

Effect of Project-Based Learning on Students' Performance in Electrical Installation and Maintenance Works in Technical Colleges in Edo State

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Abstract

The study examined the effect of project-based on students' performance in Electrical Installation and Maintenance Works in Edo state technical colleges. Two hypotheses were formulated and tested at .05 level of significance in this study. The study adopted a quasi-experimental research design precisely the pretest and posttest non-equivalent control group design. The population of the study comprised all the 189 Vocational II students' offering Electrical Wiring in the six technical colleges of Edo State. Two intact classes were used which was made up of 64 students from two technical colleges in the three senatorial district of Edo State. The instrument for data collection in this study was titled: Electrical Installation and Maintenance Works Achievement Test (EIMWAT). The data collected were analyzed using mean, standard deviation, t-test and Analysis of Covariance (ANCOVA). Mean and standard deviation were used to answer the research question while the hypotheses were analyzed and tested at .05 level of significance. The result shows that difference existed between the pretest and posttest mean score of students taught Industrial Electrical Wiring using Project-Based and Conventional Teaching Method. Finally, there was no significant interaction effect of treatments given to students based on gender in technical colleges in Edo State. Based on these findings, the researcher concluded that Project-Based and conventional teaching Method promotes academic gain, creates healthy competition and good teamwork among students. Sequel to these findings, the researcher therefore recommends that Project-Based should be adopted as instructional techniques for teaching and learning of Industrial Electrical Wiring in technical colleges in Edo State.

Introduction

Education is the pivot upon which all academics activities rotate. It may be informal or formal. Formal education consists mostly of initial education. Special needs education, some parts of adult education and vocational education are often recognized as being part of the formal education system. Therefore, in the context of the research work, the type of education which occupationally prepares the youth for useful living in the society is vocational education.

According to Uwameiye (2010), vocational education prepares youths for employment in industries, commerce and other enterprises by revealing them to practices that offer manipulative, cognitive and attitudinal skills that make them qualify for it. Vocational education also provides experiences for adult who are already employed, and whose skills may have become obsolete, and then require to update their skills. In addition, Vocational Education may provide experiences for adults who require skills in a different occupation entirely. Therefore, the aim of vocational education is to provide training for gainful employment, and re-training for progress within the occupation. Vocational education lays emphasis on exposing clients to experiences of the real world of works and the domains of skills, which are manipulative (psychomotor), informational (cognitive), and attitudinal (affective). These three domains of skill acquisition are important for the success of individuals in any job situation.

Vocational education is offered in technical colleges, leading to the award of National Technical Certificates (NTC) and Advance National Technical Certificate (ANTC). The National Technical Certificate level programme lasts three years after the junior secondary school. It is an equivalent to senior secondary education. The ANTC programme entails two years pre entry industrial work experience and ranks on the lower level of tertiary programmes. All certificates are awarded by the National Business and Technical Examination Board (NABTEB). One of the vocational programmes offered in technical colleges in Nigeria is Electrical Installation and Maintenance Works (EIMW).

Electrical Installation and Maintenance Work is the study or acquisition of electrical skills that is performed during the erection or construction of structures of building which entails the installation of electrical materials and maintenance. The objectives that guide the teaching of EIMW in technical college in Nigeria include to:

1. provide technical training to meet the demand of electrical industries and individuals by allowing the students to identify their career objective;

2. prepare an individual with job satisfying skills towards employment and self-reliance; and
3. prepare students to acquire entry level knowledge and manipulative skills for employment in technical industry (National Board for Technical Education (NBTE), 2012).

Although these objectives are laudable, there seems to be an impediment in the realization of these objectives in technical colleges because EIMW is practically oriented. To adequately realize these objectives, proper instructional techniques must be adopted to actualize these laudable objectives. Generally, the Non-traditional teaching methods help to awake students' curiosity and creativity and motivate them to participate in class activities (Kermanshachi, [2018](#)). These methods are focused mainly on the activity and independent work of students, who gradually move from the passive method of acquiring knowledge (e.g. interpretation, explanation) to more active methods of acquiring information and become more or less independent implementers of their own education this way.

However, other teaching methods like project-based, play-away method; demonstration method etc has positive impact on the students' performance. Thus, this study we be concern with the effectiveness of project-based learning method on students' performance. Bell (2010) found that project-based learning helps students become independent learners. Independent learners involve learning effective planning and organization skills, an increase in collaboration and social skills and intrinsic motivation for learning. To Harris, Mishra and Koehler (2009), incorporating technology properly into projects has the ability of mixing together technological knowledge, content knowledge and pedagogical knowledge together to create technological pedagogical content knowledge. They further explained that each piece of technology made available create different effects on human ability to think or solve, by allowing students choice, in how they present, create, research and inquire, educators give students the power of knowledge and control of student learning which truly exercise their thoughts and knowledge. Maros, Korenkova, Fila, Levicky and Schoberova (2021) stated that implementation of project-based learning can significantly change the classroom experience of both teachers and students. It can change the way teachers teach, how students learn, and how teachers and students interact. Project-based learning can also alter how students respond to the general learning process.

Statement of the Problem

Students' performance in electrical installation and maintenance works subject has not been encouraging. Judging from the recent results obtained from students of EIMW NABTEB examination for the past five years. Out of the 817 candidates that sat for the examination, 27 (3.3%) candidates passed at A and B level, 99 (12.1%) candidates passed at credit level, 236 (28.9%) passed with passed grade and 455 (55.7%) failed the examinations (see table on appendix xviii). This analysis shows poor performance in Electrical Installation and Maintenance Work in Edo State technical colleges.

A number of instructional methods have been used since EIMW have been introduced to technical colleges. It is good to provide technical college students with the best skills and attitude for acquiring knowledge so that they would be adequately prepared to deal with future technological challenges. Poor students' performance in Electrical Installation and Maintenance work seems to be attributed to mainly expository with little or no involvement in practical projects. Again, the methods that have been adopted in teaching Electrical Installation and Maintenance Work all along may not be very effective. To this end, one may say that the quality of instruction provided to the students is intricately linked to the strategies the teacher adopted in passing knowledge to students in college. Study on students' performance in schools subject reported inefficient teaching methods by school teachers as a major factor for the (Pepple, 2010).

All of the above-mentioned factors may lead to students' performance in EIMW. The problem of the study therefore is poor students' performance of EIMW. It is against this background, that the researcher sought to investigate the effect of project-based technique and small-group discussion on students' performance in Electrical Installation and Maintenance Works in technical colleges in Edo State.

Method of Study

The study adopted a quasi-experimental research design, specifically, the pretest and posttest, non-equivalent group design. According to Nworgu (2006) quasi-experimental design involved the use of intact class or pre-existing groups which are not equal in size. A quasi-experimental design means that experimental designs are applied to real situation. This is because the aim is to maintain the reality of the classroom and the conditions proper to it. Group I and II were the experimental group which received a pre-test followed by a treatment condition (project-based technique),

thereafter, a post-test. Group II was the control group, which received a pre-test followed by the control condition (lecture method) and then the post-test. The population of the study comprised all the 189 Voc. II Electrical Installation and Maintenance Works students in the six technical colleges in Edo State, Nigeria. and Sampling Technique 62 Electrical Installation and Maintenance Works students were Sample in Edo State technical colleges were used for the study. Purposive simple technique was used to select the two technical colleges in the three senatorial districts of Edo State, Nigeria. Each technical college constituted a treatment group. The selection of the schools to either experimental or control group was done using the two intact classes.

The instrument for the study was titled “Electrical Installation and Maintenance Works Achievement Test (EIMWAT)” developed by the researcher. The EIMWAT contained 55 multiple choice items with five options divided into two Parts. Part A and Part B. The version tagged Part A was used as pre-test while Part B was used as posttest. The lesson note was used by the Electrical Installation and Maintenance Works teachers who were the research assistants. Items in the EIMWAT were drawn from the topics in Electrical Installation and Maintenance Works as specified in the NABTEB curriculum for Voc. II in technical colleges. The topics included; industrial electrical wiring tools, industrial electrical wiring accessories, industrial electrical wiring material, industrial electrical wiring symbols and fitting, industrial safety regulation in electrical wiring and simple industrial electrical wiring. The items specification for the EIMWAT measured knowledge, comprehension and application the instrument was a standardized NABTEB examination questions collated for a period of five years. In the experimental group E_{G1} project-based learning (PBL) was used in College A. The research assistants helped to provide assistance to the students. In experimental group I, the teacher selected the lessons topic in which project-based learning was used to teach as indicated in the lesson plan. In experimental group II, the teacher used balloting technique to group the students into group of five students, making a total of eight groups. Groups were made up of mixed age, ability level, spatial ability and gender for the lesson. In experimental group E_{G1} , project-based technique was adopted in College A, students carried out simple industrial wiring project using electrical wiring tools, accessories, material, symbols and how to observe safety regulations in electrical wiring as part of project-based learning in classroom. Students in the treatment condition (PBL) participated in an average of two sessions per

week until they reached the session requirement of 12 session total; however, all participants completed the interaction in an average of 6 weeks. In project-based technique, each tutoring session lasted for about 45 minutes in duration.

In the control group, students were taught the same electrical wiring concept by their teacher using the conventional teaching method with the prepared lesson plans. Each lesson lasted for 45 minutes. At the end of the six weeks teaching exercise; a posttest was then administered on the three groups using EIMWAT. The scores obtained from the two groups were compared to determine if there are significant differences in students' performance of the three groups. The data for the study was analyzed using mean, standard deviation, t-test and Analysis of covariance (ANCOVA). Mean and standard deviation were used to analyze the research questions raised for the study while t-test and Analysis of covariance (ANCOVA) were used to analyze data on the hypotheses and tested at .05 level of significance. t-test and ANCOVA were used to determine whether differences were significant.

Results

Research Question 1: Is there any difference between the pretest and posttest mean scores of students taught EIMW using project-based learning and conventional teaching method in technical colleges in Edo State?

Table 1: Descriptive Statistics of Pretest and Posttest Students' Performance Mean Scores Taught Eimw Using Project-Based Technique and Conventional Teaching Method

Group		N	Pretest		Posttest		X Diff
X	SD		X	SD	X	SD	
Experimental Group							
(Project-based)		24	29.92	5.85	52.13	8.94	22.21
Control Group							
(Lecture method)		40	31.25	9.81	40.43	8.68	9.18

Table 1 shows the descriptive statistics with respect to the students' performance $\bar{X}$ scores for two groups (One control group and one experimental group). Table 1 shows that the pretest scores of these experimental and control groups had low $\bar{X}$ scores of 29.92 and 31.25 respectively. This indicates that the two groups exhibited low levels of performance $\bar{X}$ scores before treatment was administered. Table 1 also shows post-test scores with project-based and control as 52.13 and 40.43 respectively. Hence, results of the post-test mean scores shows that there is an increase in students' performance mean scores of the experimental group from 29.92 to 52.13 after the treatment with project-based approach. However, the post-test mean scores of the control group and the treatment

group were 31.25 and 40.43 respectively. Thus, in comparison, this indicates that the students in the treatment group had higher scores than the students in the control group at post-test. This increase in posttest scores seen among the treatment group may be due to the project-based approach that was administered to the treatment group

Research Question 2: What is difference between the posttest scores of students taught EIMW using Project-based Techniques and Conventional Teaching Methods on academic performance of students in EIMW in technical colleges in Edo State?

Table 2: Mean Scores of Students Taught EIMW Using Project-based and Conventional Method of Teaching

Posttest	$\bar{X}$ Diff		
	$\bar{X}$	$\bar{X}$	SD
Project-based	24	68.13	22.20
Control Group	40	40.43	21.18
Mean Gain		27.7	1.02

Table 3 shows a post-test mean scores of 24 students taught EIMW using **project based** and 40 students taught EIMW using **conventional teaching method in Edo state technical colleges**. **Posttest mean scores of the students' taught EIMW using project-based was 68.13** with a standard deviation of 22.20. While students taught EIMW using **conventional teaching method** had 40.43 with a standard deviation of 21.18, indicating a mean gain of 27.7 with a standard deviation difference of 1.02. This analysis revealed that a mean gain between students taught EIMW using **project-based and conventional teaching method in Edo state technical colleges was in favour of project-based approach**.

Table 2: ANCOVA Results for the Effect of Project-based technique and Conventional Teaching Method on the Students' Performance Mean Scores

Tests of Between-Subjects Effects

Dependent Variable: Posttest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8069.001 ^a	6	1344.833	17.349	.000	.467
Covariate	8341.613	1	8341.613	107.609	.000	.475
Pretest	2515.921	1	2515.921	32.456	.000	.214
(PB*C TM)	2346.197	1	2346.19	46.461	.000	.432
Gender	149.540	1	149.540	1.929	.167	.016
Gender {PB}	47.100	2	23.550	.304	.739	.005
Corrected Total	17293.659	125				

Hypothesis 1: there is no significant difference between the pretest and posttest mean scores of students taught EIMW using project-based technique in technical colleges in Edo State.

Table results 2 indicate an F value of 46.461 at a significant level of 0.000 for pre-test and post-test using project-based teaching method. The null hypothesis is therefore rejected for an alternate hypothesis of a significant difference between the pretest and posttest students' performance mean scores taught EIMW using project-based teaching method in technical colleges in Edo State.

Hypothesis 2: there is no significant difference between the posttest scores of students taught EIMW using project-based techniques and post test scores of students using conventional approach in technical colleges in Edo State.

Results 2 in Table indicate F-value for Project-based Teaching Method of Teaching 42.590 at .000 level of significance. The null hypothesis is therefore rejected. This indicates a significant difference between the posttest scores of students taught EIMW using project-based techniques and post test scores of students using conventional approach in technical colleges in Edo State' is therefore rejected. Thus, there is a significant difference between the posttest scores of students taught EIMW using project-based teaching method and post test scores of students using

conventional teaching method in technical colleges in Edo State. The experimental group which received treatment of project-based method of teaching had significantly higher scores than the control group which received conventional teaching method. Hence, treatment of project-based is responsible for the significant difference in mean scores.

Discussion

Results of this study shows that a significant difference exist between the pretest and posttest students' performance mean scores taught EIMW using project-based teaching method in technical colleges in Edo State. This finding is supported by Akinlabi and Adeagbo (2018); and Wekesa and Ongunya (2016) who posited that project-based approach assist learners for self and intellectual development. Emmanuel and Overson (2021), Okewelle, Emeli and Hart (2016) as well as Anazifa and Djukri (2017) also added that project-based method gives the learners the opportunity of critical thinking and problem-solving ability. This result shows that project-based approach is important in an instructional management for vocational and technical education as it is believed to create in the students the ability to learn how to create innovation, have motivation to create new things, employ scientific processes and possess strengthened ways of thinking (Reading Readiness Centers 2023; Nilsook, Chattawana & Seechaliao, 2021). The significant difference in the overall mean posttest scores between the pretest and posttest may be attributed to the fact that the project-based approach group was engaged in more research type activities consistent with constructivist principles.

Results of this study shows that there is significant difference between the posttest scores of students taught EIMW using project-based techniques and post test scores of students using conventional approach in technical colleges in Edo State. Project-based technique has a large positive impact on students' learning outcomes compared to conventional methods (Chen & Yong, 2019). Project-based learning is considered a highly effective way of education and is considered the highest level of teacher didactic skills. Therefore, we assumed that project-based learning in our experiment would be the most effective of the methods used. However, findings for research question three revealed that small-group discussion method was the most effective teaching method, followed by project-based approach while the teacher centered approach was the least effective teaching method (Roshni and Rahim 2020).

Conclusion

Based on the findings of this study, it was concluded that the use of project-based approach enhances students' performance scores in Electrical Installation and Maintenance Works than the conventional teaching method. It was also found that there was no significant difference in students' performance scores based on gender using the project-based approach

Recommendations

Based on the findings of this study, researchers recommend:

1. In view of the effectiveness of project-based technique on the students' performance it is recommended that project-based approach should frequently be used in technical colleges by educators in Electrical Installation and Maintenance Works (EIMW).
2. Educators in technical education are recommended to understand how the quality of learning depends on the nature of interactions.
3. Administrators of Technical Colleges are recommended to provide the necessary support and conducive learning environment for educators to fully utilize project-based approach and small-group discussion technique.

References

- Akinlabi, W. I & Adeagbo, I. F. (2018). Trade in Oyo State government technical colleges. *NAU Journal of Technology and Vocational Education*, 3 (1), 150-158.
- Anazifa, R.D. & Djukri (2017) on the effect of project-based learning and problem-based on students' creativity and critical thinking. *Journal Pendidikan JP11 Indonesia*, 6(2), 346-355.
- Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, 83(2), 39 – 43.
- Chen, C. H., & Yong, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review*, 26, 71–81. <https://doi.org/10.1016/j.edurev.2018.11.001>
- Harris, J., Mishra, P., & Koehler, M. (2009). Teacher technological pedagogical content knowledge and learning activity topic: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, 41(4), 393 – 416.

Kermanshachi, S. (2018, May). Development of Web-based interactive educational system replacing the traditional textbook based instructional approach. *UTA CARES Open Educational Resources (OER) Report*, Online: <https://hdl.handle.net/10106/27340>.

Maros, M., Korenkova, M., Fila, M., Levicky M., & Schoberova, M. (2021). *Project-based learning and its effectiveness: evidence from Slovakia*. Interactive Learning Environment. <https://doi.org/10.1080/10494820.2021.1954036>

National Board for Technical Education (2012). *Curriculum for Technical Colleges*. Kaduna: NBTE press.

Nilsook, P., Chattawana, P. & Seechaliao, T. (2021). The project-based learning management process for vocational and technical education. *Higher Education Studies*. 11(2), 20-29.

Nworgu, B.G. (2006). *Educational research, basic issues and methodology*. Nsukka, Enugu: University Trust Publisher.

Okwelle, P. C, Emeli, E. & Hart, T. U. (2016). Effect of group project method on student's academic achievement in car battery system in basic technology. *International Journal of Advanced Academic Research, Sciences, Technology and Engineering*. 2(8), 1 – 9.

Pepple, T.F. (2010). Effect of cooperative learning and programmed instructional strategies on Students learning outcomes in chemistry. *Unpublished Ph.D thesis, Delta State University, Abraka, Nigeria*.

Reading Readiness Centers (2023). We want every child at Reading Readiness Program to have a wonderful experience with their Early Childhood Education. *Unlocking the power of project-based learning: A comprehensive guide to boosting student engagement and achievement*. Available at: <https://www.linkedin.com/pulse/unlocking-unlocking-the-power-of-project-based-learning-a-comprehensive-guide-to-boosting-student-engagement-and-achievement/linkedin.com>

Roshni, M. & Rahim, A. (2020). Small group discussions as an effective teaching-learning methodology for learning the principles of family medicine among 2nd-year MBBS students. *Journal of Family Medicine and Primary Care*, 9(5), 2248-2252.

DOI: 10.4103/jfmprc.jfmprc_1228_19

Uwameiye, R. (2010). *Essentials of technical and vocational education*. Benin City: Ambik press.

Wekesa, N. W., & Ongunya, R.O. (2016). Project-based learning on students' performance in the secondary schools. *Journal of Education and Practice*, 7(6), 222-288.