Effects of Project and Lecture Methods on the Academic Achievement of Students in Electrical Installation in Delta State Technical Colleges

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DOI: https://doi.org/10.47772/IJRISS.2026.101100096

Received: 06 November 2026; Accepted: 10 November 2026; Published: 21 November 2026

ABSTRACT

Ensuring equitable achievement in technical education requires evidence on how male and female students perform under different instructional approaches. This study examined sex differences in students' academic achievement in electrical installation under project and lecture methods in Delta State technical colleges. Two research questions guided the study, and two null hypotheses were tested at the .05 significance level. A quasi-experimental pretest–posttest control-group design was adopted. The population comprised 1,540 students, while the sample consisted of 154 students, representing 10% of the population. The experimental group comprised 79 students taught using the project method, while the control group comprised 75 students taught using the lecture method. Data were collected using the 50-item Electrical Installation Achievement Test (EIAT). Face validity was established through review by the researcher, a Measurement and Evaluation expert from Delta State University, Abraka, and an experienced electrical installation teacher. Content validity was established using a table of specifications, while the Kuder–Richardson Formula 20 yielded a reliability coefficient of .94. The instrument was administered before and after instruction, with both groups receiving instruction covering identical content and objectives. Mean scores and standard deviations answered the research questions, while independent-samples t-tests tested the hypotheses. Under project instruction, male students recorded a mean score of 71.83 (*SD* = 8.57), compared with 72.00 (*SD* = 8.66) for female students. Under lecture instruction, male students recorded 57.00 (*SD* = 5.73), while female students recorded 56.89 (*SD* = 6.19). The reported analyses indicated no statistically significant sex difference within either instructional group. The study concluded that male and female students demonstrated comparable achievement within each method, without establishing the comparative superiority of either approach. Equal learning opportunities, teacher professional development, and adequate government funding for instructional resources were recommended.

Keywords: electrical installation, project method, lecture method, academic achievement, sex differences, technical colleges

INTRODUCTION

Technical education prepares individuals to apply knowledge in situations where understanding must lead to competent action. Electrical installation illustrates this relationship clearly: students need to understand electrical principles while learning how those principles guide the interpretation of wiring diagrams, selection of materials, connection of circuits, and identification of faults. Its educational value therefore lies in bringing theoretical understanding and practical application into a coherent learning experience. Achieving this connection requires careful attention to instruction, particularly to the opportunities students receive to examine, explain, and use what they learn. In Nigeria, Olelewe et al. (2021) demonstrated the relevance of instructional practice through an intervention involving electrical installation and maintenance students in Enugu and Lagos states. Their findings showed improved achievement among students exposed to innovative pedagogy, suggesting that how technical content is taught deserves consideration alongside the content itself.

This relationship provides a starting point for examining instructional effectiveness in Delta State technical colleges.

Academic achievement represents the extent to which students demonstrate mastery of the knowledge and understanding addressed during instruction. In electrical installation, such mastery includes recognising electrical components, explaining circuit relationships, interpreting technical information, and applying relevant principles to installation problems. Although these capabilities support practical work, achievement measured through a written assessment should be distinguished from competence demonstrated through direct practical performance. A student may recall an installation procedure without fully understanding the reasoning behind it, just as successful completion of a practical task may not reveal the depth of the student's conceptual knowledge. Effective instruction should therefore help learners connect procedures with explanations and familiar examples with unfamiliar problems. This makes the selection of a teaching method an educational decision with implications for the quality of understanding students develop and their ability to demonstrate that understanding in an achievement assessment.

One approach to developing this connection is the project method, which organises learning around purposeful activities culminating in an identifiable product or solution. Rather than encountering concepts only through explanation, students use them while planning, making decisions, carrying out tasks, and reviewing outcomes. Guo et al. (2020), in a review of project-based learning in higher education, identified the production of artefacts as an essential characteristic of the approach and highlighted the importance of evaluating clearly specified learning outcomes. Applied to electrical installation, a project might involve developing a model lighting installation or assembling a circuit that meets stated requirements. The educational purpose extends beyond producing a functioning circuit: students should also explain their choices, interpret unexpected results, and relate their work to the principles being studied. The teacher guides this process through appropriate explanations, feedback, supervision, and assessment, ensuring that practical activity remains connected to the intended learning objectives.

The lecture method approaches these objectives primarily through the teacher's organised presentation and explanation of subject matter. Concepts can be introduced sequentially, technical terms clarified, and procedures illustrated through diagrams and worked examples. Its contribution depends partly on how effectively these explanations engage students' thinking and help them develop an organised understanding of the subject. Where instruction provides few opportunities for learners to apply or question ideas, however, it becomes necessary to examine whether the understanding developed is sufficient for the demands of electrical installation. The comparison between project and lecture methods consequently concerns the learning opportunities each creates and the achievement that follows. For Delta State technical colleges, the central question is whether sustained engagement in purposeful projects leads to different academic outcomes from instruction organised mainly around teacher explanations. Addressing this question requires consideration of existing empirical evidence and the extent to which that evidence applies to the subject and setting of the present study.

Nigerian research offers relevant evidence from closely related electrical subjects. Nwalo and Eze (2021) investigated the effects of project and demonstration methods on achievement and retention in basic electricity in Ebonyi State technical colleges. Using a quasi-experimental design incorporating pretest, posttest, and delayed posttest assessments, they reported better outcomes among students taught through the project method. This finding is relevant because basic electricity provides conceptual foundations for understanding electrical installation. It suggests that purposeful application of electrical concepts can support learning beyond the immediate completion of classroom tasks. Nevertheless, the study compared project instruction with demonstration, which involves a different instructional process from lecture. Its findings therefore support further examination of project teaching without establishing its relative effectiveness against the method considered in the present investigation. The distinction is consequential: evidence favouring an approach over one instructional alternative cannot automatically establish its advantage over another.

Other Nigerian studies broaden this perspective by showing how different forms of instructional support relate to learning in electrical installation. Ideh and Onyebuenyi (2022), in a quasi-experimental study conducted in Anambra State technical colleges, reported higher achievement among students receiving audiovisual

instruction than among those taught through a conventional method. Their findings suggest that making technical content more accessible through visual and auditory representation can support understanding. More recently, Nwineh and Opigo (2025) investigated cooperative learning among 55 electrical installation students in Bayelsa State. Their mixed-method study found improved practical performance among students exposed to cooperative instruction, while participants' accounts highlighted knowledge sharing, teamwork, and interdependence. Together, these studies demonstrate the relevance of examining how students encounter technical information and participate in learning. However, audiovisual instruction and cooperative learning are distinct from project instruction, and practical performance is not equivalent to academic achievement. Their contribution is therefore contextual, helping establish the importance of instructional design while leaving the present comparison open to investigation.

International evidence provides a broader assessment of project learning and academic outcomes. Chen and Yang (2019) synthesised 30 studies involving 12,585 students and found a medium-to-large overall achievement advantage for project-based learning over traditional instruction. The review strengthens the empirical basis for considering project learning because its conclusion draws on multiple studies rather than a single classroom intervention. At the same time, differences associated with subject area and geographical setting indicate that the overall effect should not be treated as a prediction for every educational context. Electrical installation in Nigerian technical colleges has particular curricular demands and institutional conditions that may differ from those represented in the reviewed studies. The significance of the international evidence therefore lies in establishing a credible expectation that project learning can improve achievement, while also showing why that expectation requires examination within a clearly defined subject and population.

More recent reviews help explain why the outcomes of project instruction may vary. Zhang and Ma (2023), drawing on 66 experimental and quasi-experimental studies, reported positive effects on learning outcomes but found that effectiveness differed with factors such as subject area, course type, group organisation, and intervention duration. Their findings suggest that meaningful project learning depends on how activities are structured and supported, rather than on the use of a project label alone.

A complementary perspective comes from Wijnia et al. (2024), whose meta-analysis found an overall motivational advantage for problem-based, project-based, and case-based approaches compared with teacher-centred or lecture-based instruction. Because that estimate covered three approaches, it should not be attributed exclusively to project learning. Nevertheless, it suggests that purposeful learning activities may strengthen students' interest and willingness to engage. These findings offer possible explanations for improved learning while preserving an essential distinction: greater motivation is a potential contributor to achievement, rather than direct evidence that achievement has increased.

The literature thus presents a persuasive basis for investigating project instruction, but it does not settle the specific comparison addressed in this study. The Nigerian evidence reviewed includes different teaching approaches, comparison groups, subject emphases, and assessment outcomes, while the international reviews combine findings from diverse educational settings.

The unresolved issue is how project and lecture methods compare when directed towards the same achievement objectives in electrical installation within Delta State technical colleges. A focused investigation can address this issue by examining students' achievement under the two instructional conditions and interpreting the results in relation to their educational context. Accordingly, the present study investigates the effects of project and lecture methods on the academic achievement of students in electrical installation in Delta State technical colleges. It seeks to provide evidence that can inform teachers' instructional choices and support the organisation of learning experiences that connect electrical knowledge with meaningful application.

Statement of the Problem

Electrical installation education requires students to understand technical principles and apply them when interpreting wiring diagrams, explaining circuit relationships, and solving installation problems. However, instruction centred mainly on verbal explanations may provide insufficient opportunities for students to connect abstract concepts with meaningful applications. This potential disconnect raises concerns about

academic achievement and the conceptual foundation needed for practical training. The lecture method enables teachers to present information systematically, but its capacity to support understanding requires examination against approaches that actively involve learners. The project method offers such an approach by engaging students in purposeful tasks requiring planning, application, and reflection. Nevertheless, its effectiveness in improving achievement within a particular educational context cannot be assumed.

The knowledge gap addressed by this study concerns whether students exposed to project instruction achieve differently from those receiving lecture instruction in electrical installation in Delta State technical colleges. To address this gap, the study uses the project method for the experimental group and the lecture method for the control group, generating evidence to inform instructional decisions. Accordingly, what difference exists in the academic achievement of electrical installation students taught using the project method and those taught using the lecture method in Delta State technical colleges?

Research Questions

The following research questions guided the study:

8. What is the difference in the mean achievement scores of male and female students taught electrical installation using the project method in Delta State Technical Colleges?
9. What is the difference in the mean achievement scores of male and female students taught electrical installation using lecture methods in Delta State Technical Colleges?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

- There is no significant difference between the mean achievement scores of male and female students taught electrical installation using the project method in Delta State Technical Colleges.
- There is no significant difference between the mean achievement scores of male and female students taught electrical installation using the lecture method in Delta State Technical Colleges.

METHODOLOGY

The study adopted a quasi-experimental pretest–posttest control-group design to examine sex differences in students' academic achievement in electrical installation under project and lecture methods in Delta State technical colleges. The population comprised 1,540 students, while the sample consisted of 154 students, representing 10% of the population. The experimental group comprised 79 students taught using the project method, whereas the control group comprised 75 students taught using the lecture method. Data were collected using the 50-item Electrical Installation Achievement Test (EIAT). Face validity was established by the researcher, a Measurement and Evaluation expert in the Department of Guidance and Counselling, Delta State University, Abraka, and an experienced electrical installation teacher.

Content validity was established using a table of specifications. The instrument yielded a reliability coefficient of .94 using Kuder–Richardson Formula 20. The EIAT was administered before and after instruction as pretest and posttest, respectively. Both groups received instruction covering identical content and learning objectives. Mean scores and standard deviations were used to answer the two research questions, while independent-samples t-tests were used to test the two null hypotheses at the .05 significance level. These analyses compared the mean achievement scores of male and female students separately within the project and lecture groups.

Presentation of Results

Research Question 1: What is the difference in the mean achievement scores of male and female students taught electrical installation using the project method in Delta State Technical Colleges?

Table 1: *Descriptive analysis on the difference in the mean achievement scores of male and female students taught electrical installation using the project method*

Gender	N	Mean	Std. Deviation	Std. Error Mean
Project Method Male	35	71.8286	8.57317	1.44913
Female	44	72	8.6616	1.30578

Table 1 shows the difference in the mean achievement scores of male and female students taught electrical installation using the project method in Delta State Technical Colleges, it shows that male students taught electrical installation using the project method had a mean achievement score of 71.83 with a standard deviation of 8.57, while female students recorded a slightly higher mean score of 72.00 with a standard devia-

tion of 8.66. The close mean scores indicate that the achievement of male and female students was nearly the same under the project method. Similarly, the comparable standard deviation values show that the spread of scores within both groups was almost identical, suggesting a similar pattern of performance among male and female students.

Research Question 2: There is no significant difference between the mean achievement scores of male and female students taught electrical installation using the lecture method in Delta State Technical Colleges

Table 2: *Descriptive analysis on the difference in the mean achievement scores of male and female students taught electrical installation using lecture methods*

Method	Gender	N	Mean	Std. Deviation	Std. Error Mean
Lecture Method	Male	30	57.0000	5.72954	1.04607
	Female	45	56.8864	6.18782	.93285

Table 2 shows the descriptive analysis of the difference in the mean achievement scores of male and female students taught electrical installation using lecture methods in Delta State Technical Colleges, that male students taught electrical installation using the lecture method recorded a mean score of 57.00 (SD = 5.73), while female students recorded 56.89 (SD = 6.19). The close mean and standard deviation values indicate similar achievement patterns across both groups. With a mean difference of only 0.11, this shows a low difference in the achievement scores of male and female students taught using the lecture method.

Testing of Hypotheses

Hypothesis 1: There is no significant difference between the mean achievement scores of male and female students taught electrical installation using the project method in Delta State Technical Colleges

Table 3: *Independent t-test on difference between the mean achievement scores of male and female students taught electrical installation using the project method*

Gender	N	Mean	Std. Deviation	Df	t	Sig
Project Method Male	35	71.8286	8.57317	77	-0.88	.928
Female	44	72.0000	8.66160	73.377		

Table 4.7 shows that male students taught electrical installation using the project method recorded a mean achievement score of 71.83 (SD = 8.57), while female students recorded a mean score of 72.00 (SD = 8.66). The independent t-test yielded t(77) = -0.88 with p = .928. Since the p-value of .928 is greater than the 0.05 level of significance, the difference between the mean achievement scores of male and female students was not statistically significant. Consequently, the null hypothesis was accepted, indicating that there is no significant difference between the mean achievement scores of male and female students taught electrical installation using the project method in Delta State Technical Colleges.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female students taught electrical installation using the lecture method in Delta State Technical Colleges.

Table 4: *Independent t-test on the difference between the mean achievement scores of male and female students taught electrical installation using the lecture method*

Method	Gender	N	Mean	Std. Deviation	Df	t	Sig
Lecture Method	Male	30	57.0000	5.72954	72	.080	.533
	Female	45	56.8864	6.18782	69.101		

Table 4.9 shows that male students taught electrical installation using the lecture method recorded a mean achievement score of 57.00 (SD = 5.73), while female students recorded a mean score of 56.89 (SD = 6.19). The independent t-test yielded t(72) = 0.080 with p = .533. Since the p-value of .533 is greater than the 0.05 level of significance, the observed difference was not statistically significant. Therefore, the null hypothesis was not rejected. This means that there is no statistically significant difference between the mean achievement scores of male and female students taught electrical installation using the lecture method in Delta State Technical Colleges.

DISCUSSION OF FINDINGS

Gender Difference in the Academic Achievement of Students Taught Electrical Installation Using the Project Method

The finding for Research Question 1 revealed that male and female students taught Electrical Installation using the project method achieved almost the same level of performance. Male students recorded a mean score of 71.83 (SD = 8.57), while female students recorded 72.00 (SD = 8.66). The test of Hypothesis 1 further showed that the difference was not statistically significant, $t(77) = -0.088$, $p = .928$. This indicates that gender did not substantially influence students' achievement under the project method, suggesting that both male and female students benefited similarly from the practical and participatory nature of the instructional approach.

This finding agrees with Zechariah and Tumba (2024), who reported no significant difference in the achievement scores of male and female students taught Digital Electronics using a project-based instructional strategy in Colleges of Education in North-East Nigeria. Similarly, Nwalo and Eze (2021) found that both male and female technical college students improved in Basic Electricity when taught through project and demonstration methods, with project-based instruction supporting achievement across gender groups. These findings suggest that project-based instruction can provide an inclusive learning environment in which achievement depends more on students' engagement with practical tasks than on gender.

However, Fadillah et al. (2024) reported that although STEM-based approaches improved learning outcomes for both male and female students, the magnitude of the effect varied by gender. This difference may be attributed to variations in subject area, educational level, instructional design, and the nature of the project activities used.

Gender Difference in the Academic Achievement of Students Taught Electrical Installation Using the Lecture Method

The finding for Research Question 2 showed that male and female students taught Electrical Installation using the lecture method performed almost equally. Male students recorded a mean achievement score of 57.00 (SD = 5.73), while female students recorded a mean score of 56.89 (SD = 6.19). The test of Hypothesis 2 further revealed that the difference between the two groups was not statistically significant, $t(72) = 0.080$, $p = .533$. This indicates that gender did not significantly influence students' achievement under the lecture method. Although the overall achievement associated with lecture instruction was comparatively low, male and female students appeared to respond to the method in a similar manner.

This finding agrees with Shuaibu et al. (2024), who found no significant difference between the academic achievement of male and female secondary school students taught Mathematics using the lecture method in

Adamawa State, Nigeria. Similarly, Odom et al. (2021), in a meta-analysis involving undergraduate Biology and Chemistry courses in the United States, found no overall gender difference in academic performance across the courses examined, suggesting that gender differences in achievement are not inevitable and may depend largely on instructional and classroom conditions.

However, the finding differs from Farooqi et al. (2021), who reported that female university students achieved better outcomes than their male counterparts across several instructional approaches, including the lecture method. The variation between the findings may be connected to differences in educational level, subject area, classroom environment, assessment procedures, and students' prior learning experiences. Overall, the present result suggests that lecture instruction did not favour either gender in Electrical Installation.

FINDINGS

- There was no significant difference between the mean academic achievement scores of male and female students taught Electrical Installation using the project method.

- There was no significant difference between the mean academic achievement scores of male and female students taught Electrical Installation using the lecture method.

CONCLUSION

The study concluded that male and female students attained comparable levels of academic achievement in electrical installation under both project and lecture methods in Delta State technical colleges. The absence of statistically significant differences within the instructional groups suggested that neither approach conferred an achievement advantage on either sex. Although the project group recorded higher mean scores than the lecture group, establishing the statistical significance of this difference required a direct comparison between the methods. These findings underscored the importance of providing equitable learning opportunities and selecting instructional approaches on the basis of demonstrated effectiveness rather than assumptions about sex.

RECOMMENDATIONS

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

1. Electrical installation teachers should provide male and female students with equal access to instructional resources, learning activities, and constructive feedback, as no significant sex differences in achievement were found under either method.

2. Technical college administrators should organise regular professional development programmes to strengthen teachers' use of project and lecture methods and their ability to address students' individual learning needs.

3. Government should adequately fund technical colleges to provide functional workshops, electrical installation equipment, and instructional materials that support equitable learning opportunities for male and female students.

Contributions to Knowledge

1. The study has demonstrated that male and female students taught electrical installation using the project method in Delta State technical colleges achieved at comparable levels, as the difference in their mean academic achievement scores was not statistically significant.

2. The study has established that male and female students taught electrical installation using the lecture method in Delta State technical colleges recorded no statistically significant difference in their mean academic achievement scores, extending evidence of comparable achievement within this instructional setting.

Ethical Considerations

1. **Informed consent:** Institutional permission and participants' consent were obtained. Participation was voluntary, with parental consent and student assent secured for minors.
2. **Confidentiality:** Identification codes replaced names, and participants' information was kept confidential and used solely for research.
3. **Safety and fairness:** Electrical safety precautions were observed, activities were supervised, and all participants received fair treatment.

Limitations of the Study

1. The quasi-experimental design limited control over pre-existing differences between the groups; therefore, differences in achievement could not be attributed solely to instructional methods.
2. The study involved 154 electrical installation students in Delta State technical colleges, which limited the generalisation of its findings to other subjects, educational levels, and geographical settings.
3. The Electrical Installation Achievement Test assessed cognitive achievement rather than practical competence. The findings therefore did not establish students' ability to perform electrical installation tasks.
4. The absence of a delayed posttest limited conclusions about the long-term retention of knowledge acquired through either instructional method.

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