



EFFECT OF PROJECT-BASED TEACHING METHOD ON JUNIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BASIC SCIENCE IN NSUKKA LOCAL GOVERNMENT AREA OF ENUGU STATE, NIGERIA.

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ABSTRACT

This study determined the effect of project-based teaching method on students' academic achievement in Basic Science. A quasi-experimental design (pretest-posttest non-equivalent control group design) was adopted. The population comprised 2,437 JSS II students in Nsukka local government area of Enugu State, from which a sample of 144 students was drawn using multi-stage sampling technique. The Basic Science Achievement Test (BSAT), was used for data collection with a reliability index of 0.91 (K-R 20). Mean, standard deviation, and Analysis of Covariance (ANCOVA) at .05 significance level were used to analyze data. Results showed that project-based teaching method significantly enhanced students' academic achievement in Basic Science compared to conventional lecture method; gender did not significantly influence achievement; and the interaction effect of teaching methods and gender was not significant. It is therefore recommended that basic science teachers should develop and adopt project-based teaching method as it enhances overall students' academic achievement and helps reduce gender gap in the subject.

Keywords: Project-based, teaching methods, Basic Science, Academic achievement, Junior Secondary School

INTRODUCTION

Science education at the junior secondary school level plays a crucial role in fostering scientific literacy and preparing learners for further studies in science-related disciplines. Basic Science previously known as Integrated Science and now renamed to intermediate science programme introduced into Nigerian Junior secondary schools in 1972, represents the first formal exposure of students to science at this level and provides the foundation upon which senior secondary science subjects are built (Nigerian Educational Research and Development Council [NERDC], 2007). As part of recent reforms in the basic education curriculum, the Federal Ministry of Education, through the Nigerian Educational Research and Development Council, redesignated Basic Science as Intermediate Science to reflect

emerging educational priorities and contemporary global trends (NERDC, 2025). The Basic Science Curriculum was developed to stimulate learners' interest in science while equipping them with the requisite knowledge and skills necessary for scientific advancement (Federal Republic of Nigeria [FRN], 2013). Notwithstanding the significance of the subject in laying a solid foundation for science education, reports have continued to reveal persistently poor academic performance among students in Basic Science across the country.

The National Assessment of Learning Achievement in Basic Education (NALABE, 2022), conducted by the Universal Basic Education Commission (UBEC) in collaboration with UNICEF across all 36 states of Nigeria, assessed 23,564 JSS2 learners in 788 junior secondary schools on core subjects including Basic Science. The results revealed that a significant proportion of JSS2 learners failed to attain minimum proficiency levels in Basic Science, findings that raise urgent questions about the quality and effectiveness of current instructional approaches in Nigerian junior secondary schools (UBEC & UNICEF, 2022). These findings are consistent with recurring concerns in the literature regarding persistently poor achievement in Basic Science at the junior secondary level, often attributed to over-reliance on teacher-centered, lecture-based instructional methods that prioritize rote memorization over inquiry, critical thinking, and practical application (Iwe et al., 2022; Dung, 2024).

Contemporary research in science education has increasingly identified project-based learning (PBL) as an effective, evidence-backed pedagogical alternative to conventional instruction. PBL is a student-centered approach whereby learners acquire deeper knowledge through active exploration of real-world challenges over an extended period (Krajcik et al., 2023). A landmark cluster-randomized controlled trial by Krajcik et al. (2023), involving 2,371 third-grade students across 46 Michigan schools, found that students exposed to a Multiple Literacies in Project-Based Learning science intervention scored significantly higher on standardized science assessments (effect size = 0.277 SD) and demonstrated greater self-reflection and collaboration compared to the control group. Similarly, Schneider et al. (2022), in a rigorous evaluation published in *Educational Researcher*, found that a project-based learning intervention in high school chemistry and physics significantly increased science achievement and interest in pursuing STEM careers for all students regardless of academic background.

The cumulative evidence from meta-analytic research further reinforces the effectiveness of PBL. Jamila (2024), in a meta-analysis of studies conducted between 2000 and 2023, reported that project-based learning consistently outperformed traditional instructional approaches in supporting student academic achievement, with effect sizes ranging from 0.13 to 3.70 across various subject areas and educational levels. Chen and Yang (2019) similarly reported, through a meta-analysis of 30 studies published in *Educational Research Review*,

that PBL produces moderate to large positive effects on academic achievement, with instructional level, subject domain, and group size moderating these effects. These findings, while drawn primarily from international contexts, provide a strong theoretical and empirical basis for examining the applicability of PBL in the Nigerian Basic Science classroom.

Within the Nigerian context, recent studies have highlighted the inadequacy of instructional resources and the persistence of teacher-centered methods as key factors constraining Basic Science learning outcomes. Iwe et al. (2022), examining teachers' classroom practices in Bayelsa State, found that teaching strategies significantly predicted students' academic performance in Basic Science, underscoring the centrality of pedagogy in shaping achievement outcomes. Dung (2024), assessing the competencies of Basic Science and Technology teachers in Plateau State, found that many teachers lacked the requisite skills for effective lesson delivery, thereby limiting students' opportunity to engage meaningfully with science content. These findings collectively point to an urgent need for innovative, student-centered instructional strategies in Nigerian junior secondary science classrooms.

Gender has also been identified as a variable of interest in science achievement, particularly in the Nigerian context. While earlier studies reported significant male advantage in science performance (Busola, 2011; Olagunju & Babayemi, 2014), more recent evidence suggests that the gender gap is narrowing. Kyado et al. (2021) and Adu-Gyamfi and Elikem-Vorsah (2022) noted persistent but context-dependent gender differences in science achievement, while Cleopas and Igbojinwaekwu (2023), in a quasi-experimental study in Bayelsa State, found that gender did not significantly influence students' academic performance in biology when innovative teaching methods were employed. These findings suggest that the teaching method itself may be a more powerful determinant of achievement than gender, making the investigation of gender's role within a PBL context particularly relevant.

Despite the growing body of evidence supporting project-based teaching globally and a growing number of studies within Nigeria have reported promising outcomes, empirical evidence relating specifically to its impact on students' achievement in Basic Science remains limited. This gap is particularly evident at the junior secondary school level in Enugu State, with very few studies focusing on students in Nsukka Local Government Area. Consequently, there is insufficient context-specific evidence to determine the extent to which the approach can enhance learning outcomes among Basic Science students in the area.

In response to this gap in the literature, the present study investigated the effect of the project-based teaching method on the academic achievement of JSS II students in Basic Science. To achieve this objective, the study was guided by the following research questions: (1) What effect does the project-based teaching method have on students' academic achievement in Basic Science? (2) How does gender influence students' academic achievement in Basic Science? (3) What is the interaction effect of teaching method and

gender on students' academic achievement in Basic Science? In addition, three null hypotheses were formulated and tested at the 0.05 level of significance.

METHODOLOGY

The study adopted a quasi-experimental research design, specifically a pretest-posttest non-equivalent control group design. The population comprised 2,431 JSS II students (1,331 male; 1,100 female) in the 31 public junior secondary schools in Nsukka local government area of Enugu State (PPSMB, 2026). A multi-stage sampling technique was employed. At the first stage, Nsukka LGA was purposively selected due to documented poor academic achievement in Basic Science. At the second stage, two co-educational public junior secondary schools were purposively selected. At the third stage, one intact arm was randomly selected from each school. This yielded a total sample of 144 JSS II students: 74 in the experimental group (33 males, 41 females) and 70 in the control group (31 males, 39 females).

The instrument for data collection was the Basic Science Achievement Test (BSAT), a 30-item multiple choice test with options A–D, developed by the researcher from topics including kinetic theory of matter and work, energy and power — drawn from the basic science curriculum and JSSCE past questions. Face and content validity were established by three experts in Science Education, Measurement and Evaluation from the University of Nigeria, Nsukka. Content validity was further ensured using a table of specification. Reliability was determined through a trial test with 25 students from a school in Udenu LGA and computed using Kuder-Richardson formula 20 (K-R 20), yielding a reliability index of 0.91.

The experimental group was taught using the project-based teaching method while the control group received conventional lecture instruction. Both groups were taught by their regular Basic Science teachers who were trained by the researcher for three days prior to commencement. The research lasted two weeks. A pretest was administered before treatment; a posttest was administered after treatment. Scripts were collected, marked, scored, and data analyzed using SPSS version 25. Research questions were answered using mean and standard deviation, while the three hypotheses were tested using ANCOVA at .05 level of significance. Extraneous variables including teacher effect, Hawthorne effect, subject interaction, and initial group differences were controlled through teacher training, use of normal lesson periods, use of four separate schools, and ANCOVA analysis respectively.

RESULTS

Research Question 1: Effect of Project-Based Teaching Method on Students' Academic Achievement

Table 1 presents the mean and standard deviation of students' academic achievement in both groups.

Table 1: Mean and Standard Deviation of Students' Achievement in Basic Science (Project-Based vs. Conventional Method)

Groups	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain	Difference
Experimental (PBM)	74	13.47	1.74	21.49	2.61	8.02	3.93
Control (Lecture)	70	13.31	2.60	17.40	2.76	4.09	

The experimental group recorded a pre-test mean of 13.47 (SD=1.74) and a post-test mean of 21.49 (SD=2.61), giving a mean gain of 8.02. The control group had a pre-test mean of 13.31 (SD=2.60) and a post-test mean of 17.40 (SD=2.76), giving a mean gain of 4.09. The mean gain difference of 3.93 favours the experimental group, indicating that project-based teaching method enhances students' academic achievement more than the conventional lecture method.

Research Question 2: Influence of Gender on Students' Achievement

Table 2 shows the mean achievement scores of male and female students.

Table 2: Mean and Standard Deviation of Male and Female Students' Achievement in Basic Science

Gender	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain	Difference
Male	64	13.47	2.17	19.88	3.41	6.41	.55
Female	80	13.34	2.23	19.20	3.33	5.86	

Male students recorded a post-test mean of 19.88 (SD=3.41) with a mean gain of 6.41, while female students recorded a post-test mean of 19.20 (SD=3.33) with a mean gain of 5.86. The mean gain difference of .55 in favour of males is negligible, suggesting that gender has minimal influence on students' academic achievement in Basic Science.

Research Question 3: Interaction Effect of Teaching Methods and Gender

Table 3 presents mean scores by group and gender.

Table 3: Mean and Standard Deviation of Interaction Effect of Teaching Methods and Gender on Achievement

Effect of Project-Based Teaching Method on Junior Secondary School Students' Academic Achievement In Basic Science In Nsukka Local Government Area of Enugu State, Nigeria.

Group	Gender	N	Post-test Mean	Std. Dev.
Experimental (PBM)	Male	33	21.88	2.71
	Female	41	21.17	2.51
Control (Lecture)	Male	31	17.74	2.72
	Female	39	17.13	2.80

At all levels of gender, mean achievement scores were consistently higher in the experimental group than in the control group. This ordinal pattern does not suggest a significant interaction effect between teaching method and gender on students' academic achievement in Basic Science.

Hypothesis Testing

Table 4: ANCOVA Summary of Students' Achievement in Basic Science

Source	Type III SS	df	Mean Square	F	Sig.
Corrected Model	626.705	4	156.676	21.837	.000
Intercept	1184.895	1	1184.895	165.147	.000
Pretest (Covariate)	10.320	1	10.320	1.438	.232
Method	588.093	1	588.093	81.967	.000*
Gender	14.751	1	14.751	2.056	.154
Method × Gender	.104	1	.104	.014	.904
Error	997.295	139	7.175		
Total	56380.000	144			
Corrected Total	1624.000	143			

**Significant at $p < .05$*

Hypothesis One: $F(1,139) = 81.967$, $p = .000$. Since $p < .05$, the null hypothesis was rejected. There is a significant difference in mean achievement scores in favour of the project-based method group.

Hypothesis Two: $F(1,139) = 2.056$, $p = .154$. Since $p > .05$, the null hypothesis was retained. There is no significant difference in the mean achievement scores of male and female students in Basic Science.

Hypothesis Three: $F(1,139) = .014$, $p = .904$. Since $p > .05$, the null hypothesis was retained. There is no significant interaction effect of teaching methods and gender on students' mean achievement scores in Basic Science.

DISCUSSION OF FINDINGS

The finding that project-based teaching method significantly enhanced students' academic achievement in Basic Science aligns with a robust and growing body of international and national evidence. Krajcik et al. (2023), in a rigorous randomized controlled trial, demonstrated that PBL science interventions produced significantly higher scores on standardized science assessments compared to traditional instruction. Schneider et al. (2022) similarly reported that PBL interventions in high school science increased achievement for all students regardless of academic background. The meta-analytic evidence of Jamila (2024) and Chen and Yang (2019) further corroborates that PBL consistently outperforms conventional teaching across multiple subject domains and educational levels. The current study contributes Nigerian empirical evidence to this growing global consensus, confirming that the pedagogical advantages of PBL — deeper engagement, active inquiry, real-world problem solving, and collaborative learning — translate meaningfully to the Nigerian Basic Science classroom.

The finding that gender did not significantly influence students' academic achievement in Basic Science is consistent with Cleopas and Igbojinwaekwu (2023), who found that gender did not significantly affect achievement in biology in Bayelsa State when innovative teaching methods were used. This corroborates the position that effective, student-centered teaching methods can neutralize gender-based performance disparities. The result also aligns with Okorie and Ezeh (2016), who reported no statistically significant gender difference in chemical bonding achievement. While earlier studies by Busola (2011) and Olagunju and Babayemi (2014) reported male advantage in science performance, the present findings suggest that the gender gap in Basic Science is increasingly context- and method-dependent, supporting the position advanced by Kyado et al. (2021) that pedagogical approach is a stronger predictor of achievement than gender.

The non-significant interaction effect between teaching method and gender confirms that project-based teaching method benefits both male and female students equally, regardless of gender. Students in the experimental group consistently outperformed those in the control group at all gender levels. This finding underscores the equity dimension of PBL as an instructional approach, consistent with Schneider et al. (2022) who reported that PBL improved science achievement for all students regardless of ability and background. These findings collectively reinforce the case for the adoption of project-based teaching as a universal, inclusive instructional strategy in Nigerian Basic Science classrooms.

CONCLUSION

This study established that project-based teaching method is significantly more effective in improving students' academic achievement in Basic Science compared to the conventional

lecture method in Nsukka local government area of Enugu State, Nigeria. Gender was not a significant determinant of academic achievement, and the interaction effect of teaching methods and gender on achievement was not significant. Given the evidence from NALABE (2022) of persistently low Basic Science learning outcomes among JSS2 learners in Nigeria, these findings highlight the urgent relevance of adopting innovative, student-centered instructional approaches such as project-based teaching to improve Basic Science education outcomes nationally.

RECOMMENDATIONS AND POLICY IMPLICATIONS

Based on the findings of this study, the following recommendations are made:

1. Basic science teachers should develop and adopt project-based teaching method as it significantly enhances overall students' academic achievement and helps reduce gender gaps in Basic Science performance.
2. Regular sensitization workshops and in-service training programmes should be organized to retrain basic science teachers on the implementation of project-based teaching method.
3. Project-based teaching method should be incorporated into pre-service teacher education curricula to equip prospective teachers for effective implementation.
4. Curriculum planners and the Federal Ministry of Education should formally integrate project-based teaching method into the national curriculum framework for Basic Science, in line with the evidence of its effectiveness documented in both international studies (Krajcik et al., 2023; Schneider et al., 2022) and the present study.
5. Government and professional bodies should fund further research on project-based teaching across diverse geographical contexts, subject areas, and student demographic variables, particularly to strengthen evidence specific to the Nigerian educational context.

From a policy standpoint, the persistent low achievement documented by NALABE (2022) underscores the need for a systemic shift from teacher-centered to student-centered instructional approaches in Nigerian secondary education. Policy frameworks should prioritize funding for instructional materials, teacher professional development, and curriculum reform that support learner-centered, inquiry-based methods such as project-based teaching.

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