



EFFECT OF PROJECT-BASED AND DEMONSTRATION TEACHING STRATEGIES ON STUDENTS LEARNING OUTCOMES IN GENERAL METALWORK IN KWARA AND NIGER STATES, NIGERIA.

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ABSTRACT

The study investigated the effect of project-based and demonstration teaching strategies on students learning outcomes in general metalwork in Kwara and Niger States, Nigeria. Two research question and two null hypotheses guided the study. A Quasi-experimental research design was adopted for the study. The study was conducted in for technical colleges in Kwara and Niger State. The total of 59 respondents made up of 15 female students and 44 male students of technical colleges in Kwara and Niger State. The instruments, General Metalwork Technology Achievement Test (GMTAT) and General Metalwork Technology Interest Inventory (GMTII) are the two sets of lesson plans was subject to face and content validation by three experts from Department of Industrial and Technology Education, Federal University of Technology Minna, Niger State. A trial testing of the two sets of instruments was carried out to determine the internal consistency of the General Metalwork Achievement and Retention Test (GMART), and General Metalwork Interest Inventory (GMII) instruments using 20 randomly selected NTC II students from Government Technical College (GTC), Ankpa, Kogi State. Data collected for the study, was analysed using Statistical Package for Social Science (SPSS) version 23.0. Descriptive and inferential statistics was used to analyse the data. The findings among others revealed that both project based and demonstration teaching strategies are effective for improving students' academic achievement, interest and retention in general metalwork in technical colleges but project based is more effective for enhancing students' academic achievement and interest level of technical college students in general metalwork. Based on the finding it was recommended that General metalwork teachers should adopt the use of project based teaching strategy to enhance students' academic achievement and interest in general metalwork.

KEYWORDS: Vocational and Technical Education, Technical Colleges, General Metalwork, Teaching Strategies, Project Based Learning Strategy, Demonstration Method, Learning Outcomes, Interest and Achievement.

INTRODUCTION

Vocational and Technical Education is the factory for production of the needed technologists, technicians and craftsmen as well as skilled artisans who are required to turn the nations economics development around. According to Baba, Peter and Bala (2017), technical and vocational education and training (TVET) is the most reliable vehicle for self-sustenance, economic prosperity and political supremacy of a nation over others. TVET programmes vary from one country to another and are delivered at different institutions which include Universities, Polytechnics, Colleges of Education (Technical) and Technical Colleges.

Technical colleges are mainly established for the training of students to acquire practical skills, knowledge and attitudes essential for employment in various trades. Technical colleges are

institutions where students acquire knowledge, skills and attitudes in various occupations. They are post primary institutions equivalent to senior secondary schools. According to Beako et al (2018) technical colleges are established to prepare individuals to acquire practical skills and basic scientific knowledge. The general education courses offered in technical colleges in Nigeria include; English Language, Social Studies, Civil Education, Basic Science and Religion Studies, while trade areas include; Block laying and Concreting, Carpentering and Joinery, Fitting and Machining, Electrical Installation Work and Maintenance, Vehicle Body Building, Motor Vehicles Mechanic Work as well as fabrication and welding. In addition to the trade areas, students are expected to offered one of the trade related subject called General Metalwork.

General Metalwork is one of the trade related subject offered in technical colleges. Lkama, (2019) explained that general metalwork is a practical process of transforming metals to form various shapes and sizes, parts, assemblies, or large-scale structures. The general metalwork in this study covers a wide range of work from large ships and bridges to precise engine parts and delicate jewelry. It therefore includes a correspondingly wide range of skills, processes, and tools. Modern metalworking processes, though diverse and specialized, can be categorized as forming, cutting, or joining processes, furthermore today's machine shop includes a number of machine tools capable of creating precise and useful work piece.

The objective of general metalwork technology according to Lkama (2019) includes: the ability of the trainee to be able to select and use common measuring instruments, produce simple engineering components using casting process, identification of physical properties, manufacturing process and application of ferrous and nonferrous metal is common use. However, the successive attainment of the foregoing objectives depends on the effective adoption of the right teaching strategies.

Teaching strategies could be defined as both the teaching methods and materials used in the process of teaching. Instructional strategies determine the approaches a teacher may adopt to attain the learning objectives (Amadi & Akpomi, 2016). Dorgu (2015) explained that teaching strategies are approaches or methods used to assist the learner acquire or learn the desire contents and be able to develop achievable goal in the future. Teaching strategies in the context of this study is view as a combination of process where the teacher manages the class/workshop and used all the facilities to enhance students understanding in general metalwork which can only be achieved by effective learning strategies such as project-based learning strategies.

Project based learning strategy is a self-evaluation of learning and social skills which are indispensable for lifelong and life wide learning in knowledge-based society. Problem base learning (PBL) defined by Holm (2011) in a practice-based manner as "student-centered instruction that occurs over an extended time period, during which students select, plan, investigate and produce a product, presentation or performance that answers

a real-world question or responds to an authentic challenge. Project based in this study can increase students' interest because students' involvement in authentic problems, in working with others, in building real solutions. This strategy has some advantages over other teaching strategies like demonstration method.

Demonstration method is a technique of teaching concepts, principles, or real things by combining oral explanation with manipulation of real things, equipment or materials. Pulka and Volk, (2012) explained that demonstration as a teaching strategy is seen as the process of obtaining knowledge of technical and practical skill from an individual, a group or an institution. Demonstration trains the students to be good observers, encourages learning by doing and showing how tools, equipment and materials should be handled. Teachers need to adopt proper teaching methods to teach general metalwork for effective learning outcomes.

Learning outcomes are statements that describe the knowledge or skills students should acquire by the end of a particular assignment, class, course, or program, and help students understand why that knowledge. Akir *et al* (2012) explained that learning outcomes is the measurable skills, abilities, knowledge or values that students should be able to demonstrate as a result of a completing a course. Learning outcomes in the contest of the study measure the potential applications of knowledge and skills acquire by students in general metalwork class. Students learning outcomes mostly depends on students interest.

Interest as a zeal or willingness of participating in activity from which one derives some pleasure. Ogundola *et al.*, (2020) explained interest does not come as a result of force; it is as a result of an individual's eagerness to learn. Therefore, interest as an affective behaviour can be aroused and sustained in teaching and learning through appropriate teaching strategy. Interest in this study is the tendency of fabrication and welding students to become absorbed in arc and gas welding. There is need for technical teachers to stimulate students' interest in learning without which students' achievement will be minimal.

Achievement is the action of accomplishing something. Academic achievement of students therefore is the translation of the students' performance in achievement test into scores obtained in a cognitive test. Students' academic achievement refers to students' performance or

attainment in a subject (Adegunle, 2016). Additionally, student achievement can describe the level of achievement of students in terms of knowledge, skills and experience of learning formulated by learning objectives for the school curriculum (Nemeth & Long, 2012). The test results were followed by students reflects the extent to which students can achieve learning goals in each subject in educational institutions, thus increasing student achievement illustrates the quality of education is getting better. Likewise, declining student achievement illustrates the quality of education is low which will affect the students retention.

Several studies such as Marco et al., (2019) achievement based on gender to include that male and female genders are different in several respects such as the rate of brain development, brain lateralization (Marco et al., 2019), brain tasks execution strategies (Gomez et al., 2011), seeing and hearing endowed capabilities (Naomi, 2018), classroom learning climatic conditions (Hodgins, 2008) and learning strategies or styles (Mahmud & Nur, 2018). Opare (2011) also noted the effects of stereotyped belief notion that science and technology subjects are unfeminine and that women who study those courses are unattractive; the apparent perception of "low factor of safety" in some courses as well as "strength requirement" are some of the major factors that undermine the level of attendance and performance of female students in vocational education related trades, inclusive of general metalwork. Each or all of these factors poses constraint to academic achievement of students based on gender if left unchecked. One probable cause of this disparity may also not be unconnected to teaching methods employed by instructors to teach the students which were described by the National Business and Technical

Statement of the Research Problem

Technical College students have been having poor results in their final year National Business and Technical Examination Board (NABTEB) certificate particularly in metalwork. These results show that average failure rate in metalwork technology trade in the year 2014, 2015, 2016, 2017, 2018, were 73%, 69%, 68%, 72%, 47%, respectively (NABTEB, 2021). The metalwork craftsmen and master craftsmen are neither employed by relevant industries nor be self-employed, because of the limited skills acquired which may be as a result of wrong teaching methods of teaching used by their teachers and resources provided for the school for teaching. Therefore, there is need for a change of method and technique in the teaching of metalwork, so as to enable the students of technical college acquire adequate knowledge and skills for the world of work, hence, the problem of the study is to find out the effect of project based teaching strategies and demonstration teaching strategies on student learning outcomes in general Metalwork (MWT) in government technical colleges in Kwara and Niger State.

Aim and Objectives of the Study

The aims of this study is to determine the effects of project based and demonstration teaching strategies on students learning outcomes in general metalwork in technical colleges in Kwara and Niger States; specifically, the study will seek to determine the effect of:

1. Project-based and demonstration teaching strategies on students achievement in general metalwork.
2. Project-based and demonstration teaching

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demonstration teaching strategies on student achievement in general metalwork?

2. What is the effect of project-based and demonstration methods on students interest in general metalwork?

Hypotheses

The following null hypotheses was tested at 0.05 level of significance to guides the study

- HO₁: There was no significant difference between the means achievement score of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies.
- HO₂: There was no significant difference between the means interest score of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies.

METHODOLOGY

This study adopted a Quasi-experimental design. Specifically, the pre-test –post-test non-equivalent control group design for the study. Hence, an intact class was used in order not to disturb the academic programmes of schools involved in the study. The use of intact classes in a quasi-experimental design is supported by Dogru, (2014) who believed that learners in a secondary school class in most cases, form natural clusters having similar age, height and other attributes. The study was conducted in all the NBTE accredited technical colleges in Kwara & Niger States that have the trade area offering general metalwork as a trade related subject. The targeted population for this study used 76 NTC II (61 male and 15 female) students who are taking general metalwork in the twelve Technical Colleges in Kwara and Niger State. The sample for the study comprised of 59 NTC II General Metalwork students from four technical colleges in Kwara and Niger State. The instruments that was used for data collection are General Metalwork Technology Achievement Test (GMTAT), General Metalwork Technology Retention Tests (GMTRT) and General Metalwork Technology

Interest Inventory (GMTII). The researcher prepared two sets of lesson plans for the topics (module) selected for the study. Each set contains three lesson plans that lasted for three weeks and a minimum of 90 minutes duration. The instruments, General Metalwork Technology Achievement Test (GMTAT) and General Metalwork Technology Interest Inventory (GMTII) are the two sets of lesson plans was subject to face and content validation by three experts from Department of Industrial and Technology Education, Federal University of Technology Minna, Niger State. A trial testing of the two sets of instruments was carried out to determine the internal consistency of the General Metalwork Achievement and Retention Test (GMART), and General Metalwork Interest Inventory (GMII) instruments using 20 randomly selected NTC II students from Government Technical College (GTC), Ankpa, Kogi State. Data collected for the study, was analysed using Statistical Package for Social Science (SPSS) version 23.0. Descriptive and inferential statistics was used to analyse the data. The Descriptive statistics used in analysing the data is mean statistics that answered research questions. While inferential statistics was employ for the study using the General Linear Model (univariate) to perform the Analysis of Covariance (ANCOVA). If the significant of F calculated is less than 0.05, the null hypotheses was rejected and if the significance of F calculated is greater than 0.05, the null hypotheses was accepted.

RESULTS AND DISCUSSION

Research Question One

What is the effect of project-based and demonstration teaching strategies on student achievement in general metalwork?

The data for answering Research Question 1 is presented in table 4.1

Table 4.1: Mean of Pre-test and Post-test Achievement Scores of Students taught general metalwork using project-based and demonstration teaching strategies.

Groups	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Project Based Teaching Strategies	27	7.48	3.50	23.85	3.59	16.37
Demonstration Teaching Strategies	32	11.09	3.40	23.47	3.94	11.47

Table 1 shows that, the experimental group I taught with project based teaching strategies had pre-test mean achievement score of 7.48 with standard deviation of 3.50 and post-test score of 23.85 with standard deviation of 3.59. The mean gained between the pre-test and post-test of the experimental group I was 16.37. The experimental group II taught with demonstration teaching strategies had pre-test mean achievement score of 12.00 with standard deviation of 3.40 and post-test score of 23.47 with standard deviation of 3.94. The

mean gained between the pre-test and post-test of the experimental group II was 11.47. The experimental group I had higher mean gained than experimental group II.

Research Question Two

What is the effect of project-based and demonstration methods on students interest in general metalwork? The data for answering Research Question 2 is presented in table 4.2

Table 4.2: Mean of Pre-test and Post-test Interest Scores of Students taught general metalwork using project-based and demonstration methods

Groups	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Experimental Group I	27	2.27	0.28	3.45	0.13	1.18
Project-Based Experimental Group II	32	1.83	0.57	3.42	0.14	1.59
Demonstration Methods						

Table 2 shows that, the experimental group I taught with Project Based Teaching Strategies had pre-mean achievement score of 2.27 with standard deviation of 0.24 and post-test score of 3.45 with standard deviation of 0.13. The mean gained between the pre-test and post-test of the experimental group I was 1.18. The experimental group II taught with demonstration teaching strategies had pre-test mean achievement score of 1.83 with standard deviation of 0.57 and post-test score of 3.42 with standard deviation of 0.38. The mean gained between the pre-test and post-test of the experimental group II was 1.59. The

experimental group I had higher mean gained than experimental group II.

HYPOTHESES

Hypothesis One

There will be no significant difference between the means achievement score of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies.

The data for testing Research hypothesis 1 is presented in table 4.7

Table 4.7: Analysis of Covariance for the Test of Significance Difference Between the Achievement Scores of Students Taught General Metalwork Using Project Based Teaching Strategy and those Taught with Demonstration Teaching Strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2.771 ^a	2	1.385	0.095	.003
Intercept	3785.156	1	3785.156	0.000	.823
Pretest	0.622	1	0.622	0.837	.001
Group	2.771	1	2.771	0.665	.003
Error	816.755	56	14.585		
Total	33803.000	59			
Corrected Total	819.525	58			

a. R Squared = .003 (Adjusted R Squared = -.032)

Table 4.7 show the F-calculated value for testing the significance difference between the achievement scores of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies. The F calculated value of 0.665 was obtained with associated exact probability value of .003. Since the associated probability of 0.003 was less than 0.05 set as a level of significance, the null hypothesis which stated that there is no significance difference between the mean achievement scores of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies was rejected. Hence, there was

significance difference between the mean achievement scores of students taught between the mean achievement scores of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies.

Hypothesis Two

There will be no significant difference between the means interest score of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies.

The data for testing Research hypothesis 2 is presented in table 4.8

Table 4.8: Analysis of Covariance for the Test of Significance Difference Between the Interest Scores of Students Taught General Metalwork Using Project Based Teaching Strategy and Those Taught with Demonstration Teaching Strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	.070 ^a	2	.035	1.987	.147
Intercept	29.958	1	29.958	1692.975	.000
PREINTEREST	.052	1	.052	2.963	.091
TEACHINGMETHOD	.000	1	.000	.025	.875
Error	.991	56	.018		
Total	697.112	59			
Corrected Total	1.061	58			

a. R Squared = .066 (Adjusted R Squared = .033)

Table 4.8 show the F-calculated value for testing strategy and those taught with demonstration

hypothesis which stated that there is no significance difference between the mean interest scores of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies is accepted. Hence, there was no significance difference between the mean interest scores of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies.

DISCUSSION OF FINDINGS

Findings in the table 4.1 relating to research question 1 on effects of project based teaching

strategy and those taught with demonstration academic achievement. This means that students expressed that they achieved meaningful learning as a result of the project-based learning application and the method was adequate for the instruction process, improved their performance in the course and related the content with daily life. The finding is related to the findings of Tanner and Tanner (2008), that the project method represents a problem-centred instructional design is geared at integrating subject matter, teaching reflective thinking and helping learners to solve their problems. Similarly the finding of this study is

supported by the findings of Evans (2009) that found significant improvement in the students' academic achievement and peer interaction. Furthermore the finding supports Eze *et al.*, (2021) revealed that project teaching method is relatively more effective than demonstration teaching method in improving students' academic achievement in general metalwork.

Furthermore, findings on the test of significant difference among the achievement scores of students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategy revealed statistically significant difference between the achievement mean scores of students taught general metalwork using project based teaching strategies and those taught with demonstration teaching strategies. Evidently, the treatment students in the project based teaching strategies group exposed to be responsible for the significant difference in the achievement mean score of students between the two groups. The finding is in conformity with the findings of Eze *et al.*, (2021) that they study found a statistically significant difference in the mean academic achievement scores of students taught general metalwork using project teaching method and those taught using demonstration teaching method. This finding is in agreement with (Borich, 2011); (Thompson and Soyibo, 2012); and (Nsa, 2002), who found that project teaching method is relatively more effective than demonstration teaching method in enhancing students' academic achievement in social studies, chemistry and agricultural Science respectively. This finding supported the finding of Halil, Haydar and Aziz (2018) that there is a significant difference in the academic achievement of students on instruction of AUTOCAD programming as a result of project-based learning application. This could be because project-based learning stimulates critical thinking skills and involves the active engagement of learners as they collaborate in groups

The Findings on table 4.2 relating to research question 2 on the effects of students taught general metalwork using project based teaching method had lower mean gain interest scores than students taught using demonstration method in Niger and Kwara state Nigeria revealed that, students taught general metalwork using demonstration teaching strategy obtained higher interest mean scores than the students taught with project based teaching strategy in the general metalwork interest

inventory. The finding of this study is in support of the finding of Okocha (1994) who reported that demonstration method was more effective in learning physic concepts. This showed that, demonstration method was more effective than the lecture method. This is in line with Moore (1996) reports which said that students remember 90% of what they see and do than what they hear. This finding is also in line with Fred (2010) findings, who reported that teacher demonstration method was more effective in learning chemistry subject at central/high school Kanas City Missouri than individual laboratory. This result is in congruence with the findings of Aladag (2010); Ugwu (2014) and Mohammed, Bala & Ladu (2016) on the academic achievement of students in their studies. The result shows that demonstration method gives the students opportunity to repeat what the teacher had done in the class and students who were actively committed to the learning process achieve success.

The finding on table 2 hypotheses 4 revealed that there was no significance difference between the mean interest scores of students students taught general metalwork using project based teaching strategy and those taught with demonstration teaching strategies. The finding is in conformity with the findings of Ezech (2006) who also reported a similar findings of statistical significant difference in the interest mean scores of students taught map work using scale models and those taught using conventional teaching methods in his study titled: effect of the use of scale models on academic achievement and interest of students in map-work.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the findings of the study, it was concluded that both project based and demonstration teaching strategies are effective for improving students' academic achievement, interest and retention in general metalwork in technical colleges but project based is more effective for enhancing students' academic achievement and interest level of technical college students in general metalwork. Also there is no significant difference in the mean achievement, interest and retention scores of male and female students in the teaching of general metalwork in technical colleges. The implication of the finding is that, the adoption of demonstration teaching strategy hold the potential to enhance students' academic achievement, interest and retention in

general metalwork. Nevertheless, the findings are limited to the contents of general metalwork at technical colleges in Nigeria. Therefore, it is concluded that, project based teaching strategy had positive effects on students' academic achievement, interest and retention in general Metalwork.

RECOMMENDATIONS

Based on the findings from the study, the following recommendations were made:

1. General metalwork teachers should adopt the use of project based teaching strategy to enhance students' academic achievement, interest and retention in general metalwork.
2. General metalwork students should also embrace teaching and learning through the use of project based teaching strategy in other to enhance their academic achievement, interest and retention.
3. All students should be given equal opportunity, the same level of encouragement and motivation irrespective of gender in the teaching and learning of general metalwork.

Suggestion for Further Research

Based on the findings of this study the following suggestions were made for further research:

1. A similar study to determine the effect of project based teaching strategy in other vocational areas such as motor vehicle mechanics work, building construction, electronics work, fabrication and wedding and woodwork should be carried out.
2. Effect of project based and demonstration teaching strategy on student's psychomotor achievement and retention in general metalwork and fabrication and welding at technical colleges in Nigeria.

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