is the effect of activity-based teaching techniques on academic achievement of foundry craft students’ in moulding process in technical colleges in Rivers State?

Table 1: Pretest-Posttest means and standard deviation scores of foundry craft students in moulding process in technical colleges in Rivers State

Category of Treatment	N	Pre-test X_1	SD ₁	Post-test X_2	SD ₂	Mean Difference	Mean Gain (\bar{X})	Decision
Discussion Technique	33	14.95	5.83	57.33	6.68	42.38		

Activity-Based Techniques	34	19.02	5.42	76.78	6.65	57.76	15.38	Positive Effect
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Source: Authors (2022)

The data presented in table 1 revealed that discussion teaching technique had a mean score of 14.95 and standard deviation of 5.83 in the pre-test and a mean score of 57.33 and standard deviation of the 6.68 making a pre-test post-test which give rise to a mean difference of 42.38. Activity-based teaching technique group had a mean score of 19.02 and standard deviation 5.42 in the pre-test and a post-test mean of mean of 76.78 and standard deviation of 6.65 which give rise to a mean difference of 57.76. Furthermore, the pretest - posttest mean gain was giving as 15.28. From these results, it was deduced that foundry craft students achieved slightly higher when taught moulding process with activity-based teaching technique than when taught with discussion teaching technique in technical colleges in Rivers State.

Research Question 2

What is the effect of activity-based teaching techniques on academic achievement of foundry craft students' in heat treatment process in technical colleges in Rivers State?

Table 2: Pretest-Posttest means and standard deviation scores of foundry craft students in heat treatment process in technical colleges in Rivers State

Category of Treatment	N	Pre-test X_1	SD ₁	Post-test X_2	SD ₂	Mean Difference	Mean Gain (\bar{X})	Decision
Discussion Technique	33	83.63	4.41	10.71	2.65	72.92	2.8	Positive Effect
Activity-Based Techniques	34	93.06	4.67	22.94	2.97	70.12		

Source: Authors (2022)

From table 2, it was deduced that discussion teaching technique had a pretest mean score of 83.63 and standard deviation of 4.41 whereas the posttest mean score of 10.71 and standard deviation of the 2.65 with a pre-test post-test which give rise to a mean difference of 72.92. Meanwhile, activity-based teaching technique group had a mean score of 93.06 and standard deviation 4.67 in the pre-test and a post-test mean of mean of 22.94 and standard deviation of 2.97 which give rise to a mean difference of 70.12. Furthermore, the pretest - posttest mean gain was calculated to be 2.8. The results above indicated that foundry craft students achieved higher when taught heat treatment process with activity-based teaching technique compared to when they are taught with discussion teaching technique in technical colleges in Rivers State.

Testing of the Hypotheses

HO₁: There is no significant difference between the mean achievement scores of foundry craft students taught moulding process using activity-based teaching technique and those taught using chart in technical colleges in Rivers State.

Table 3: Analysis of Covariance (ANCOVA) of Student Achievement in Moulding Process when taught using Activity-Based Teaching Techniques and Discussion Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12816.093 ^a	2	6408.047	726.696	.000
Intercept	23048.968	1	23048.968	2613.838	.000
Pretest	3460.761	1	3460.761	392.463	.000
Group	5000.578	1	5000.578	567.084	.000
Error	846.533	64	8.818		
Total	462776.000	67			
Corrected Total	13662.626	66			

a. R Squared = .938 (Adjusted R Squared = .937)

Table 3 above presents the F calculated value or the effect of activity-based teaching techniques on academic achievement of foundry craft students of technical colleges in Rivers State. The F- calculated value for treatment is 567.084 with a significance of F at .000

which is less than .05. Therefore, the null hypothesis was rejected at 0.05 level of significance. This signifies that there is notable or significant difference between the achievements of students when taught moulding process with activity-based teaching technique and when they are taught with discussion teaching technique in technical colleges in Rivers State.

HO₂: There is no significant difference between the mean achievement scores of foundry craft students taught heat treatment process using activity-based teaching technique and those taught using chart in technical colleges in Rivers State.

Table 4: Analysis of Covariance (ANCOVA) of Student Achievement in Heat Treatment Process when taught using Activity-Based Teaching Techniques and Discussion Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12835.191 ^a	4	3208.798	364.532	.000
Model					
Intercept	3279.744	1	3279.744	372.592	.000
Pretest	4223.152	1	4223.152	479.767	.000
Group	18.281	1	18.281	2.077	.000
Error	827.436	64	8.803		
Total	462776.000	67			
Corrected Total	13662.626	66			

a. R Squared = .939 (Adjusted R Squared = .937)

The table above presents the effect of activity-based teaching techniques on academic achievement of foundry craft students of technical colleges in Rivers State. The F- calculated value for treatment is 2.077 with a significance of F at .000 which is less than .05. Therefore, the null hypothesis was rejected at 0.05 level of significance. This signifies that there is notable or significant difference between the achievements of students when taught heat treatment process using activity-based teaching technique and when they are taught with discussion teaching technique in technical colleges in Rivers State. It is therefore imperative adopt activity-based teaching techniques which will not only stimulate and motivate to the learners but will also have the potential of improving their learning outcomes significantly.

Discussion of Findings

The data presented in table 1 revealed that discussion teaching technique had a mean score of 14.95 and standard deviation of 5.83 in the pre-test and a mean score of 57.33 and standard deviation of the 6.68 making a pre-test post-test which give rise to a mean difference of 42.38. Activity-based teaching technique group had a mean score of 19.02 and standard deviation 5.42 in the pre-test and a post-test mean of mean of 76.78 and standard deviation of 6.65. The result revealed that foundry craft students achieved higher when taught moulding process with activity-based teaching technique than when taught with discussion teaching technique in technical colleges in Rivers State. Analysis of Covariance was used to test the hypothesis one (1) in table 3 and the F- calculated value for treatment of 567.084 with a significance of F-ratio of .000 is less than .05. Thus, there was a notable or significant difference between students' achievements when taught moulding process with activity-based teaching technique and when they are taught with discussion teaching technique in technical colleges in Rivers State. This implies that, activity-based teaching technique is more effective than discussion teaching method in enhancing academic achievement of foundry craft students in technical colleges in Rivers State. The higher achievement of the experimental group may be linked to the findings of Mandor (2002) as cited in Ogundu (2011) which indicated that the use of manipulative technique in teaching vocational skills could enhance performance by involving students in workshop, they can acquire process skills, making understanding of technical concepts easier and learning become less difficult.

From table 2, it was deduced that discussion teaching technique had a pretest mean score of 83.63 and standard deviation of 4.41 whereas the posttest mean score of 10.71 and standard deviation of the 2.65 with pretest - post-test mean difference of 72.92. Activity-based teaching technique group had a mean score of 93.06 and standard deviation 4.67 in the pre-test and a post-test mean of mean of 22.94 and standard deviation of 2.97 which give rise to a mean difference of 70.12. Analysis of Covariance was used to test the hypothesis two (2) in table 4 and the F- calculated value for treatment is 2.077 with a significance of F at .000 which is less than .05. Therefore, the null hypothesis was rejected at 0.05 level of significance. This indicated that there was a notable or significant difference between the achievements of students when taught heat treatment process using activity-based teaching technique and when they are taught with discussion teaching technique in favour of activity-based teaching technique. The finding of the present study is in line with the study of Momoh (2005) as cited in Ogundu (2011) which indicated that the three domains of students are influenced in greater proportion by the use of activity-based teaching technique. Momoh continued that student could discover facts, organize ideas as well as build concepts on their own to enhance performance.

Conclusion

The desire to find the most appropriate teaching technique to assist foundry craft students in their academic activities, stimulate and sustain their interest cannot be over-emphasized. Two objectives, research questions and hypotheses were posed and formulated to guide the study. The study found that there was significant difference in the mean achievement of students taught moulding process and heat treatment process using activity-based teaching technique and those taught using discussion teaching method. The difference in achievement between foundry craft students taught moulding process and heat treatment process using activity-based teaching technique and those taught using discussion teaching method was found to be significant at 0.05 level of significance.

Recommendations

In line with the findings of this study, the following were recommended;

1. Activity-based teaching technique should be adopted for teaching foundry craft in technical colleges in Rivers State and Nigeria in general.
2. Activity-based teaching technique should be encouraged in technical colleges through the provision of tools, materials, machines as well as equipment by the government (Federal, State and Local), Non-governmental organizations (NGOs) and students' alumni (Old Boys/Girls).
3. Foundry craft teachers should be trained on how to teach using activity-based teaching technique in technical colleges in Rivers State and Nigeria in general.

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