Direct Research Journal of Education and Vocational Studies

Vol. 6(3), Pp. 1-8, November 2024,

https://journals.directresearchpublisher.org/index.php/drjevs

Research Article
ISSN: 2734-2174

Effects of Demonstration, Project-based and Lecture Instructional Methods on Polytechnics Students' Academic Achievement in Workshop Practice in Delta and Edo States

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ABSTRACT

The study examined the effects of demonstration, project-based, and lecture instructional methods on polytechnic students' academic achievement in workshop practice in Delta and Edo States. Four research questions were raised and answered and four corresponding hypotheses were formulated and tested at the 0.05 significant level. A non-equivalent pre-test, post-test, quasi-experimental research design using a factorial design was adopted for the study. The population of this study comprised a total of 235 National Diploma (ND) Year II workshop practice students in three (3) government-owned polytechnics in Delta and Edo States for the 2022/2023 session. As the number of ND II polytechnics students offering Workshop Practice was not large, purposive sampling techniques were carried out, and the sample size of the study remained 235. The instrument used for the study was the Work Practice Achievement Test (WPAT). Face validity of the WPAT was done by three experts from Delta State University, Abraka. The reliability of the validated instrument was computed using the Kuder-Richardson formula-21, and a reliability index of 0.71 was obtained. The students learned in their various groups for six weeks and at the end of the instruction, a post-test was administered to the students with the WPAT. Data collected for the research questions were answered using mean scores and standard deviations. The findings showed that there was: significant difference in the mean academic achievement scores of polytechnic students taught workshop practice using demonstration, project-based and lecture instructional methods but no significant difference in the mean academic achievement scores of male and female students taught workshop practice with various instructional methods in Delta and Edo States polytechnics.

Keywords: *Academic achievement, Delta and Edo States, demonstration, gender, lecture, project-based, pre-test, post-test*

Article information
Received 8 October 2024;
Accepted 1 November 2024
Published 6 November 2024
DOI: https://doi.org/10.26765/DRJEVS50812457

Citation: Akinseinde,S. I., Umunadi, K.E., and Aiminhiefe, M. I. (2024). Effects of Demonstration, Project-based and Lecture Instructional Methods on Polytechnics Students' Academic Achievement in Workshop Practice in Delta and Edo States. *Direct Research Journal of Education and Vocational Studies*. Vol. 6(3), Pp. 1-8. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

The Nigerian polytechnics are set up with the view of preparing individuals to become technologists, technicians, and competent managers in different disciplines. Courses offered in polytechnics are designed to meet the needs, hopes, and dreams of Nigerians as well as bring about the economic and industrial development of the nation. In polytechnics, workshop practice is a course that focuses on the practical use of advanced equipment, machineries, and tools to diverse manufacturing tasks and the goal is to provide a consistent and appropriate attitude to the task, as well as a positive outcome (Shani, 2018). Nwadiani & Ugolo (2011) noted that instructional methods used by lecturers in the teaching of workshop practice constituted one of

the major factors contributing to students' academic achievement, which is a measure of the extent to which a student has performed in a particular set of tasks that have been taught. Instructional methods that could be used to facilitate the teaching and learning of technical subjects, particularly in workshop practice in polytechnics, are the use of demonstration and project-based methods. The demonstration method in technical fields, especially in the workshop practice classroom, may help to capture students' attention and help them comprehend the information the lecturer is presenting to them. Project-Based Instructional Method is a teaching method in which students learn by actively engaging in real-world and meaningful projects. Project-based instructional method can be described as a student-centered method that takes a long period in which students pick, plan, research and produce a product. The use of a project-based learning method could enable students to acquire an exploration skill and discover their learning type as well as their method of learning. In Project Based Learning, teachers make learning come alive for students.

Workshop practice is a crucial aspect of vocational education, particularly in polytechnics. It provides students with hands-on experience and practical skills necessary for their future careers. In recent times, the teaching and learning of Workshop practice have been faced with numerous problems that are capable of hampering the attainment of the objectives specified by the National Policy on Education (FGN, 2013). One such problem is the low academic achievement in workshop practice as observed from the examination results of some polytechnics in Nigeria including Delta and Edo States between 2020 and 2022, while there were also some students that dropped out from Polytechnics.

This problem of poor academic achievement among workshop practice students has over the years been attributed to lecturers' use of ineffective instructional methods in workshop practice classes. According to the researcher's own observations, workshop practice lecturers now rely more on the lecture method of instruction than on the creative, student-centered teaching approach. Apparently, the lecture method does not encourage the development of workplace basics skills, which are essential for students to be employable in the 21st century workplace. It may be that lecturers' lack of use of innovative teaching methods such as demonstration and project-based instructional methods is the major factor contributing to students' poor academic achievement in workshop practice. However, the demonstration and project-based instructional methods might be used as an effective strategy in enhancing students' academic achievement which may produce the desired effective teaching such that students' academic achievement improves. To the best of the researcher's knowledge, whether this demonstration method and those taught with project-based instructional methods could enhance students' academic achievement better than the lecture method among workshop practice students in Polytechnics in Delta and Edo States is yet to be empirically established. Besides, studies have also indicated that disparities exist between male and female students' achievement in technical courses because generally, male students have been observed to achieve higher than female in vocational and technical courses (Umunadi, 2011). The use of lecture method has not been able to bridge academic achievement on the basis of sex. Demonstration and project-based methods may bridge the gap between academic achievement of male and female in Workshop Practice.

Purpose of the study

The main purpose of the study is to examine the effects of demonstration; project-based and lecture instructional methods on polytechnics Students' academic achievement in workshop practices in Delta and Edo States.

Concept of academic achievement

Academic achievement is a multifaceted concept that encompasses a student's performance and success in educational endeavors. It is often used to assess a student's knowledge, skills, and accomplishments in various academic subjects or areas of study. According to Bell (2012) academic achievement is used to measure students' success in educational institutions or how well students meet standards set out by examining bodies or the institution. Academic achievement in this study is the outcome of students' effort in examinations (Eze et al., 2016). The definition of academic achievement depends on the indicators used to measure it. Among the many criteria that indicate academic achievement, there are curricular-based criteria such as grades or performance on an educational achievement test.

Concept of workshop practice

Workshop Practice is a study programme that prepares students to handle practical work in an engineering setting. The goal of workshop practice is for students to become familiar with a variety of techniques and how they are used in the creation of things. The backbone of the genuine industrial environment is workshop practice, which aids in the development and enhancement of the relevant technical hand skills required by technicians working in diverse engineering industries and workshops (Gujarat Technological University, 2019). This implies that workshop practice as a course of study aims to teach students the fundamentals of various hand tools and how to use them in diverse manufacturing applications.

Workshop practise for students is the foundation of the technology that creates a true industrial environment for students and aids in enhancing the pertinent technical hand skills required by the technicians working in the various engineering industries (Prashant et al., 2020). Students have the chance to improve their knowledge of choosing acceptable materials, using the right tools and equipment, following best practises for production, and operating machines in workshop practise. The ability to solve difficulties in the workplace and at home is a skill that workshop practise teaches students (Prashant et al., 2020). Regardless of branch, incorporating workshop practice into daily industrial and domestic life aids in the resolution of issues. Walczak et al.(2013) explained that workshop practice presents students with a comprehensive overview of engineering materials, tools, and equipment typically utilized in the engineering sector, as well as a clear and succinct explanation of the fundamental concepts of manufacturing processes. Workshop practice as a course enable learners to understand the fundamentals of several workshop procedures such as primary and secondary shaping, metal joining methods, surface finishing, and heat treatment. Bench work, fitting, arc welding, sheet metal work, carpentry, blacksmithing, and foundry are some of the hand-working processes covered in workshop practice. It also highlights the need to follow safety precautions in workshop procedures and describes how to keep track of the practices.

Concept of demonstration method

Demonstrations are ways to illustrate concepts in a lecture or lesson without utilizing traditional methods or a visual aid. Students are able to observe a subject in action in real life by delivering it in a variety of ways. The demonstration method is a teaching method that makes it easy for teachers to teach students in such a way that they find it less difficult to connect theories to actual practice, or make students easily understand and translate theories to actual practice (Mubanga & Mubanga, 2020). The purpose of using demonstrations method is to show the process of occurrence of an event based on the teaching materials and how they are attained and an ease to the understanding for students in teaching and learning processes (Ramadhan & Surya, 2017). Demonstration is a form of presentation whereby the teacher or learner shows how something works or operates, or how something is done. It is a teaching method that allows students to see the teacher actively engaged as a learner and a model rather than merely telling them what they need to know. Demonstration method is the method of exhibiting and demonstrating things, ideas, rules, and sequence etc. It is an activity to engage the learners in the task by concentration and paying heed to them to convey the subject matter to the students. The purpose of using demonstration method is to exhibit the existence of the material to be learned and taught (Doyle & Zakrajsek, 2018). A demonstration in Workshop practice may be defined as a pedagogical event whose objective is to illustrate a scientific concept (Ogbuanya, Akintonde & Bakare, 2017). Inductive demonstrations can also be presented by the instructor asking numerous questions without frequently providing responses. An advantage of an inductive demonstration is that it emphasizes inquiry, which enables students to think critically and form hypotheses based on what they know (Odu, 2018). For instance, to motivate and arouse students' curiosity before teaching, to show a phenomenon, concept, law, theory, or process, and to assist students in articulating and exploring their existing ideas (Papavlasopoulou, Giannakos, & Jaccheri, 2019).

Concept of project-based method

The word “project” in “project-based learning method” emphasizes the development of an idea, imagination and planning. According to Ayaz and Söylemez (2015), the project is actually a work that needs to be planned out and because of this, project-based learning emphasizes developing an idea, imagination, planning, and editing. Project-based teaching method is an active strategy that encourages learners to become as involved and engaged in the learning process as possible. It calls on the teacher to invigorate the learning situation by fostering student collaboration to research, make choices, and address project obstacles. In order to facilitate deeper learning, it is also necessary to activate an assessment system that fosters attention, reflection, and a critical attitude (Torre-Neches, Rubia-Avi & Aparicio-Herguedas, 2020).

Project-based teaching method is a method whereby students plan and develop projects connected to the professional world (Almulla, 2020). The project-based learning method is especially suitable for technical subjects where students also have to use, integrate and implement what they have learned in a number of subjects. Zahran (2018) stated that in project-based learning, students plan, implement, and evaluate projects that have real-world applications beyond the classroom. Moreover, learning activities that are interdisciplinary, long term, student-centered, and integrated with real-world issues and practices are emphasized, rather than short, isolated lessons. Learning not only prepares one for life but should also be an integral part of life itself. Simulating real problems and real problem solving is an integral function of project-based learning (Özdemir, 2018).

The use of project-based learning in class is possible after providing the information that is needed for the project. Classroom activities should be student-centered, cooperative, and interactive. Group members are responsible for their own learning. The teacher plays the

role of the collaborator, the facilitator and the learner (Moursund, 2019). The children represent their experiences and show their understanding of the concepts involved by explaining them. The teacher helps the children develop questions their investigation will answer. Besides, the finished project should be consistent with known principles and standard practices. Project should be selected on their value and relevance to the learning objectives. Students need to understand the activities, the reason for doing it and the skill to develop on completion of the project (Akinseinde, 2020).

METHODOLOGY

Non-equivalent pre-test, post-test, planned variation quasi-experimental, research design using a 3 × 2 factorial design. The design has treatments (instructional methods) at three levels (demonstration method, project-based and lecture methods), sex at two levels (male and female). The 3 × 2 Factorial Matrix research design is shown in (Table 1). This design was considered appropriate due to the intact classes and the rigid school timetable that would not allow the researcher to fully randomize the subjects. The design however allowed the researcher to assign students to experimental and control groups based on their intact classes. The quasi-experimental design also allowed for some control and manipulation of the independent variables or the learning conditions to be done.

Table 1: Graphical Representation of the 3 × 2 Factorial Matrix Research Design.

Group	Pre-test	Treatment	Post-test	Gender
Demonstration Meth	Q_1	X_1	Q_2	Male; Female
Project-based Method	Q_3	X_2	Q_4	Male; Female
Lecture Method	Q_5	X_3	Q_6	Male; Female

where
O_1 = Pretest for Demonstration Method group
X_1 = Experimental Treatment for Demonstration Method group
O_2 = Posttest for Demonstration Method group
O_3 = Pretest for Project Based Method group
X_2 = Experimental Treatment for Project Based Method group
O_4 = Posttest for Project Based Method group
O_5 = Pretest for lecture method group
X_3 = Experimental Treatment for lecture method group
O_6 = Posttest for lecture method

Population of the study

The population of this study comprises a total of 235 National Diploma (ND) Year II students offering Workshop Practice in three government-owned polytechnics in Delta and Edo States for the 2022/2023 session (Table 2).

Sample and sampling techniques

Since the number of polytechnics in Delta and Edo States and the ND II students offering Workshop Practice (WP) is not large, all the students offering the course were used for the study. The sample size of the study was 235. Hence, three intact classes of workshop practice were used, one from each polytechnic. For this study, one class was randomly assigned to each of the treatment groups using a simple random sampling technique with one instructional method. In this way, demonstration method (experimental group) was assigned to Delta State Polytechnic, Otefe-Oghara; Project-based method (experimental group) was assigned to Auchi Polytechnic, Auchi and the lecture method was assigned to Delta State Polytechnic, Ogwashi-Uku. The selected schools and the assigned treatment methods are illustrated in (Table 3).

Research instrument

The instrument that was used for the study is the Work Practice Achievement Test (WPAT) based on the lesson plan developed by the researcher. The WPAT was used for data collection. The WPAT consists of two sections. Section A contained instruction on the student's bio-data (group number and sex) while Section B contains of 50 multiple-objective test-items with option letters A – D covering six concepts or topics.

Validity of the instrument

To validate the Work Practice Achievement Test (WPAT), the researcher requested the assistance of three experts, from Delta State University, Abraka, one of whom is the researcher's supervisor. Two of the experts, which also include one of the researcher's Supervisors, were in the Technical Education Department and the other one was from Measurement and Evaluation.

Reliability of the instrument

The researcher carried out a trial test of the WPAT on 50 ND II students from Anambra State Polytechnic, Mgbakwu. Data collected through the test was used to compute the reliability of the instrument. The Kuder-Richardson formula-21 was used to compute the reliability index which yield 0.71. The reliability was done in order to determine the internal consistency of WPAT and he instrument was found reliable.

Treatment

Before the commencement of actual instruction in each sampled polytechnic, there was administration of pre-test to determine the equivalence of the groups as well as to measure the level of prior knowledge of the topics on which the test was based. For six weeks, the regular workshop practice lecturers at each polytechnic used the

Table 2: Population Distribution of ND II Students Offering Workshop Practice in all the Four (4) Government-owned Polytechnics in Delta and Edo States.

Name of Polytechnics	State	Number of Students		
		Male	Female	Total
Auchi Polytechnic, Auchi,	Edo	76	62	138
Delta State Polytechnic Ogwashi-Uku	Delta	29	18	47
Delta State Polytechnic, Otefe-Oghara	Delta	31	19	50
Total		136	99	235

Source: Office of the Head of Department in Delta and Edo States Polytechnics, 2022/2023 Academic Session.

Table 3: The selected polytechnics and the assigned instructional methods

Treatment Method	Name of Polytechnics	State	Number of students offering workshop practice		
			Male	Female	Total
Demonstration Method	Delta State Polytechnic, Otefe-Oghara	Delta	31	19	50
Project-based Method	Auchi Polytechnic, Auchi.	Edo	76	62	138
Lecture method	Delta State Polytechnic, Ogwashi-Uku	Delta	29	1	47
	Grand Total		136	99	235

Source: Researcher calculation of sample size.

Table 4: Comparison of the mean achievement score of workshop practice students taught with demonstration, project-based and lecture instructional method

Treatment Group	Number	Mean	Standard Deviation (SD)	Mean Difference	Mean	Standard Deviation (SD)	Mean Difference
Demonstration method	50	11.84	4.62		51.62	15.13	
Project-based instructional method	138	12.35	7.18	0.51	58.65	15.45	7.03
Lecture instructional method	47	12.17	4.37	0.81	42.05	13.09	16.60
Total	235						

Table 5: Comparison of the mean achievement scores of male and female students taught workshop practice using demonstration method in Polytechnic in Delta and Edo States

		Post-test Scores		
Sex	N	Mean	Std. Deviation	Mean Difference
Male	31	49.16	11.63	6.47
Female	19	55.63	19.24	
Total	50			

lesson plans that the researcher made for each group to teach and the students learned in their various groups. In the lecture group, the instructors only used the lecture method, and in the other groups, demonstration and project-based instructional methods were used. At the end of the instruction by the instructors of the respective groups in each polytechnic, a post-test was administered to the students with the same WPAT.

Method of data analysis

The research questions were answered using mean scores and standard deviations. Hypotheses were tested with one-way ANOVA and independent t-test. On the analysis, Hypotheses One was tested using one-way ANOVA while Hypotheses Two to Four were tested using independent t-test. All hypotheses were tested at 0.05 alpha level of significance.

RESULTS AND DISCUSSION

Table 4 shows that the Demonstration instructional method post-test mean scores was 51.62, with standard deviation of 15.13; the Project-based instructional method group post-test had mean scores of 58.65, with standard deviation 15.45 while the Lecture instructional method group has post-test mean scores of 42.05, with standard deviation of 13.09. The pre-test and post-test mean achievement scores for the demonstration instructional method had a difference of 39.78, the difference between the pre-test and post-test mean achievement scores for project-based was 46.30 while the difference between the pretest and posttest mean achievement scores for lecture instructional method was 29.88. This is an indication that the Project-based and Demonstration enhance learning better than the Lecture instructional method. At the same time the Project-based Instruction method tend to be the best. Table 5 shows that the post-test mean academic achievement scores of male students taught workshop practice using demonstration method in polytechnic in Delta and Edo states are 49.16, with standard deviation of 11.63 while the female students taught using the demonstration method had post-test mean scores of 55.63, with standard deviation of 19.24.

Table 6: Comparison of the mean achievement scores of male and female students taught workshop practice using project-based instructional method in Delta and Edo States.

		Post-test Scores		
Sex	**N**	**Mean**	**Std. Deviation**	**Mean Difference**
Male	76	59.84	15.63	2.65
Female	62	57.19	15.22	
Total	138			

Table 7: Comparison of the mean achievement scores of male and female students taught workshop practice using lecture instructional method in Delta and Edo States**.**

		Post-test Scores		
Sex	**N**	**Mean**	**Std. Deviation**	**Mean Difference**
Male	29	43.44	11.89	3.64
Female	18	39.80	14.89	
Total	47			

The post-test mean score is higher for female students (55.63) compared to male students (49.16).

Table 6 shows that the posttest mean academic achievement scores of male students taught workshop practice using project-based instructional method in Polytechnic in Delta and Edo states are 59.84, with standard deviation of 15.63 while the female students taught using the project-based instructional method had posttest mean scores of 57.19, with standard deviation of 15.22. The post-test is higher for male students (59.84) compared to female students (57.19).

Table 7 shows that the post-test mean academic achievement scores of male students taught workshop practice using lecture method in polytechnic in Delta and Edo states are 43.44, with standard deviation of 11.89 while, the female students taught using the lecture method had post-test mean scores of 39.80, with standard deviation of 14.89. The post-test, is higher for male students (43.44) compared to female students (39.80). Analysis of Hypothesis One showed that there was significant difference in the mean academic achievement scores of polytechnic students taught workshop practice using demonstration method, project-based and lecture instructional methods in Delta and Edo States. The direction for this significant difference was explained by a Post-hoc test which revealed that: all the students in the demonstration and project-based instructional methods significantly outscored those in the lecture instructional method while students in the demonstration and project-based instructional methods significantly differ from one another. This implies that project-based instructional method enhanced students' achievement more than demonstration and the lecture instructional methods. This finding is in line with a study by Alachi et al. (2016) which found that there is statistically significant difference in the mean score of students' achievement in physics between the group taught with project-based method and lecture method. This finding is consistent with Eze et al. (2020) who found out that project-based instructional method enhanced students' achievement more than demonstration and the lecture instructional methods. Analysis of Hypotheses Two, Three and Four showed that there was no significant difference in the mean academic achievement scores of male and female polytechnic students taught workshop practice using demonstration, project-based and lecture instructional methods in Delta and Edo States. This finding aligns with Onyeka, and Okoye (2023) who found that there was no significant difference in the mean academic achievement scores of male and female students taught using demonstration and project-based instructional methods and also in line with the findings of Almusharraf et al (2020) who observed that lecture method has both advantages and limitations when it comes to the academic achievement of male and female students.

Findings

The findings of the study indicate that:

1. There was significant difference in the mean academic achievement scores of polytechnic students taught workshop practice using demonstration method, project-based and lecture instructional methods.
2. There was no significant difference in the mean academic achievement scores of male and female students taught workshop practice using demonstration method in polytechnics in Delta and Edo States.
3. There was no significant difference in the mean academic achievement scores of male and female

polytechnic students taught workshop practice using project-based instructional method.
4. There was no significant difference in the mean academic achievement scores of male and female polytechnic students taught workshop practice using lecture instructional method.

Conclusion

From the findings of this study, it was concluded that all the students in the demonstration and project-based instructional methods significantly outscored those in the lecture instructional method. Also, students in the demonstration and project-based instructional methods significantly differ from one another. That is, the project-based instructional method enhanced students' achievement more than the demonstration and lecture instructional methods. Since the result of the study showed that demonstration, project-based, and lecture instructional methods interact with sex and ability of students in a way that significantly affects students' academic achievement, it can therefore be concluded that the instructional methods and ability interact to influence students' academic achievement.

Recommendations

Based on the findings of this study the following recommendations were made:

1. Workshop practice lecturers should make a deliberate efforts to incorporate demonstration and project-based instructional methods into the teaching of workshop practice so as to encourage active engagement in learning, learning by doing, and gaining knowledge and experience in the classroom, as well as to promote better academic achievement among polytechnic students.
2. Workshop practice lecturers should ensure active participation of both male and females during the teaching and learning of workshop practice through the use of demonstration and project-based instructional methods to enhance academic achievement in students irrespective of sex and ability.
3. In view of the fact that demonstration and project-based instructional methods are more effective in teaching workshop practice and enhancing students' academic achievement than lecture methods, polytechnic administrators such as Rectors, Deans, and Heads of Departments should encourage lecturers writing textbooks on workshop practice to incorporate practical ways of demonstration and project-based instructional methods in the teaching of workshop practice concepts in polytechnic students to improve students' achievement.

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