



Effectiveness of Project-Based Learning on Achievement in Basic Science among Private and Public Junior Secondary School Students: Implications for Evaluator

OLUBUKOLA OLUTOSIN AKANNI

University of Lagos, Akoka, Nigeria

Abstract. Project-based learning is a learner-centred teaching methodology that allows students to acquire key knowledge and skills through the development of projects that respond to real-life problems. Project-based learning has fast gained its popularity and benefits in Western climes, as one of the 21st century revolutionised teaching method. This study investigated the effectiveness of project-Based Learning (PBL) on students' achievement in basic science in public and private junior secondary schools in Ikeja Local Government Area of Lagos State. Quasi-experimental research design was used multi-stage sampling technique was used to select two hundred (200) junior secondary school students from four schools (two public and two private schools). Two research instruments were used for data collection: a self-constructed questionnaire titled: "Effectiveness of Project-Based Learning on Students' Achievement in Basic Science" (EPBLSABS), and Basic Science Achievement tests (BSAT). Three hypotheses were tested to guide the study at 0.05 level of significance. Findings from the study revealed that project-based learning (PBL) exerted a marked significant difference between the academic achievement of students taught Basic Science using project-based learning and those taught using traditional methods in both public and private junior secondary schools. Based on these findings, it was recommended that School teachers should ensure that they get up-to-date skills set on best practices of using project-based learning (PBL) in order to impart knowledge in Basic Science on their students. Also, school administrators, should take proper scrutiny of teachers to ensure that emphasizes and inclusion of project-based learning (PBL) techniques in their teaching lesson plans for robust learning of their students.

Keywords: Effectiveness, Project-based Learning, Achievement, Students.

1. Introduction

Teaching and learning is a continuous process. Commonly used teaching methods in Nigerian schools includes lecture, collaboration, demonstration, recitation, memorization, or combinations of these methods. 21st century teaching in schools have evolved into the using of some different new methods; some of which are Direct Instruction, Flipped Classrooms, Kinesthetic Learning, Differentiated Instruction, *Project-based learning*, Inquiry-based Learning, Expeditionary Learning, Personalized Learning, Game-based Learning Etc. Teaching approaches can be broadly classified into two. These are: teacher-centered and student-centered approaches. In a teacher-centered approach to learning, teachers are the main authority figure in this method, students are viewed to receive instruction from the teacher dogmatically and their primary role is to passively receive information (via lectures and direct instruction) with an end goal of testing and assessment. It is the primary role of teachers to pass knowledge and information's onto their students. In this method, teaching and assessment are viewed as two separate entities. Student learning is measured through objectively scored tests and assessments. Student-Centered Approach to learning is a process whereby teachers are the authority figure in this method, teachers and students play an equally active role in the learning process. The teacher's primary role is to coach and facilitate student learning and overall comprehension of material. However, for a particular teaching method to be appropriate and efficient it has to be in relation with the characteristic of the learner and the type of learning it is supposed to bring about.

21st century education, especially in this part of the world emphasize that students should continue to be educated in the same way as they were in the past, being taught with a standardized curriculum through

rote learning and individualized testing, as a one-size-fits-all pace. Far too many students are struggling to learn because they are disengaged and lack motivation. Kember (2017) described two broad orientations in teaching: the teacher-centred/content-oriented conception and the project based oriented conceptions. In a very useful breakdown of these orientations, he supports many other authors' views in relation to project-based learning, which includes that knowledge is constructed by students and that the teacher is a facilitator of learning other than a presenter of information.

Project-based learning is one of the modern student-centered teaching methods that engages students in acquiring knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks.

Larmer, in the Buck Institute for Education (2015), has summed up Project Based Learning (PBL)'s basic premise as a student led, open-ended authentic project that emphasizes the growth of knowledge and core competency skills like collaboration, creativity and critical thinking (Larmer, 2014). Condliffe (2016) defines PBL as an approach where students try to find solutions to an essential question that is based on a real-world challenge. This approach requires students to actively investigate and explore significant content and learn skills that are crucial to the process of inquiry to be able to answer the essential questions that will result in deeper learning through active exploration of real-world problems and challenges. Grant (2012) opines that PBL, is a student-centered learning where, learning is not a linear road of specific learner outcomes, but instead an open and flexible approach, where multiple subjects can cross. Through inquiry, students are able to collaborate and develop their own learning instead of being led by the teacher instruction. According to Demirhan (2022), project-based learning is a comprehensive approach to classroom teaching and learning that is designed to engage students in investigating a complex, authentic problems and carefully designed products and tasks. Omeje, (2014) opines that project-based learning is an instruction that comprises four components: Purposing, planning, executing and judging. This is seen as a means of teaching the students self-discipline; students have to define the problem, plan their work, find appropriate resources, carry out the plans and draw conclusion. It involves assigning a particular work to students or a group of students to work and compare at their spare time and report to the teacher as when demanded.

PBL is a process of learning whereby students learn through inquiry. Students pursue knowledge through reflecting and asking questions. In order for students to begin to ask questions, they must be intrinsically motivated in order for a reflection to occur. PBL requires critical thinking, problem solving, collaboration, and various forms of communication. To answer a driving question and create high-quality work, students need to do much more than remember information. They need to use higher-order thinking skills and learn to work as a team. Moursund (2015) opines that students have a voice and control over, how they "shape their learning to fit their own interests and abilities." This allows students to create content that may be more meaningful and memorable to the student, which begins to also suggest mastery learning. Rogers (2013) identified the important precondition for project method as the need for a leader or person who is perceived as an authority figure in the situation, is sufficiently secure within his/herself and in relationship to others that experiences an essential trust in the capacity of others to think and learn for themselves'. Choice in the area of the learning is emphasized by Burnard (2016), as he interprets Rogers' ideas of project method as 'students might not only choose what to study, but how and why that topic might be an interesting one to study'. He also emphasizes Rogers' belief that students' perceptions of the world were important, that they were relevant and appropriate. The definition therefore emphasizes the concept of students having 'choice' in their learning. Harden and Crosby (2011) describe teacher-centred instruction strategies as the focus of the teacher in transmitting knowledge, from the expert to the novice. In contrast, they describe project method as focusing on the students' learning and 'what students do to achieve this, rather than what the teacher does'. This definition emphasizes the concept of the student 'doing'.

Lea and Stephenson (2013) summarize characteristics of project method to include the following tenets:

- Reliance on active rather than passive learning,
- Emphasis on deep learning and understanding,
- Increased responsibility and accountability on the part of the student,
- Increased sense of autonomy in the learner
- Interdependence between teacher and learner,
- Mutual respect within the learner teacher relationship, and
- Reflexive instruction to the teaching and learning process on the part of both teacher and learner.

According to Gibbs (2015), PBL draws from similar concepts when he describes project method courses as those that emphasize: learner activity rather than passivity. Students' experience on the course outside the institution and prior to the course; process and competence, rather than content; where the key decisions about learning are made by the student through negotiation with the teacher. Gibbs elaborates details on these key decisions to include: What is to be learnt, how and when it is to be learnt, with what outcome, what criteria and standards are to be used, how the judgments are made and by whom these judgments are made? In a similar vein, Harden & Crosby (2011). In their book for use in second level education (post-primary), entitled 'A Guide to Student-Centered Instruction', they present the main principles of project method as:

- Learner has full responsibility for her/his learning.
- Involvement and participation are necessary for learning
- Relationship between learners is more equal, promoting growth, development becomes a facilitator and resource person
- Learner experiences confluence in his education (affective and cognitive domains flow together)
- Learner sees himself differently as a result of the learning experience

Project-based learning is an educational activity in which a group of students working together during a period of time, receive instruction and feedback from an instructor, work an assignment or (practical) problem, acquiring knowledge, skills and attitudes (Baert, Beunens, & Dekeyser, 2022). Project-based learning is an instructional method centred on the learner. Instead of using a rigid lesson plan that directs a learner down a specified part of learning outcome or objectives. Project-based learning allows in-depth investigation of a topic (Erdem, 2022; Harris & Katz, 2021). Project based learning actively engages in problem solving learning process through planning, doing and completing projects. The new teaching paradigm embraces the belief that children learn best by applying concept to real world scenarios. (Chard, 2021). The Chinese philosopher, Confucius stated this concept concisely "I hear and I forget, I see and I remember, I do, and I understand". It is through this process that the brain gains understanding and assimilation of the lesson being learned and retains the understanding of that lesson at a higher rate than traditional classroom, single – topic instruction. Project – based learning is considered to be revolution in education, replacing out dated passive learning model of single topic study with active learning using "multiple – intelligence." Project-based learning offers a wide range of benefits to both students and teachers. A growing body of academic research supports the use

of project-based learning in school to engage students, cut absenteeism, boost cooperative learning skills, and improve academic performance. For students, benefits of project-based learning include:

- Increased attendance, growth in self-reliance, and improved attitudes toward learning (Thomas, 2020)
- Academic gains equal to or better than those generated by other models, with students involved in projects taking greater responsibility for their own learning than during more traditional classroom activities (Boaler, 2022)
- Opportunities to develop complex skills, such as higher-order thinking, problem-solving, collaborating, and communicating (Intel, 2013)
- Access to a broader range of learning opportunities in the classroom, providing a strategy for engaging culturally diverse learners (Railsback, 2022)

For many students, the appeal of this approach to learning comes from the authenticity of the experience. Students take on the role and behaviour of those working in a particular discipline. Whether they are making a documentary video about an environmental concern, designing a travel brochure to highlight sites of historical significance in their community, or developing a multimedia presentation about the pros and cons of building a shopping mall, students are engaged in real-world activities that have significance beyond the classroom.

For teachers, additional benefits include enhanced professionalism and collaboration among colleagues, and opportunities to build relationships with students.

Rogus (2021) asserts that students may not be challenged to gain a deeper understanding of what is learnt or to apply the content to real situation without actively engaged in the activities. By assigning a project or task to students to accomplish, it empowers them to learn outside the classroom lessons and develop contextual situation in which they can transfer the knowledge. With the above principles, project-based learning will be very effective for teaching acquisition of skills and practical skills as applicable in Basic Science.

Project-based learning, according to Biajone (2015), is a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks. Gulbahar and Tinmaz, (2014) in their study asserted that project-based learning can

produce positive attitudes towards students learning process, work routines, abilities in problem-solving and self-esteem. This implies that project-based learning is a method through which the teacher can promote students' positive attitude, interest, achievement and retention in learning. This is why the researcher advocates that project-based learning will be a suitable instructional method for JSS Basic Science.

With project-based learning children are exposed to a wide range of skills and competences such as collaborations, project planning, decision making, and time management (Blank, 2021, Dickinsen 2022). Project-based learning also increases motivation. Teachers often note improvement in attendance, more class participation and greater willingness to do homework (Bottoms and Webb, 2022; Monursund, Dielefeldt, and Underwood, 2021). It also helps students retain more knowledge and skill when they are engaged in stimulating projects. With projects, kids use higher order thinking skills rather than memorizing facts in an isolated context without a connection to how and where they are used in the real world (Blank, 2021; Bottoms & Webb, 2022; Reyes; 2022).

Through collaborative learning, PBL allows students to bounce ideas of each other, voice their own opinions, and negotiate solutions and skills that will be necessary in the work place (Bryson, 2020; Reyes, 2022). It enables students to make and see connections between disciplines, increase social and communication skills and provides opportunities to contribute to their school community. It enables children take pride in accomplishing things that has value outside the classroom and allow children to use their individual strengths and diverse approaches to learning (Thomas, 2022). It also provides a practical, real-world way to learn and to use technology (Kadel, 2022; Moursund, Dielefeldt, & Underwood, 2021), and increase problem solving skills (Moursnud, Dielefeldt & Underwood, 2021).

With many changes occurring in the field of education, why is PBL being called upon to help drive the new era of learning? According to the Buck Institute for Education (2015), research shows that learners not only respond by feeding back information, but they also actively use what they know to explore, negotiate, interpret, and create. They construct solutions, thus shifting the emphasis toward the process of learning. In addition, cognitive research has revealed much more about the nature of problem solving. Educationists have benefited from this research, as teachers have learned how to effectively scaffold content and activities to amplify and extend the skills and capabilities of students. Secondly, the world has changed, and nearly all teachers, understand how the industrial culture has

shaped the organization and methods of schools in the 19th and 20th centuries, and they recognize that schools must now adapt to a new century. It is clear that children needs both knowledge and skills to succeed. This need is driven not only by work force demands for high-performance employees who can plan, collaborate, and communicate, but also by the need to help all young people learn civic responsibility and master their new roles as global citizens (Buck Institute for Education, 2015). In this sense, the need for educationists to adapt to a changing world is the primary reason that PBL is increasingly popular. PBL is an attempt to create new instructional practices that reflect the environment in which children now live and learn. And, as the world continues to change, so will teaching methodologies, based on this premise, is the perceived effectiveness of PBL as it is widely being explored as the best method for teaching science.

Science is the foundation upon which present day technological breakthrough is built upon. Nations all over the world including Nigeria are striving hard to develop scientifically and technologically. Onanuga (2015) defines science as an integral part of human society whose impact is felt in every sphere of human life, so much that it is intricately linked with a nation's development. Science is the theory upon which the technology is built, without science; there cannot be intuition for technology (Onanuga, 2015). Integrated Science, as it was previously called, is the foundation for the science subjects like mathematics, physics, Chemistry, Biology, Geography, Physical and Health Education. It also cuts -across many other fields of human study. Today, based on recent development in science and technology, integrated science is taught as Basic science in both public and private schools at Junior Secondary School level. The main reason for teaching basic science is that it widens the knowledge of the students in science, which enables them to appreciate the unity among science subjects. Furthermore, the recipients may gain the commonality of the approach to solve problems of scientific nature. According to the Odugbuni (2020), basic science enables students to be able to: observe carefully and thoroughly, report completely and accurately, organize information acquired, generalize on the basis of acquired information, predict as a result of the generalization, design experiments (including control experiments where necessary, to check predictions), use models to explain phenomena, where appropriate and continue the process of inquiry when new data do not conform to predictions.

The goal of science education according to Feinstein, (2021) is to help students become competent outsiders "with respect to science and

technology; that is, teach them how to recognize moments when scientific and technological information would be useful and enable them to locate, integrate with their own experiences, and reach an informed opinion or decision. He alleges that traditional education instead produces marginal insiders, whose scholastic experiences and rudimentary understanding of science often dampen their interest and impede their confidence in dealing with scientific information. To achieve these objectives, it is suggested that the teaching and learning of basic science should involve the use of innovative methods in teaching. Such methods are not limited to discovery, problem-solving, open-ended field trip and laboratory method among others.

Achievement is defined as a thing done successfully, typically by efforts, courage or skill. It is the process of actualizing something. Academic Achievement is described by Adeyemi, (2021) as the scholastic standing of a student at a given moment which states individual abilities. It refers to a person's learning ability which could be positive or negative performance. Academic achievement is used to measure a student's cognitive, affective and psychomotor domains. Students' academic achievement can be explained in form of grades obtained from tests or examination on courses taken. Academic achievement as described by Adeyemo, (2015) as the scholastic standing of a student at a given moment, which states individual abilities. Students' academic achievement can be explained in form of grades, obtained from tests or examinations on courses taken. In Nigeria, the level of students' academic achievement in junior secondary schools is determined through external examinations like Basic Education Certificate Examination (BECE) conducted by the Exam Development Centre (EDC) of the State. Achievement of instructional objective as explained by Utulu and Alonge (2022) showed that project-based learning actively engages students in the effective mastery of the subject matter and promotion of a positive attitude towards the subject. As noted by the ministry of Education in its National Report on the Development of Education in Nigeria, presented at the International Conference on Education in September 2001, teaching instructions adopted should make learning more learner-centered in order to promote imaginative, critical and creative skills in students. In a project-based learning class, students take a participative role by leading discussions and teachers become facilitators in this regard, teachers facilitate students' discussion and interject only when necessary, allowing students to put the language to use and explore aesthetics of learning materials (Oludipe and Idowu, 2021).

The achievement of the objectives of basic science depends largely on what the teacher does in the

classroom during the implementation stage. The teacher should adopt the most appropriate teaching method, skills and materials in promoting learning. The method adopted should be one that can enable the teacher present the lesson effectively and at the same time give students the maximum opportunity of participating actively in the learning process (Offorma, 2016). In recent times, emphasis on teaching methodology has shifted from the teacher-know-all to the student-centered approach. Hence educational activities should be centered on the learner for maximum self-development and fulfilment. Teaching is an art of creation and the product of this creation is the human personality. Teaching is a systematic activity deliberately engaged in by the teacher to facilitate the learning of the intended knowledge, skills and values by the student and getting the necessary feedback (Offorma, 2016). This calls for the introduction of a constructivist teaching method like project-based learning (PBL). Constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction rather than passively receiving information. Project-based learning (PBL) is practical oriented and student-centered approach to teaching. It fosters critical thinking, problem solving and philosophy of learning by doing, which helps to motivate interest and enhance retention in subjects like basic science

Another factor which determines the academic achievement of students in basic science is the type of school (public owned or privately owned). Public and private schools are institutions owned as the names denote. The public schools in Nigeria have Federal, State, and Local Governments as their proprietors while the private schools have individuals, associations or organizations as the owners. The superiority of private schools and public schools remain an unending debate among scholars. Olatoye (2019) suggests that there exists a significant difference in mathematics and science achievement of public and private school pupils in which private school pupils performed better than their public-school counterparts. However, in a study comparing students' academic achievement in business studies in public and private Junior Secondary School Certificate Examinations (JSSCE) in Edo state, according to (Igbinedion (2021), it revealed that there was a significant difference in the academic achievement in business studies between public and private schools from 2018 to 2020. Results further showed that the percentage achievement trend of public schools was higher than those of private schools. These discussions so far, show that there is a need to investigate the effectiveness of PBL on private and public junior secondary school students' achievements in basic science.

1.1 Statement of the Problem

Basic science forms the foundation of other disciplines in science. It is a driving force for technological breakthrough and national development. Despite the already existing methodologies available to teaching of science, the state of science learning in Nigeria is still a concern to all and sundry. Teacher-centered methodology

seems obsolete and insufficient in teaching basic science and the evidence of this can be seen in the achievements in basic science among junior secondary school students. There has been an increasing concern about the overall academic achievement of public and private junior secondary school students in basic science, as measured by the Basic Education Certificate Examination (BECE). The table below further highlights this.

Table 1: Percentage of Passes and Failures at the BECE (in Basic Science) for a 4-Year Period

Year	Distinction	Credit	Pass	Fail
2016	10.2	21.1	41.5	27.2
2017	9.8	16.5	42.8	30.9
2018	5.4	14.7	38.6	41.3
2019	8.3	18.9	41.2	31.6
Average	8.43	17.80	41.03	32.75
Total Average	13.11	17.8	41.03	32.75

D-Distinction, C-Credit, P-Pass, F-Fail

Source: Digest of Education Statistics, Federal Ministry of Education, 2020.

The data in table one above showed that students' performances in basic science were more at the pass and failure grades than distinction and credit grades. Few percentages of the students made it at the distinction and credit level (13.11%) while the pass and failure grades amounted to 41.03% and 32.75% respectively within the review period. Since the quality of performances' decreases from distinction down to failure grades, it implied that the results were dismal. The poor academic achievement of students basically has largely been attributed to poor teaching methods adopted by the teachers as seen in several researches on achievement among others.

A look at the performance from 2016 to 2019 in the Basic Education Certificate Examinations shows that achievement targets have not been met. State public and private schools achieved an average performance of 50% in Basic Science, as against their target which was 69% (Global Delivery Initiative, 2019). Further, Osuolale (2014) in his study highlighted that the problems of teaching and learning of basic science in junior secondary schools in Nasarawa State originated from the poor foundation and ineffective teaching methods in Basic science. Some parents and other stakeholders in secondary education have argued that private schools have a more positive attitude towards intellectual development of students and therefore offer higher learning opportunities, experiences and various pedagogical practices to improve their students' performance and achievement in academics unlike the public schools. In the past, research efforts had been focused on identifying factors that militate against student's learning outcomes in Basic science. The manner in which the subject is presented to students can significantly influence their interest and knowledge. While the manner of presentation is supposed to be activity based, most Nigerian secondary school teachers rely

on expository lecture method. Specific challenges facing teachers include:

- Recognizing situations that make for good projects
- Structuring problems as learning opportunities
- Collaborating with colleagues to develop interdisciplinary projects
- Managing the learning process
- Integrating technologies where appropriate
- Developing authentic assessments

Teachers may have to be willing to take risks to overcome initial challenges. A supportive administration can help by implementing more flexible schedules, such as block schedules or team planning time, and providing teachers with professional development opportunities. Odugbuni (2020) pointed out that despite the thirty (30) years existence of learning style theories (detailing how people learn), most teachers still dispense information using traditional teaching methods without regard to student's learning abilities. These methods are theoretical, extremely didactic and teacher-directed, instead of being experimental or activity-based. It is for this reason that Onanuga (2015) recommended that schools, teachers, guidance counselors and other educational specialists need to employ a wider variety of teaching methods from modifying assessments and instructional strategies in the classroom to entirely redesigning the way in which students are taught in school. It is against this background that this study investigated the effectiveness of PBL on private and public junior secondary school students' achievements in science in Ikeja Local Government Area of Lagos state.

1.2 Objectives of the Study

The objectives of this study are:

- Determine the difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in public junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.
- Determine the difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in private junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.
- Determine the comparative effectiveness of project-based learning (PBL) on Basic Science achievement among public and private junior secondary school students within Ikeja Local Government Area of Lagos State, Nigeria.

1.3 Hypotheses

The following postulated research hypotheses guided the conduct of the study:

- There is no significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in public junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.
- There is no significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in private junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.
- There is no significant impact of the comparative effectiveness of project-based learning (PBL) on Basic Science achievement based on gender (i.e. gender difference) among public and private junior secondary school students within Ikeja Local Government Area of Lagos State, Nigeria.

2. Research Design

quasi-experimental research design, which is one of the quantitative research methods, was used to test

and compare the effects of PBL on achievement in Basic Science among students in public and private junior secondary schools in Ikeja Local Government Area of Lagos state.

2.1 Population of the Study

The population of this study comprises the adolescent students in junior public and private secondary schools in Ikeja Local Government Area. The total population projection of students between ages 12-14 years stands at 22,196. There are currently 13 public junior secondary schools in the Ikeja local government area, with 63 private junior secondary schools. JSSII students was used for the study, with a total population of 3,782 students in the public junior secondary schools and 1,168 students in private junior secondary schools within the Ikeja local government. (Lagos State School Census Report, 2019-2020)

2.2 Sample and Sampling Techniques

Multi-stage sampling techniques were employed in the study. A simple random sampling technique was used to select the four schools needed for the study. These four schools comprised of two public and two private schools within the Ikeja local government. Stratified sampling procedure was employed to select two hundred respondents from JSS II classes among the four selected secondary schools in the study area. Fifty students were selected from each of the four selected schools in Ikeja Local Government Area

2.3 Research Instrumentation

The two main instruments to be used in assessing the students' achievement in Basic Science are: A questionnaire titled: Effectiveness of Project Based Learning on Students' Achievement in Basic Science" (EPBLSABS) and a Basic Science Achievement Test (BSAT) compiled by the researcher from past questions of Junior Secondary School Basic Certificate Examinations. (2014-2019). the achievement test comprises of 20-multiple choice questions. These test items cover the topics that were treated during the term. The research instrument was validated by experts in the field of measurement and evaluation, who ensures the face and content validity, the instruments have a reliability of 0.82 for the questionnaires and 0.785 for the Basic- Science Achievement Test.

3. Results

Descriptive Analysis of Students' Demographics

Table 2: Demographic Information of the Students

Variables		Levels of Variables	No of Students (n)	Percentage (%)
School Name	Private Schools	School A	51	25.5
		School B	48	25.5
School Name	Public (Government) Schools	School A	51	25.5
		School B	50	25.5
		Total	200	100.0
Gender	Male		100	50.0
	Female		100	50.0
	Total		200	100.0
Age Group	12 years below		81	40.5
	13 – 15 years		118	59.0
	16 years above		1	0.5
	Total		200	100.0
School Type	Public (Government-Owned)		101	50.5
	Private		99	49.5
	Total		200	100.0

Hypotheses Testing

Hypothesis 1: There is no significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in public junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.

Table 3: Paired Samples *t*-Test (Dependent Samples *t*-Test) of Difference between Academic Achievement (Basic Science) of students taught using PBL and those taught using traditional teaching method in Public Junior Secondary Schools within Ikeja Local Government Area of Lagos State, Nigeria.

Modes of Item Construction	N	Mean	Std. Dev.	d.f.	t-cal.	Sig.(p) value	Decision
Achievement in Basic Science before PBL treatment (Pre-test)	101	12.03	1.81	100	23.597**	<0.001	Reject H_0
Achievement in Basic Science after PBL treatment (Post-test)		17.85	1.72				
Achievement in Basic Science before & after PBL treatment		5.82	2.48				

$p = < 0.001 < 0.01$

Table 3 revealed that there was an increase in the average academic achievement after the PBL treatment (i.e. in the post-test) as compared to their average academic achievement before the PBL treatment (i.e. in the pre-test), table 3 was more concerned with the meagre difference of 5.82 that emerged between the average academic achievement (before and after the PBL treatment) in the Basic Science.

This mean difference (5.82) in the average academic achievement before and after the PBL treatment was found to be statistically significant as it yielded a *t*-value of 23.597** and a *p*-value that is $< 0.001 < 0.05$ (statistical benchmark) at 100 degrees of freedom.

All these numerical evidences imply that the null hypothesis is therefore rejected; hence, *there is a significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in public junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.*

Hypothesis 2: There is no significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in private junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.

Table 4: Paired Samples *t*-Test (Dependent Samples *t*-Test) of Difference between Academic Achievement (Basic Science) of students taught using PBL and those taught using traditional teaching method in Private Junior Secondary Schools within Ikeja Local Government Area of Lagos State, Nigeria.

	Modes of Item Construction	N	Mean	Std. Dev.	d.f.	t-cal.	Sig.(p) value	Decision
Academic Achievement (Basic Science)	Achievement in Basic Science before PBL treatment (Pre-test)	99	11.96	1.51	98	27.607**	<0.001	Reject H_0
	Achievement in Basic Science after PBL treatment (Post-test)		17.99	1.46				
	Achievement in Basic Science before & after PBL treatment		6.03	2.17				

$p = < 0.001 < 0.01$

Table 4 revealed that there was an increase in the average academic achievement after the PBL treatment (i.e. in the post-test) as compared to their average academic achievement before the PBL treatment (i.e. in the pre-test), table 7 was more concerned with the meagre difference of 6.03 that emerged between the average academic achievement (before and after the PBL treatment) in the Basic Science. This mean difference (6.03) in the average academic achievement before and after the PBL treatment was found to be statistically significant as it yielded a *t*-value of 27.607** and a *p*-value that is $< 0.001 < 0.05$ (statistical benchmark) at 98 degrees of freedom.

All these numerical evidences imply that the null hypothesis is therefore rejected; hence, *there is a significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in private junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria.*

Hypothesis 3: There is no significant impact of the comparative effectiveness of project-based learning (PBL) on Basic Science achievement based on gender among public and private junior secondary school students within Ikeja Local Government Area of Lagos State, Nigeria.

Table 5: Independent-Samples *t*-Test of Difference between Male and Female Students' Perception on the Effectiveness of Project-Based Learning (PBL) within Junior Public Junior Secondary Schools within Ikeja Local Government Area of Lagos State, Nigeria.

	Gender	N	Mean	Std. Dev.	d.f.	t-calculated	Sig. (p) value	Remark	Decision
Effectiveness of project-based learning (PBL)	Male	48	89.33	8.51	99	1.657	0.101	Not Significant	H_0 is Accepted
	Female	53	86.87	6.38					

$p = 0.101 > 0.01$

Table 6: Independent-Samples *t*-Test of Difference between Male and Female Students' Basic Science Achievement (Post-Test) within Junior Private Junior Secondary Schools within Ikeja Local Government Area of Lagos State, Nigeria.

	Gender	N	Mean	Std. Dev.	d.f.	t-calculated	Sig. (p) value	Remark	Decision
Effectiveness of project-based learning (PBL)	Male	52	84.90	5.86	97	0.858	0.393	Not Significant	H_0 is Accepted
	Female	47	85.94	6.11					

$p = 0.393 > 0.01$

From analysis of data on public junior secondary schools in table 5, it was observed that the male students with an average (mean) of 89.33 had better perception on the effectiveness of project-based learning (PBL) their female counterparts (whose average score is 86.87); the observed gender difference (3.46) in their perception; attracted a *t-calculated* value of 1.657 whose significant level (*p-value*) was 0.101. This *p-value* was observed to be greater than the statistical benchmark of 0.05.

From analysis of data on private junior secondary schools in table 6, it was observed that the female students with an average (mean) of 85.94 had better perception on the effectiveness of project-based learning (PBL) their male counterparts (whose average score is 84.90); the observed gender difference (1.04) in their perception; attracted a *t-calculated* value of 0.858 whose significant level (*p-value*) was 0.393. This *p-value* was observed to be greater than the statistical benchmark of 0.05.

Hence, there is an acceptance of the null hypothesis, thereby implying that, there is no significant impact of gender (i.e. gender difference) on the effectiveness of project-based learning (PBL) on Basic Science achievement among public and private junior secondary school students within Ikeja Local Government Area of Lagos State, Nigeria.

4. Discussion of Research Findings

Finding 1: revealed that there is a significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in public junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria. This present research finding was well supported by Ezeudu (2021) who indicated that project-based learning method improves student's achievement in sciences more than the traditional teaching methods like lecture, demonstration and so on, with regards to the above statement. Similar work of Boaler in (2022) who employed quasi experimental research design for the purpose of comparing students' performance on some criterion measure, to assess students' capabilities, achievement and interest for three years using

traditional versus project-based method of instruction in two schools. With a total number of 300 SS 2 students sampled for the work for three years, his empirical result of the study revealed that students at the project-based school passed the national examination administered in three years of the study more than traditional school students, the better performance was due to their increased interest and retention in mathematics.

Finding 2: revealed that there is a significant difference between the academic achievement of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in private junior secondary schools within Ikeja Local Government Area of Lagos State, Nigeria. This present research finding was well supported by Ezeudu (2021) who indicated that project-based learning method improves student's achievement in sciences more than the traditional teaching methods like lecture, demonstration and so on, with regards to the above statement. Similar work of Boaler in (2022) who employed quasi experimental research design for the purpose of comparing students' performance on some criterion measure, to assess students' capabilities, achievement and interest for three years using traditional versus project-based method of instruction in two schools. With a total number of 300 SS 2 students sampled for the work for three years, his empirical result of the study revealed that students at the project-based school passed the national examination administered in three years of the study more than traditional school students, the better performance was due to their increased interest and retention in mathematics.

Finding 3: revealed that there is no significant impact of the effectiveness of project-based learning (PBL) on Basic Science achievement based on gender among public and private junior secondary school students within Ikeja Local Government Area of Lagos State, Nigeria. This present research finding was not supported by Olatoye and Adekoye (2020) carried out a study on the effect of project-based demonstration and lecture teaching strategies on senior secondary students' achievement in an aspect of Agricultural Science, and then discovered that there was a significant interaction effect of

treatment and gender on students' achievement in an aspect of agricultural science.

5. Conclusion

Based on the research findings, it could be inferred that project-based learning (PBL) did not exert significant impact on students' academic achievement (in Basic Science), of students taught Basic Science using project-based learning (PBL) and those taught using traditional teaching method in public and private junior secondary schools.

Finally, gender could not exert any significant impact on the effectiveness of project-based learning (PBL) on Basic Science achievement

6. Recommendations

Based on the findings and conclusion in this study, it would be appropriate to recommend that:

- School teachers should ensure that they get up-to-date skills set on best practices of using project-based learning (PBL) to impart knowledge in Basic Science. This could happen when they make frantic effort to attend top-notch (online/offline) seminars and workshop in relation to education technology.
- Head Teachers/Head of Academic Units in schools should take proper scrutiny into the lesson plans which these school teachers submit to them, they should also always emphasise that subject teachers plan their lessons with the use of project-based learning (PBL) techniques in mind.
- The School Administrators/School Heads/School Managers should brace up and be on top of their game to ensure relevant funds are disbursed on the inclusion of project-based learning (PBL) across all school subjects.
- The Nigerian Government/Ministry of Education/ all well-meaning stakeholders should encourage these school teachers with financial aids or incentives to attend paid and expensive top-notch seminars and workshop in relation to best practices of using project-based learning (PBL) to impart knowledge in Basic Science. This will discourage them from the idea of depending on their years of teaching experience and academic qualification which hold no waters in the 21st century education space.

7. Implications for Evaluators

- With all that has been said and done in this research, it is noteworthy to establish the following implications for evaluators
- Project-based learning (PBL) helps to impart knowledge in Basic Science by improving the content of teaching and in turn students' achievement in the subject being taught was boosted.
- Project-based learning (PBL) in teaching of Basic Science assist teachers that desire to stay relevant in the 21st century education space.
- Project-based learning (PBL) techniques utilised by teachers, improve students' achievement in Basic Science and they will not remain at a low ebb.
- Project-based learning (PBL) in teaching mathematics related topics in basic science, excites students and helps change their old perception on Basic Science.

References

- Adeyemi, T.O. (2021). Predicting students' performance in Junior Secondary Certificate Examination, in Ondo state, Nigeria. *Humanity and Social Sciences Journals*, 3(1)" 26-36.
- Adeyemo, D.A. (2015). Parental involvement and interest in schooling and school environment: As predictors of academic self-efficacy among fresh secondary school students in Oyo State, Nigeria. *Electronic Journal of Research in Educational Psychology*, 5(1), 163-180.
- Baert, H., Beunens, L., & Dekeyser, L., (2022). Doing with understanding: lesson from research on problem and project-based learning. *Journal of Learning Sciences*, 7, 271-312.
- Biajone, J. (2015). Promoting positive attitudes towards statistics in pedagogy students through project work. ICOTS-7. State University of Campinas. Brazil.
- Blank, W. (2021). Anthentia instruction. In W.E. Blank & S. Hawall (Eds). Promising practices for connecting high school to the real world. (5-21). Tawpa, F.C. University of South Florida. (ERIC Document Reproduction Service No ED 407586).
- Boaler, J. (2022). Learning from Teaching: Exploring the relationship between reform curriculum and equity. *Journal for Research in Mathematics Education*, 33(4), 239-258.
- Buck Institute for Education. (2015). Project-based learning for the 21st century.

- Burnard, P. (2020). Carl Rogers and Postmodernism: Challenges in Nursing and Health Sciences. *Nursing and Health Sciences 1*, 241-247.
- Chard, S. (2021). Project approach: Foundation theory learning. Retrieved from http://www.project_approach.com/foundation/learning.htm.
- Dickinsen, K.P (2022). Providing educational services in the summer youth employment and training programme. (Technical assistance of labour, office of policy & Research (ERIC Document Reproduction Service) No. ED. 420756
- Erdem, M. (2022). Proje labanlı Öğrenme. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 22*, 172-179.
- Ezeudu, (2021). "The Development and preliminary validation of an Achievement Test in Teachers' Training College. Selected units of organic chemistry: Unpublished M. Ed Thesis University of Nigeria, Nsukka.
- Federal Ministry of Education, *Digest of Education Statistics*, August 2017.
- Feinstein, N. (2021). Salvaging Science Literacy. *Science Education*, 95, 168-185.
- Global Delivery Initiative (GDI). (2016). STEM Education: The Tool Addressing the Gap in Lagos State Secondary Schools. Available from: <http://www.scienceambassadors.org.ng>.
- Grant, M. M. (2022). Getting a grip on project-based learning: Theory, cases and recommendations. *Meridian: A Middle School Computer Technologies Journal*, 5(1), 83.
- Great School Partnership. (2021). *National Science Education Standards*. Washington, DC: National Academy Press.
- Gulbahar, Y., & Tinmaz, H. (2014). Implementing project-based learning and e-portfolio assessment in an undergraduate course. *Journal of Research on Technology in Education*, 38(3), 309-327.
- Harden, R. M. & Crosby, J. (2021). AMEE Guide No 20: The Good Teacher is more than a Lecturer -v/ the Twelve Roles of the Teacher. *Medical Teacher 22*(4), 334-347.
- Harris, J.H., & Katz, L.G. (2021). Young investigators: The project approach in the early years. New York Teachers College Press.
- Huba, M. E., & Freed, J. E. (2021). *Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning*.
- Kadel, S. (2022). Students to Complex County's oral history. Hood River News. Retrieved July 9, 2002, from <http://www.gorgenews.com/Archives/H Rarch/HR121>.
- Kember, D. (2017). A Reconceptualisation of the Research into University Academics Conceptions of Teaching. *Learning and Instruction 7*(3), 255-275.
- Kraft, N. (2015). "Criteria for authentic project-based learning <http://www.rmedenver.com/useguide/pbl.htm> Accessed on 20/10/2008.
- Lagos State Ministry of Education. (2019). *Annual School Census Report 2019*. Lagos: Directorate of Policy Planning, Research and Statistics.
- Larmer, J., & Mergendoller, J. R. (2014). Why we changed our model of the "8 essential elements of PBL." Buck Institute for Education. Retrieved from www.bie.org.
- Lea, S. J., Stephenson, D., & Troy, J. (2013). Higher Education Students' Attitudes to Student-Centred Learning: Beyond 'Educational Bulimia'. *Studies in Higher Education 28*(3), 321-334.
- Moursund D. Dielefeldt, T. and Underwood, S. (2011). Foundation for the Road Ahead. Project-based learning and information Technologies. Washington, D.C: National Foundation for the improvement of education, Retrieved July 10, 2002 from <http://www.Iste.org/research/roadhead/pbl.htm>.
- Moursund, D. (2015). Project-based learning in an information-technology environment. *Learning and Leading with Technology*, 25, 4-5.
- National Research Council (2021). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Nicol, D. J., & Macfarlane-Dick, D. (2016). Formative Assessment and Self-Regulated Learning: a Model and Seven Principles of good feedback Practice. *Studies in Higher Education*, 31(2), 199-218.
- Odugbumi, A. O. (2020). Science and Technology Education in Nigeria. The Euphoria, Frustrations and Hopes. The 21st Inaugural Lecture. Lagos State University.
- Offorma, G.C. (2016). Curriculum implementation and instruction. Onitsha: Uni-world Educational Publishers.
- Olatoye, R. A. & Agbatogun, A. A. (2019). Parental Involvement as Correlates of Pupils' Achievement in Mathematics and Science in Ogun state, Nigeria. *Educational Research and Review*. 14 (10), 457-464.
- Olatoye, R.A. & Adekoye, Y.M., (2020). "Effect of project-based learning on Agricultural Science." In: O.A. Afemikhe and J.G. Adewale (Eds). *Issues in Educational measurement and Evaluation in Nigeria*,

Published by Institute of Education,
University of Ibadan, Nigeria.

*Information and Communication
Technology (IJEDICT)* 8(1), 4-15.

- Oludipe and Idowu D (2021). Developing Nigerian Integrated Science Curriculum *Journal of Soil Science and Environmental Management* 2 (8), 134-145.
- Omeje, H.O. (2014). "Effect of Project method on academic achievement for low ability students in carpentry and joinery". An Unpublished M.Ed Thesis, Department of Vocational Teacher Education. University of Nigeria, Nsukka.
- Osuolale, O.J. (2014). Problems of Teaching and Learning Science in Junior Secondary Schools in Nasarawa State, Nigeria. *Journal of Education and Practice*. 5(3) 109-118
- Railsback, H.O. (2022). The problem method: A problem-based learning model's effect on critical thinking skill of forth-and fifth-grade social studies students.
- Reyes, R. (2022). Native perspective on the school reform movement: A hot topic porthland, OR: Northwest Regional Education Laboratory, comprehensive center Region. <http://www.n.wrac.org/pnd/hot/native.htm>
- Rogers, C. R. (2013a). 'As a Teacher, can I be Myself? In *Freedom to Learn for the 80's*. Ohio: Charles. E. Merrill Publishing Company.
- Rogoff, B. (2021). Cognitive development through social interaction In Vgotsky and Piaget. P. Murphy (Ed.), *Learners, Learning and Assessment*. London: Open University Press.
- Rogus, J.F. (2021). Promoting self-discipline: A comprehensive approach. *Theory into Practice*, 24(4), 61- 70.
- Sana, I. & Saiqa, I. A. (2022) "I almost Learnt to Learn": Promoting Learner's Autonomy through Project Based Learning in Access Classrooms Language in India.
- Simon, B. (2015). Why no Pedagogy in England? In J. Leach and B. Moon (Eds.), *Learners and Pedagogy*. London: Sage Publications.
- Thomas, J.N. (2020). Project-based learning overview. Novato, C.A. Buck Institute for Education.
- Tretten, R. & Zacharou, P. (2021). Learning about project-based learning: Assessment of project-based learning in Tinker tech schools. San Rafael, CA: The Auto desk foundation.
- Utulu, S. C. and Alonge, A. (2022). Use of Mobile Phones [32]for Project Based Learning by Undergraduate Students of Nigerian Private Universities. *International Journal of Education and Development using*