THE INFLUENCE OF INQUIRY-BASED LEARNING ON STUDENTS' PERFORMANCE IN BIOLOGY IN EGOR LOCAL GOVERNMENT AREA IN EDO STATE.

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DECLARATION

I **Ayomide Esther OJESANMI** declare that this project on “The Influence of Inquiry-based Learning on Students’ Performance in Biology in Egor Local Government area in Edo State” is an original work done by me under the supervision of Prof. John Egharevba, Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin.

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Ayomide Esther Ojesanmi. **Date**

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CERTIFICATION

We, the undersigned, certify that this research work was carried out by Ayomide Esther Ojesanmi in the department of Curriculum and Instructional Technology, faculty of Education, University of Benin.

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Project supervisor

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Dr. (Mrs.) I. K OTEZE
Project Coordinator

Date

Prof F.O IDEHEN
Head of Department

Date

DEDICATION

This project is dedicated to Almighty God, the source of all wisdom, knowledge, and understanding, for His endless grace and guidance throughout the course of this study.

It is also lovingly dedicated to my parents, for their unending love, encouragement, and sacrifices that have shaped my academic pursuit.

Finally, this work is dedicated to all Biology students and teachers who strive daily to make science education more meaningful through creativity, curiosity, and inquiry.

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ABSTRACT

This study investigated the influence of inquiry-based learning on students' academic performance in Biology in selected secondary schools in Egor Local Government Area of Edo State. The study adopted a descriptive survey research design, using a structured questionnaire as the main instrument for data collection. A total of 100 SS2 students were randomly selected from five secondary schools within the study area. The data collected were analyzed using mean scores, standard deviation, frequency, and percentage to answer the research questions that guided the study.

The findings revealed that students taught through inquiry-oriented strategies demonstrated better understanding, participation, and retention of Biology concepts compared to those taught through conventional methods. The study also found that inquiry learning increased students' motivation, curiosity, and willingness to collaborate with peers. However, challenges such as inadequate laboratory facilities, large class sizes, and limited time hindered full implementation of inquiry-based teaching.

Based on these findings, the study concluded that inquiry-based learning significantly enhances students' academic performance and engagement in Biology. It therefore recommended that teachers be adequately trained on the use of inquiry methods, laboratories be well-equipped, and policies be put in place to support practical, student-centered approaches in the teaching of science subjects.

CHAPTER ONE

INTRODUCTION

Background of the study

Education is a cornerstone of societal development, and the effectiveness of teaching methods plays a critical role in shaping students' academic success. Over the years, traditional teaching methods, characterized by teacher-centered approaches and rote memorization, have dominated classrooms (Freeman et al., 2014). However, these methods often fail to engage students actively or foster critical thinking (Prince & Felder, 2006).

In response, innovative teaching strategies such as inquiry-based learning have emerged, emphasizing student participation, exploration, and discovery (Hmelo- Silver et al., 2007).

Biology, the scientific study of life and living organisms, is a foundational subject in secondary education, offering insights into the natural world and fostering critical thinking skills. Despite its significance, students' performance in biology has often been suboptimal, attributed to traditional teaching methods emphasizing rote memorization over conceptual understanding.

Inquiry-Based Learning (IBL) has emerged as a pedagogical approach to enhance student engagement and comprehension. IBL encourages students to explore, ask questions, and develop solutions through active participation, aligning with the constructivist theory of learning, which posits that learners construct knowledge through experiences and reflections.

Recent studies have highlighted the efficacy of IBL in science education. For instance, a meta-analysis by Freeman et al. (2014) found that active learning strategies, including IBL, significantly improve student performance in STEM subjects. Similarly, a study by Jeffery et al. (2016) demonstrated that students engaged in inquiry-based biology labs developed more expert-like attitudes toward science, enhancing their interest and confidence in the subject.

Unlike traditional methods that provide answers first, inquiry-based learning starts with questions. Students are given problems that require them to think critically, ask their own questions, conduct investigations, and share their findings. In biology class, this means students learn complex concepts by actually doing science—making hypotheses, running experiments, and working with data. This not only helps them learn the material better but also builds crucial scientific skills.

Despite its potential, the implementation of inquiry-based learning faces numerous barriers, including a lack of teacher training, inadequate resources, and systemic resistance to change (Windschitl, 2003). Many educators continue to rely on traditional teaching methods, which prioritize the transmission of factual knowledge over the development of inquiry skills (Crawford, 2014). This study seeks to address these challenges by providing empirical evidence on the effectiveness of inquiry-based learning in improving students' academic performance in biology.

In the modern educational landscape, the gap between teaching practices and student needs has become increasingly apparent (Darling-Hammond, 2010). While traditional teaching methods have historically served as the foundation of formal education, they often fail to prepare students for the demands of the 21st century, which require critical thinking, creativity, and the ability to adapt to new information (Trilling & Fadel, 2009). In science education, these limitations are particularly pronounced, as traditional approaches struggle to convey the dynamic and exploratory nature of scientific inquiry (Osborne, 2014).

Biology, as a core science subject, exemplifies this issue. The traditional model of biology education often reduces the subject to a series of disconnected facts and processes, neglecting the broader context and real-world applications that make the discipline relevant and engaging (Michael, 2006). This approach not only undermines students' interest in biology but also limits their ability to apply their knowledge to solve complex problems. As a result, student performance in biology frequently falls short of expectations, raising concerns about the effectiveness of current teaching methods (Tanner & Allen, 2005).

Inquiry-Based Learning (IBL) is an active learning approach where students construct knowledge through exploration, problem-solving, and critical thinking (National Research Council [NRC], 2022). In science education, particularly biology, inquiry-based learning shifts from rote memorization to fostering conceptual understanding and scientific skills (Abdulahi et al., 2023). Despite Nigeria's emphasis on STEM education, biology performance remains suboptimal (WAEC, 2023), with a 2022 report showing only 38% of students achieving credits in biology (Federal Ministry of Education, 2022). Studies globally link inquiry- based learning to improved academic outcomes. For instance, a meta-analysis by Jiang et al. (2021) found inquiry-based learning increased science scores by 12% compared to traditional methods. However, limited research exists on its efficacy in Nigerian secondary schools (Okafor & Eze, 2024), creating a gap this study addresses.

Statement of the Problem

Despite the documented benefits of Inquiry-based learning, its implementation in biology classrooms remains limited. Traditional lecture-based methods continue to dominate, often leading to passive learning and disengagement among students.
This persistent reliance on conventional teaching approaches contributes to the ongoing issue of poor performance in biology.

Moreover, challenges such as inadequate teacher training, lack of resources, and rigid curricula hinder the adoption of Inquiry-based learning strategies. Teachers may be unfamiliar with Inquiry-based learning methodologies or lack the support needed to integrate them effectively into their teaching practices.

Despite the critical role biology plays in scientific and technological advancement, students' performance in the subject has remained consistently poor in many secondary schools. Examination reports from various education boards have shown a trend of low achievement and weak understanding of core biological concepts. This underperformance is often attributed to conventional teaching methods that prioritize memorization over comprehension and do not actively involve students in the learning process.

Traditional lecture-based instruction limits students' critical thinking and problem- solving abilities, which are essential for mastering biology. Students are often passive recipients of information, resulting in surface-level understanding and disengagement. In contrast, inquiry-based learning (IBL) promotes student participation, encourages curiosity, and mirrors the processes scientists use to explore biological phenomena.

However, despite growing advocacy for IBL in science education, its implementation remains limited. Factors such as inadequate teacher training, lack of resources, large class sizes, and rigid curricula hinder its adoption. As such, there is a pressing need to investigate whether IBL can significantly enhance student performance in biology and how feasible it is within the context of secondary schools.

This study seeks to bridge that gap by evaluating the influence of inquiry-based learning on students' academic achievement in biology, to provide empirical evidence to support more effective teaching practices

Purpose of the Study

The primary purpose of this study is to examine the influence of Inquiry-Based Learning on students' performance in biology. Specifically, the study aims to:

- Assess the impact of IBL on students' academic achievement in biology.
- Evaluate changes in students' attitudes and engagement resulting from IBL implementation.
- Identify challenges and facilitators associated with the adoption of IBL in biology classrooms.

Research Questions

To achieve the objectives of this study, the following research questions will be addressed:

- How does Inquiry-Based Learning affect students' academic performance in biology?
- What changes occur in students' attitudes and engagement when taught using Inquiry-based learning strategies?
- What are the challenges and facilitators of Inquiry-based learning in biology education?

Hypotheses

Based on the research questions, the study will test the following hypotheses:

- Inquiry-Based Learning has no significant effect on students' academic performance in biology.
- Inquiry-Based Learning has no significant effect on changes that occur in students' attitude and engagement.
- There is no significant effect on the challenges and facilitators of Inquiry- Based Learning in Biology education

Significance of the Study

This study holds significance for various stakeholders in education:

- Students: By identifying effective teaching strategies, the study can enhance students' learning experiences and outcomes in biology.
- Teachers: Insights from the study can guide teachers in adopting pedagogical approaches that foster active learning and student engagement.
- Educational Institutions: The findings can inform curriculum development and teacher training programs, promoting the integration of IBL in science education.
- Policy Makers: Evidence from the study can support policy decisions aimed at improving science education through innovative teaching methodologies.

Scope of the Study

The study focuses on biology as a core science subject, examining the impact of inquiry-based learning on students' academic performance, engagement, and conceptual understanding. The research is restricted to secondary school students and biology teachers within Egor local government, providing a targeted analysis of the teaching and learning processes. The study compares two teaching approaches—inquiry-based learning and traditional methods—to evaluate their respective impacts. While the findings may have broader implications for science education, the study does not extend to other subjects or educational levels, nor does it consider long-term outcomes beyond the immediate context of the research.

Operational Definition of Terms

Inquiry-Based Learning (IBL): A student-centered teaching approach that involves exploring questions, problems, and scenarios, fostering active learning and critical thinking.

Academic Performance: The measurable outcomes of students' learning, typically assessed through grades, test scores, and comprehension of subject matter.

Student Engagement: The level of interest, motivation, and participation exhibited by students in the learning process.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter examines existing scholarship regarding inquiry-based learning's (IBL) impact on biology students' academic outcomes. It is structured around conceptual definitions, theoretical foundations, and empirical research related to the study variables. The review commences with a broad perspective on science education pedagogy, narrows to biology education specifics, and offers a comprehensive analysis of IBL—including its conceptualization, evolution, typologies, advantages, and implementation barriers. Conclusively, it assesses relevant theories and empirical data to identify the research void.

Concept of Teaching and Learning in Science Education Meaning of Science Education

Science education denotes the systematic instruction and acquisition of scientific concepts, principles, methodologies, and the cultivation of attitudes and competencies essential for inquiry and critical thought. As Okebukola (2002) asserts, it empowers learners to observe, classify, quantify, hypothesize, experiment, and infer conclusions about natural phenomena. Its objectives encompass nurturing intellectual growth, practical proficiency, and an informed populace adept at evidence-based decision-making.

Per Nigeria's National Policy on Education (FRN, 2014), science pedagogy across educational tiers should prioritize activity-based, learner-centered "learning by doing"—aligning with global constructivist paradigms over rote memorization.

Goals of Science Education

UNESCO (2015) and Nigeria's secondary curriculum outline science education goals as:

- Building a Foundation of Functional Literacy

The primary aim is to foster a practical scientific literacy that students can use in their daily lives. This involves:

· Mastering Foundational Principles: Achieving a working knowledge of key concepts across major scientific disciplines, from genetics and thermodynamics to ecological interdependence.

· Critically Evaluating Information: Developing the ability to dissect and assess the validity of scientific claims encountered in media, advertising, and public discourse.

· Appreciating the Scientific Enterprise: Understanding that science is a evidence-based, self-correcting process shaped by human curiosity and skepticism, not a static collection of infallible truths.

- Honing the Practices of Scientific Inquiry

This pillar focuses on the "how" of science, transforming students from passive recipients into active investigators. Key skills include:

· Designing and Executing Investigations: Learning to formulate testable questions and carry out controlled experiments.

· Analyzing Evidence and Reasoning Critically: Cultivating the ability to interpret data, identify biases, and logically draw conclusions from evidence.

· Developing Models and Constructing Arguments: Creating visual and conceptual models to explain phenomena and building evidence-based arguments to support their findings.

- Cultivating a Scientific Disposition

This goal targets the attitudes and intellectual habits essential for a lifelong learner. It strives to instill:

· Inquisitive Engagement: Nurturing a sense of wonder about the universe and a drive to understand underlying mechanisms.

· Balanced Skepticism: Encouraging a questioning mindset that demands evidence while remaining open to new ideas and paradigm shifts.

· Resilience and Intellectual Integrity: Learning that progress often comes through iterative failure and persistent effort.

· Ethical Consideration: Prompting reflection on the moral and societal consequences of scientific breakthroughs and technological applications.

- Equipping Students for Future Challenges

Science education serves vital pragmatic functions for both the individual and society at large, by:

· Sparking STEM Pathways: Inspiring and preparing the next generation of innovators, researchers, and technical professionals.

· Empowering Civic Participation: Enabling citizens to contribute meaningfully to public debates on science-driven issues like climate policy, vaccine efficacy, and resource management.

· Navigating a Technological Landscape: Providing the fluency needed to adeptly use, understand, and adapt to rapidly evolving technologies.

- Promote Tech Literacy: Understand and responsibly use technology.
- Foster Environmental Awareness: Teach the importance of conservation, sustainability, and ecosystem understanding.
- Inform Decision-Making: Equip students to make informed decisions based on scientific evidence.

Trends in Modern Science Teaching

Contemporary science pedagogy increasingly emphasizes active learning and student participation, Information and Communication Technology integration in instruction, Curriculum inclusion of local/global scientific challenges and collaborative learning frameworks. Inquiry-based Learning underpins these trends by developing

Overview of Biology Education Nature of

Biology

Biology is the branch of science that examines living organisms and how they interact with their surroundings. It covers a wide range of topics, including the structure, functions, growth, evolution, classification, and distribution of life forms—from tiny molecules to entire ecosystems.

Main themes in biology include:

Cells as life's foundation; Biology studies cells as the basic units of life, Evolution; It explores how living things have changed and diversified over time, Biological organization; It looks at how systems operate within and between organisms, Homeostasis; It examines how organisms keep their internal systems stable, Adaptation; It investigates how species adjust to their environments.

Major branches of biology:

- Botany – the study of plants
- Zoology – the study of animals
- Microbiology– the study of microscopic organisms
- Genetics – the study of heredity and genetic variation
- Ecology – the study of how organisms relate to each other and their environment

Why biology matters: At the most personal level, biology explains who we are.

- Health and Disease: Biology is the foundation of all medicine. It allows us to understand how our body works, what goes wrong in disease (from a common cold to cancer), and how to develop treatments, vaccines, and cures.

- Genetics and Heredity: It reveals why you have your mother's eyes or your father's height. It explains the genetic basis of inherited conditions and is the cornerstone of modern advancements like gene therapy.

- The Mind-Body Connection: Neuroscience, a branch of biology, is unraveling the mysteries of the brain, consciousness, mental health, and how our thoughts and emotions are linked to our physical bodies.

For Sustaining Our Planet: The Web of Life

- Environmental Conservation: Biology helps us understand ecosystems, the impact of pollution, and the importance of biodiversity. It provides the knowledge needed to combat climate change, protect endangered species, and manage natural resources like forests and fisheries sustainably.

- Agriculture and Food Security: By understanding plant science, genetics, and soil biology, we can develop more resilient crops, increase yields, and create sustainable agricultural practices to feed a growing global population.

- Biotechnology: Using biological processes to develop products, biotechnology gives us life-saving insulin, disease-resistant crops, and even sustainable biofuels as an alternative to fossil fuels.

For Shaping Our Future: Innovation and Ethics

· Medical Breakthroughs: From CRISPR gene editing to personalized medicine and regenerative therapies using stem cells, biological research is creating solutions to some of humanity's most challenging health problems.

· The Origin and Nature of Life: Biology explores the history of life on Earth through evolution, providing a unifying explanation for the incredible diversity of species. It also fuels the search for life beyond our planet in the field of astrobiology.

· Bioethics: As our power to manipulate life grows (e.g., cloning, genetic engineering), biology provides the essential knowledge we need to navigate the complex ethical questions these technologies raise. thinking and lifelong learning skills.

In essence, biology is a continually growing and evolving field that deepens our understanding of life and the world we live in.

Importance of Biology in the Curriculum

Secondary biology education serves critical functions:

.Understanding Life and Living Systems

Biology helps students understand how living organisms function, grow, and interact. This knowledge builds a strong foundation for understanding the human body, plants, animals, and ecosystems.

Promotes Scientific Thinking

Studying biology develops critical thinking, observation, experimentation, and problem-solving skills. These are essential for academic growth and everyday decision-making.

Supports Health Education

Biology provides knowledge about nutrition, diseases, hygiene, and the human body. This empowers students to make informed health choices and understand medical advice.

Encourages Environmental Awareness

Biology teaches about the environment, conservation, and sustainable living. It helps students recognize the importance of protecting natural resources and biodiversity.

Career Preparation

Biology is a gateway to careers in medicine, agriculture, biotechnology, research, nursing, and environmental science. Introducing it early helps students discover interests and talents in these fields.

Informs Ethical and Social Decision

Biology raises awareness of bioethics, genetics, and ecological issues, helping students think deeply about their impact on the world.

In short, biology is essential in education because it connects students to the living world, equips them with life skills, and prepares them for future challenges and careers.

Nwagbo (2006) notes biology also cultivates critical analysis through studying living systems.

Challenges in Teaching Biology in Nigeria Notable impediments

include:

Inadequate Teaching Materials and Resources: Many schools lack essential tools like microscopes, charts, lab equipment, and updated textbooks, making it hard to teach biology effectively.

Poor Laboratory Facilities: Biology requires practical experiments, but most schools have either poorly equipped labs or none at all, limiting hands-on learning.

Large Class Sizes: Overcrowded classrooms make it difficult for teachers to give individual attention or conduct meaningful practical lessons.

Shortage of Qualified Teachers: Some biology teachers lack proper training or subject mastery, which affects the quality of teaching and student understanding.

Lack of Continuous Professional Development: Few opportunities exist for teachers to upgrade their knowledge or learn new teaching methods, leaving them stuck with outdated practices.

Poor Student Attitude and Interest: Some students see biology as difficult or boring, often due to how it's taught—focusing too much on theory and memorization.

Language Barriers: Scientific terms and concepts are often hard for students to grasp, especially when English is not their first language.

Inconsistent Curriculum Implementation: Differences in how the curriculum is delivered across schools and regions lead to gaps in student learning and performance.

Lack of Government Support: Limited funding and weak policy enforcement result in underdeveloped science programs and neglected facilities in public schools.

Addressing these challenges requires investment in teacher training, school infrastructure, and curriculum development to make biology more engaging and effective in Nigeria.

Concept and Philosophy of Inquiry-Based Learning (IBL)

Meaning of Inquiry-Based Learning

Inquiry-Based Learning is a teaching methodology where learners investigate questions or scenarios to construct knowledge actively. Justice et al. (2007) characterize it as "instructional techniques driven by student inquiry." Its philosophical basis—aligned with Dewey's (1938) experiential learning and Bruner's (1961) discovery learning—holds that active discovery surpasses passive reception in knowledge retention.

Historical Development of Inquiry-Based Learning

The roots of inquiry-based learning (IBL) can be traced back to the earliest philosophical traditions, through educational reformers of the 19th and 20th centuries, up to contemporary constructivist models of science education. Over centuries, inquiry has been promoted as a superior approach to rote memorization, emphasizing curiosity, discovery, and critical thinking.

Early Philosophical Foundations (Ancient to 17th Century)

The earliest traces of inquiry-oriented learning can be found in Socrates' dialectical method in ancient Greece. Socrates (470–399 BC) used questioning as a pedagogical strategy to stimulate reflective thinking, thereby allowing learners to discover knowledge through dialogue (Brickhouse & Smith, 1994). Similarly, Plato and Aristotle promoted experiential and observational learning, with Aristotle applying empirical methods in his study of natural phenomena, laying a foundation for scientific inquiry (Gutek, 201In the 17th century, Comenius (1592–1670) emphasized the use of objects and real-life experiences in teaching, instead of rote learning. He argued that learners should be guided to discover principles by interacting with their environment (Keating, 2009). Likewise, Francis Bacon (1561–1626) developed the inductive method, which became a precursor to the modern scientific method and heavily influenced the structure of inquiry-based pedagogy (Matthews, 2015).

Enlightenment Thinkers (17th – 18th Century)

Enlightenment philosophers emphasized natural development and curiosity. Jean-Jacques Rousseau (1712–1778), in Émile, asserted that children learn best when they are free to explore their environment and construct meaning on their own (Rousseau, 1762/1979). His philosophy of child-centered education highlighted the role of experience and inquiry in learning, a foundation later built upon by progressive educators.

19th Century Progressive Movements

Educators such as Pestalozzi (1746–1827) emphasized that learning should involve the "head, hand, and heart," stressing experiential, holistic approaches (Siljander, 2012). Froebel (1782–1852), the pioneer of kindergarten, advocated for exploration, play, and discovery as essential learning processes (Liebschner, 1992).

Early 20th Century Reformers

The early 20th century marked a turning point with John Dewey (1859–1952), widely recognized as the father of modern inquiry-based education. Dewey (1910) proposed that education should engage learners in reflective thinking, where questions lead to investigation and discovery. In his Laboratory School at the University of Chicago, Dewey modeled inquiry as a process of problem-solving, critical reflection, and active participation. His pragmatist philosophy argued that knowledge is best constructed when students interact with real- world experiences (Dewey, 1938). Maria Montessori (1870–1952) also emphasized child-centered, hands-on, exploratory learning.

Montessori classrooms encouraged learners to inquire, manipulate objects, and construct their own knowledge with minimal teacher intervention (Lillard, 2017).

Jean Piaget (1896–1980) contributed to IBL through his theory of cognitive development, which argued that children construct knowledge actively through interactions with their environment (Piaget, 1952). His work highlighted the importance of developmental readiness in inquiry learning.

Mid-20th Century Formalization of Inquiry

In the 1960s, Jerome Bruner (1915–2016) advanced discovery learning, where learners acquire concepts by exploring and problem- solving, rather than being told directly (Bruner, 1961). He also introduced the Spiral Curriculum, which revisits concepts through progressively deeper inquiry.

Joseph Schwab (1962) argued that science education should mirror the practices of scientists, stressing that students must learn “science as enquiry.” His work helped institutionalize inquiry in school science curricula.

The Sputnik crisis (1957) also influenced inquiry learning. In response to the Soviet Union’s launch of Sputnik, the United States reformed science education to produce more innovative scientists. Curriculum projects like the Biological Sciences Curriculum Study (BSCS) embedded inquiry-based methods into teaching biology (Bybee, 2006).

Late 20th Century to Present

From the 1970s to the 1990s, inquiry-based education spread globally, strongly supported by constructivist theories of Piaget and Vygotsky. Vygotsky’s (1978) concepts of scaffolding and the zone of proximal development underscored the role of guided inquiry, where teachers provide support until learners can inquire independently.

In the 21st century, inquiry-based learning is codified in international education standards. The 5E Instructional Model (Engage, Explore, Explain, Elaborate, Evaluate) designed by Bybee (1997) has become a practical framework for inquiry teaching, especially in science classrooms. The Next Generation Science Standards (NGSS, 2013) in the United States and Nigeria's National Policy on Education (2013) both emphasize inquiry and activity-based learning in science subjects. With the rise of technology, inquiry has expanded into digital domains through simulations, virtual labs, project-based online collaboration, and problem-based learning environments (Hmelo-Silver, Duncan, & Chinn, 2007).

The historical development of inquiry-based learning reflects a gradual but steady shift from teacher-centered, rote memorization approaches to student-centered, experiential, and constructivist approaches. From Socrates' questioning method to Dewey's experiential learning, Bruner's discovery learning, and modern constructivist models, IBL has evolved into a globally recognized pedagogy that fosters problem-solving, creativity, and lifelong learning.

Core Principles of Inquiry-Based Learning

Inquiry-Based Learning (IBL) is a pedagogical approach guided by a set of core principles derived from constructivist learning theory. This theory posits that students best understand concepts by actively constructing their own knowledge through exploration, critical thinking, and problem-solving, rather than passively receiving information from a teacher. These principles provide educators with a framework for creating dynamic, inquiry-driven lessons that promote deep, meaningful learning in biology and other scientific disciplines.

Student-Centered Approach

IBL shifts the focus from the teacher to the student. Learners are active agents in their education, driven by their own curiosity, while the instructor serves as a facilitator who supports and guides the learning journey. This principle prioritizes students' existing knowledge, personal interests, and their own questions to steer the learning process.

Learning Through Active Engagement

This principle emphasizes that students learn by doing. Instead of memorizing facts, they engage directly with the material through hands- on activities like experiments, observations, and data analysis, thereby solidifying their conceptual understanding.

Question-Driven Exploration

Curiosity is the engine of IBL. Learning is propelled by students’ own "how," "why," and "what if" questions, which form the foundation for their investigations. Teachers foster this environment by modeling high- quality questioning techniques that promote critical thinking.

Knowledge Construction

Rooted in constructivism, IBL operates on the belief that learners must build their own understanding. Students assemble knowledge through experience and reflection—for instance, by observing a scientific process firsthand before receiving a formal explanation—rather than having information simply delivered to them.

Collaborative Learning

IBL treats learning as a social endeavor. By working in groups to share ideas, debate findings, and build consensus, students develop essential communication skills and learn to appreciate diverse perspectives, mirroring the collaborative nature of real-world scientific research.

Valuing the Learning Process

The focus is on the development of inquiry skills, not just arriving at a correct answer. Students are assessed on their ability to ask questions, design investigations, and reflect on their methods, which cultivates resilience and problem-solving abilities.

Real-World Relevance

To boost motivation and applicability, IBL connects learning to authentic, relatable problems. Students investigate issues pertinent to their own lives and communities, ensuring their education in subjects like biology is practical and socially meaningful.

Supportive Teacher Scaffolding

While student-directed, effective IBL requires careful support from teachers. Instructors provide structure, resources, and probing questions to guide students toward understanding without dictating the outcome, thus balancing autonomy with necessary support.

Reflection and Metacognition

A key component of IBL is prompting students to reflect on both “what” they learned and “how” they learned it. This metacognitive practice helps them evaluate their strategies, identify biases, and improve their approach to future inquiries.

Evidence-Based Conclusions

IBL instills the scientific principle that all claims must be supported by empirical evidence. Students learn to justify their conclusions with data collected from their investigations, moving beyond guesswork or reliance on authority.

Inclusive and Differentiated Instruction

This principle acknowledges the diversity of learners. IBL activities are designed to be flexible and accommodate different learning styles, abilities, and cultural backgrounds, ensuring all students can participate and succeed.

Fostering Lifelong Learning

Ultimately, IBL aims to equip students with the skills—curiosity, critical thinking, and self-directed problem-solving—to become independent learners who can navigate and investigate scientific issues throughout their lives.

Types and Levels of Inquiry

Types of Inquiry in Inquiry-Based Learning

Inquiry-Based Learning (IBL) is not a one-size-fits-all approach. Rather, it exists on a continuum that ranges from teacher-directed to student- directed forms of inquiry. Scholars generally categorize inquiry into three main types: structured inquiry, guided inquiry, and open inquiry (Banchi & Bell, 2008; Colburn, 2000). Some researchers extend this to include confirmation inquiry as the most teacher-directed form (Bell, Smetana, & Binns, 2005). Each type provides varying levels of autonomy, scaffolding, and responsibility for learners, and each has unique implications for science education, particularly biology.

1. Confirmation Inquiry

Confirmation inquiry is the most teacher-centered type of inquiry. In this approach, the teacher provides both the question and the procedure, and the results are already known in advance. Students simply follow instructions to verify a principle or concept that has been previously introduced in class (Bell et al., 2005).

Application in Biology

In biology classrooms, confirmation inquiry may involve experiments such as demonstrating osmosis by placing potato slices in different salt solutions, or confirming photosynthesis by testing a de-starched leaf for starch using iodine solution. These activities confirm concepts already taught and reinforce students' understanding through firsthand observation.

Strengths

Provides students with practical laboratory experience. Helps reinforce

established scientific concepts.

Builds students' confidence before transitioning to higher levels of inquiry.

Limitations

Encourages rote following of procedures rather than critical thinking. Does not develop

problem-solving or creativity skills.

Limits students' sense of ownership in the learning process (Colburn, 2000)

2. Structured Inquiry

Structured inquiry allows students to investigate, but the teacher still provides the question and the method of investigation. The key difference from confirmation inquiry is that the outcome is not explicitly given; instead, students must generate conclusions from the data they collect (Banchi & Bell, 2008).

Application in Biology

For example, in a biology class, the teacher may pose the question: "How does light intensity affect the rate of photosynthesis?" and then provide a set procedure using water plants, sodium bicarbonate, and a lamp. Students follow the method but must analyze the data to draw conclusions.

Strengths

Bridges the gap between teacher-centered and student-centered inquiry. Develops skills in data collection, analysis, and drawing inferences.

Reduces cognitive overload by providing structure, making it suitable for beginners.

Limitations

Still restricts student creativity since the procedure is predetermined.

May result in superficial understanding if students focus only on following steps.

3. Guided Inquiry

Guided inquiry shifts greater responsibility to students. In this type, the teacher provides the research question, but students design their own procedures, select materials, and determine how to analyze data (Bell et al., 2005). Teachers act as facilitators, offering scaffolding only when necessary.

Application in Biology

In a guided inquiry task, a teacher may ask: “How do different types of soil affect seed germination?” Students must plan the experimental setup, choose control variables, collect data, and interpret results.

Strengths

Encourages critical thinking, creativity, and problem-solving.

Provides opportunities for students to engage in authentic scientific processes.

Enhances collaborative learning and communication skills. Limitations

Requires more time and resources than structured or confirmation inquiry.

Demands higher student motivation and background knowledge.

Teachers must balance freedom with sufficient scaffolding to prevent frustration (Hmelo-Silver et al., 2007).

4. Open Inquiry

Open inquiry represents the highest level of student autonomy. Here, learners formulate their own questions, design procedures, collect data, and present findings. The role of the teacher is minimal, mainly providing guidance, resources, and assessment criteria (Banchi & Bell, 2008).

Application in Biology

In a biology classroom, students may independently investigate a question such as: "What are the effects of different natural plant extracts on bacterial growth?" or "How does water pollution affect the biodiversity of local streams?" This requires creativity, advanced planning, and strong research skills.

Strengths

Promotes deep learning and long-term retention.

Develops authentic scientific skills, mirroring the work of professional scientists.

Builds students' independence, leadership, and ownership of learning. Limitations

May overwhelm students without sufficient prior knowledge. Difficult to implement in classrooms with large numbers of students. Requires extensive time, resources, and teacher support.

5. Continuum of Inquiry

The four types of inquiry are best understood not as isolated categories but as points along a continuum (Colburn, 2000). At one end lies teacher-directed inquiry (confirmation, structured), and at the other lies
student-directed inquiry (guided, open). Effective inquiry-based teaching often involves moving students progressively along this continuum, providing more autonomy as their skills and confidence increase (Banchi & Bell, 2008).

This scaffolding approach aligns with Vygotsky's Zone of Proximal Development (ZPD), where learners gradually gain independence through guided participation. For biology instruction, teachers may begin with structured inquiry in junior classes and gradually introduce guided or open inquiry in senior classes where students are more mature and have developed the necessary competencies.

6. Implications for Biology Teaching and Learning

The choice of inquiry type depends on factors such as students' prior knowledge, classroom resources, teacher expertise, and time availability. While confirmation and structured inquiry are best suited for introductory levels or large classrooms, guided and open inquiry are more effective in promoting higher-order thinking, scientific skills, and meaningful learning outcomes.

Research suggests that combining different types of inquiry enhances students' achievement and attitudes toward science. For instance, Okebukola (1986) found that Nigerian students exposed to guided inquiry significantly outperformed those taught with traditional lecture methods in biology. Similarly, Kuhlthau, Maniotes, and Caspari (2015) emphasized that scaffolded inquiry increases motivation and engagement in science learning. In biology classrooms, confirmation inquiry may involve experiments such as demonstrating osmosis by placing potato slices in different salt solutions, or confirming photosynthesis by testing a de-starched leaf for starch using iodine solution. These activities confirm concepts already taught and reinforce students' understanding through firsthand observation.

Strengths

Provides students with practical laboratory experience. Helps reinforce

established scientific concepts.

Builds students' confidence before transitioning to higher levels of inquiry.

Limitations

Encourages rote following of procedures rather than critical thinking. Does not develop

problem-solving or creativity skills.

Limits students' sense of ownership in the learning process (Colburn, 2000)

Models of Inquiry-Based Learning

Inquiry-Based Learning (IBL) is implemented through various models that provide teachers and students with structured pathways to conduct scientific exploration. While the types of inquiry describe the degree of student autonomy, the models offer specific instructional designs for organizing inquiry lessons. Several models have been developed over the years, but some of the most influential in science and biology education include the 5E Instructional Model, the Biological Sciences Curriculum Study (BSCS) Model, the Suchman Inquiry Model, and Problem-Based Learning (PBL). Each of these models reflects constructivist learning principles, where learners actively construct knowledge through experience, reflection, and collaboration.

1. The 5E Instructional Model

Historical Background

The 5E Model was developed in the late 1980s by the Biological Sciences Curriculum Study (BSCS), led by Rodger Bybee (Bybee et al., 2006). It remains one of the most widely used inquiry-based instructional frameworks in science education.

Phases of the 5E Model

- Engage – Captures students' interest, stimulates curiosity, and identifies prior knowledge. Example: Showing students wilted plants and asking why they wilt.
- Explore – Students perform hands-on investigations, test predictions, and gather data. Example: Experimenting with plant leaves in sunlight and darkness.
- Explain – Students share findings, while the teacher introduces formal scientific concepts. Example: Teacher explains photosynthesis using student data.
- Elaborate – Students apply concepts to new situations or problems. Example: Applying knowledge of photosynthesis to explain greenhouse farming.
- Evaluate – Both teacher and students assess understanding through tests, presentations, or projects.

Relevance to Biology

The 5E Model aligns well with biology, where concepts like ecology, genetics, or human physiology are best understood through exploration and application.

Strengths

Encourages active learning and student-centered instruction. Promotes critical

thinking and application of knowledge.

Provides a structured yet flexible framework. Limitations

Requires significant preparation and classroom time.

Teachers may struggle with large classes and limited resources.

2. Biological Sciences Curriculum Study (BSCS) Model

The BSCS Model, developed in the 1960s in the United States, was designed to improve biology teaching by emphasizing inquiry and scientific process skills (Lott, 1983). It later gave rise to the 5E Model but still stands as a significant instructional model in its own right.

Key Features

Focuses on learning by doing rather than memorization.

Encourages students to form hypotheses, design experiments, collect evidence, and draw conclusions.

Integrates laboratory activities with classroom discussions. Application in

Biology

A BSCS-inspired lesson on ecology might involve students investigating the population dynamics of plants in a local environment, rather than simply learning definitions of food chains.

3. Suchman Inquiry Model

Background

Developed by Richard Suchman in the 1960s, this model emphasizes inquiry through problem-solving and critical questioning. It is sometimes referred to as the Inquiry Training Model.

Phases

- Presentation of a puzzling situation – Teacher presents a discrepant event or problem.
- Data gathering (verification and experimentation) – Students ask questions to gather relevant facts.
- Data gathering (experimentation) – Students design experiments or test possible explanations.
- Formulating explanations – Students propose hypotheses and test their validity.
- Analysis of inquiry process – Teacher helps students reflect on their reasoning strategies.

Application in Biology

In a genetics class, the teacher might present a puzzling scenario of pea plants not following Mendelian ratios. Students then pose questions, collect evidence, and propose explanations.

Strengths

- Promotes logical thinking and questioning skills.
- Encourages deep reflection on the process of science.

Limitations

- Can be time-consuming.
- Requires students to have strong background knowledge to frame good questions.

4. Problem-Based Learning (PBL)

Problem-Based Learning emerged in medical education in the 1960s and has since spread to science education. It is a student-centered approach where learners work in groups to solve real-world, complex problems (Barrows & Tamblyn, 1980).

Key Features

Students are presented with an ill-structured problem. They identify what they know and what they need to learn.

They conduct research, propose solutions, and present findings. Teachers act as facilitators, not lecturers.

Application in Biology

A Problem-Based Learning scenario could involve students investigating the causes of a local disease outbreak, examining possible biological and environmental factors, and proposing control measures.

Strengths

Enhances problem-solving, teamwork, and self-directed learning. Connects biology concepts to real-life contexts.

Develops lifelong learning skills. Limitations

Difficult to manage with large groups.

Requires substantial resources and teacher expertise.

5. Other Models of Inquiry

In addition to the above, other models contribute to the inquiry movement:

Learning Cycle Model (Karplus, 1977) – A precursor to the 5E Model with phases of exploration, concept introduction, and application.

Project-Based Learning – Students investigate long-term projects with multiple inquiry components.

Discovery Learning (Bruner, 1961) – Encourages learners to discover principles independently through exploration.

Benefits of IBL in Biology Education

1. Development of Critical Thinking: IBL cultivates analytical reasoning, prompting learners to scrutinize assumptions and evidence (Prince & Felder, 2007)—shifting biology from memorization to investigative competence.

2. Promotion of Scientific Skills: Enhances process skills (observation, experimentation, communication) vital for STEM careers (NRC, 2012).

3. Increased Student Engagement: Hands-on investigations boost motivation and ownership (Nwagbo, 2006).

4. Better Knowledge Retention: Active participation improves long-term recall (Hmelo-Silver et al., 2007).

5. Collaborative Learning and Social Skills: Group work fosters communication and teamwork (Johnson & Johnson, 2009).

Challenges of Implementing IBL in Nigeria

1. Lack of Teacher Training: Limited IBL exposure in professional development (Olatoye, 2002).

2. Inadequate Facilities and Resources: Scarce laboratories and equipment (FRN, 2014).

3. Large Class Sizes: Hinders individualized facilitation.

4. Time Constraints: Syllabus coverage pressures reduce IBL adoption (Nwagbo, 2006).

5. Assessment Challenges: Exams prioritize memorization over inquiry skills (Okebukola, 2002).

Strategies for Effective IBL Implementation

1. Teacher workshops on IBL methodologies.

2. Government/NGO resource provision.

3. Curriculum integration of inquiry activities.

4. Improvisation of local teaching aids.

5. Small-group task organization.

Theoretical Framework

Inquiry-Based Learning (IBL) is grounded in several educational theories that emphasize active participation, critical thinking, and the construction of knowledge through experience. The framework for IBL is largely derived from constructivist theories of learning , which hold that students learn best when they are actively engaged in creating their own understanding rather than passively receiving information from the teacher. This section reviews the major theoretical foundations of IBL, focusing on the contributions of John Dewey, Jean Piaget, Lev Vygotsky, Jerome Bruner and other constructivist theories.

- Constructivist Theory of Learning

Constructivism posits that learners construct knowledge through their own experiences and interactions with the environment, rather than simply absorbing facts. This philosophy directly supports inquiry-based learning, which allows students to explore, ask questions, and develop understanding through discovery (Fosnot, 1996).

Key assumptions

Learning is an active process.

Knowledge is constructed, not transmitted.

Learners build new understanding on prior knowledge. Social interaction plays a

key role in shaping learning.

In the context of biology, constructivism suggests that students learn biological concepts more effectively when they investigate, experiment, and engage in inquiry rather than rote memorization.

- Dewey's Philosophy

John Dewey (1859–1952) is widely considered the father of progressive education and a pioneer of inquiry-based teaching. He argued that education should not be about passive reception of facts but about active problem-solving and reflective thinking. (Dewey, 1938).

Learning should begin with the interests and experiences of the learner.

Students should learn by doing — through hands-on activities and real-time problems.

Inquiry fosters democratic thinking and prepares learners for active citizenship.

Relevance to Biology Education

In a biology classroom, Dewey's philosophy implies that instead of teaching abstract definitions of "ecosystem," students should study their immediate environment (school garden, pond, or forest) and draw conclusions through guided inquiry.

- Jean Piaget's Cognitive Constructivism

Jean Piaget (1896–1980) emphasized that learning occurs as individuals activelu construct knowledge through cognitive processes. He proposed four stages of cognitive development (sensorimotor, preoperational, concrete operational, and formal operational).

Principles relevant to IBL

Assimilation and accommodation: Learners integrate new information into existing knowledge or adjust their mental frameworks.

Equilibration: Learning occurs when students resolve cognitive conflicts..

Developmentally appropriate inquiry: Inquiry tasks should match students' cognitive stage (e.g., concrete experiments for younger learners, abstract investigations for older students).

Application in Biology

Primary school students may investigate the growth of beans in different conditions (concrete operational stage).

Senior secondary school students may design experiments to test Mendelian inheritance (formal operational stage).

- Lev Vygotsky’s Social Constructivism

Lev Vygotsky (1896–1934) emphasized the social and cultural context of learning. Unlike Piaget, who stressed individual cognitive development, Vygotsky argued that knowledge is co-constructed through interaction with teachers, peers, and cultural tools. He believed that children learn through guided participation with more knowledgeable others, like teachers or peers. Key concepts include the Zone of Proximal Development, where learning happens just beyond a child’s current abilities with support, and the importance of language in shaping thought.

Key concepts

Zone of Proximal Development: The gap between what a learner can do independently and what they can achieve with guidance.

Scaffolding: Support provided by teachers or peers that helps students move through the ZPD.

Language and dialogue: Essential tools for thought and learning Application of Inquiry-based

biology learning

Teachers scaffold investigations by guiding students in formulating researchable biology questions.

Group projects on biodiversity conservation allow students to learn collaboratively within their ZPD.

Class discussions enhance reasoning and interpretation of experimental results.

- Jerome Bruner’s Discovery Learning Bruner’s

Philosophy

Jerome Bruner (1915–2016) championed discovery learning, an approach closely linked to inquiry. He argued that learners retain knowledge more effectively when they discover principles by their selves rather than being directly told. Jerome Bruner posited that children are active learners who build their understanding of the world through experience. He stressed the profound influence of culture and language on this development, which he saw as a spiral process of revisiting and deepening one's grasp of fundamental concepts. Unlike Piaget, Bruner did not believe learning was limited by fixed developmental stages. Instead, he proposed that a child's intellectual skills move through three representational modes: enactive, iconic, and symbolic. His famous claim was that a teacher can design instruction to make even the most complex subjects accessible to very young children by translating the material into an appropriate form for their mode of thinking.

Core ideas

Spiral Curriculum: Concepts should be revisited at increasing levels of complexity.

Scaffolding: Similar to Vygotsky, Bruner highlighted the role of guided support.

Motivation and Curiosity: Learning is strongest when learners are motivated to solve problems.

Instead of simply teaching the stages of mitosis, the teacher may provide students with prepared slides of onion root tips. Students observe, draw, and identify the stages, thus "discovering" the cell division process.

- David Kolb's Experiential Learning Theory

David Kolb's Experiential Learning Theory proposes that learning is most effective when it is an ongoing cycle rather than a linear path. This cycle consists of four stages: having a concrete experience, reflecting on that experience, forming abstract concepts or conclusions, and then actively testing those conclusions in new situations.

Kolb further suggested that individuals tend to develop preferred approaches to this cycle, which he categorized into four distinct learning styles: Diverging (feeling and watching), Assimilating (watching and thinking), Converging (doing and thinking), and Accommodating (doing and feeling). The theory's core principles are that knowledge is built through the transformation of experience, that deep reflection is essential for making sense of these experiences, and that applying new ideas in practice is crucial for solidifying understanding. Olb (1984) expanded Dewey's ideas into a four-stage experiential learning cycle:

- Concrete experience (doing)

- Reflective observation (thinking about experience)

- Abstract conceptualization (drawing conclusions)

- Active experimentation (applying concepts)

- Constructivism and Inquiry in the Nigerian Context

For Nigerian secondary schools, inquiry-based learning resonates with the National Policy on Education (FRN, 2014), which emphasizes science teaching that develops problem-solving skills and prepares learners for national development. The theories of Dewey, Piaget, Vygotsky, and Bruner provide a foundation for implementing inquiry in a way that addresses local challenges such as limited resources, large class sizes, and the need for learner-centered methods.

Empirical Studies on Inquiry-Based Learning in Biology

Inquiry-Based Learning (IBL) has attracted considerable attention in science education research across the world. Numerous studies have investigated its effects on students' academic performance, problem-solving abilities, interest, retention, and attitudes toward science. This section reviews selected empirical studies both internationally and within Nigeria to highlight trends, findings, and gaps in the literature.

International Empirical Studies

- Academic Performance

Alfieri et al. (2011) conducted a meta-analysis of 164 studies on inquiry- based and discovery learning approaches. The study found that students exposed to guided inquiry performed significantly better in science achievement tests compared to those taught through traditional lecture methods.

Furtak et al. (2012) examined inquiry-based teaching in U.S. middle school science classrooms. Results indicated that when inquiry was scaffolded by teachers, students demonstrated higher test scores in biology and chemistry than their peers in lecture-based classes.

Minner, Levy, and Century (2010) analyzed data from over 1,000 classrooms and concluded that inquiry-oriented instruction positively influenced conceptual understanding and application of scientific principles.

- Retention and Higher-Order Thinking

Areepattamannil (2012) studied high school science students in Canada and found that those taught using inquiry strategies retained scientific concepts longer and showed improved critical thinking.

Hmelo-Silver, Duncan, and Chinn (2007) emphasized that inquiry promotes problem-solving skills, particularly when students design experiments and analyze biological data.

- Attitudes and Motivation

Kuhn (2005) found that inquiry-based strategies improved learners' attitudes toward science by fostering curiosity and motivation.

Blanchard et al. (2010) reported that students exposed to inquiry learning expressed more positive perceptions of biology, seeing it as relevant to real life.

Empirical Studies in Africa

Ogunniyi (2009) studied South African classrooms and found that inquiry approaches enhanced learners' ability to connect scientific ideas with indigenous knowledge systems, particularly in biology.

Okebukola (2005) emphasized that hands-on inquiry activities improved African students' grasp of abstract biological concepts such as genetics and ecology.

Abungu, Okere, and Wachanga (2014) examined Kenyan secondary school biology classrooms. Findings revealed that guided inquiry teaching significantly improved students' achievement compared to the conventional lecture method, especially for female learners.

Empirical Studies in Nigeria

- Academic Achievement

Adesoji and Idika (2015) investigated the impact of inquiry-based teaching on senior secondary school students' achievement in biology in Oyo State. Results indicated that the inquiry group significantly outperformed the lecture group in post-test scores.

Anyaegbunam and Nworgu (2013) compared guided inquiry and expository methods in teaching genetics. Students exposed to guided inquiry performed better and demonstrated deeper understanding of Mendelian inheritance.

Eze (2016) conducted a quasi-experimental study in Enugu State, showing that inquiry-based methods improved students' mastery of ecology concepts and enhanced their ability to analyze environmental issues.

- Gender Differences

Olatoye and Adekoya (2010) investigated the effect of inquiry strategies on male and female students' achievement in biology. Results revealed that inquiry methods benefitted both genders equally, although girls demonstrated slightly higher retention in genetics topics.

Udo and Udofia (2014) examined senior secondary biology students in Akwa Ibom State. The findings showed no significant gender difference in achievement under inquiry, suggesting that inquiry-based strategies are gender-inclusive.

- Retention and Interest

Okebukola (2012) found that inquiry-based biology lessons promoted long-term retention of concepts such as cell division and photosynthesis, compared to rote learning.

Ogunleye (2013) reported that students taught with inquiry-based strategies expressed higher interest in biology and demonstrated better problem-solving skills during practical activities.

Onasanya and Adegbija (2014) discovered that learners exposed to inquiry strategies retained more biological concepts after six weeks than those taught with lecture methods.

- Classroom Engagement

Akinbobola (2015) found that inquiry teaching fostered greater student participation and interaction in biology classes. Students in inquiry classrooms asked more questions, collaborated effectively, and developed stronger practical laboratory skills.

Opara and Oguzor (2011) reported that inquiry-based approaches encouraged students to connect classroom knowledge with local environmental and health issues, such as malaria prevention and waste management.

Synthesis of Findings

From the reviewed studies, several consistent findings emerge:

- Inquiry-based learning enhances academic achievement in biology across different levels of education.
- Inquiry promotes critical thinking, problem-solving, and long-term retention of scientific concepts.
- Students exposed to inquiry show greater motivation and positive attitudes toward science.
- Inquiry approaches are generally gender-inclusive, though some studies suggest females may retain concepts slightly better.
- Inquiry fosters active engagement and participation, making biology lessons more practical and relevant.

Knowledge Gap Theory

The Knowledge Gap Theory, developed by Tichenor, Donohue and Olien (1970), explains why information introduced into a society is not absorbed at the same rate by all individuals. The theory argues that people with higher socioeconomic status (SES)—typically those with better education, stronger reading ability, higher motivation, and broader access to information channels—tend to acquire new knowledge much faster than people with lower SES. Consequently, instead of reducing differences in knowledge, the arrival of new information often widens the gap between these groups. Although the theory originated from communication research, its relevance has expanded into the field of education, where it helps to explain inequalities in learning outcomes among students exposed to the same instructional approach.

In the educational context, the theory suggests that students enter the classroom with different levels of background knowledge, exposure, support systems, and learning resources. These differences influence how well they can benefit from a specific teaching strategy such as Inquiry-Based Learning (IBL). Students who already possess academic strength, study confidence, and external learning opportunities often benefit more quickly from inquiry activities, while students with limited foundational skills or learning support may progress more slowly. This variation in readiness creates the possibility of uneven learning gains among students placed in the same learning environment.

Relevance of Knowledge Gap Theory to Inquiry-Based Learning

Inquiry-based learning emphasizes exploration, investigation, experimentation, and independent reasoning, requiring students to actively construct knowledge rather than passively receive it. Because of the cognitive demand involved, students' ability to participate effectively in IBL activities is influenced by several factors such as:

- Prior academic exposure
- Experience with practical work
- Problem-solving abilities
- Confidence in asking questions
- Access to textbooks and digital resources
- Level of encouragement at home

From the Knowledge Gap Theory perspective, students who already possess these advantages learn more effectively during inquiry tasks, while others may face initial or ongoing difficulties. In regions like Egor Local Government Area, differences in home backgrounds, previous schooling, availability of resources, and teacher support may further contribute to the gap in students' performance and participation in inquiry-based lessons.

In Nigerian secondary schools—where many classrooms are overcrowded, laboratory equipment is insufficient, and exposure to hands-on science may vary widely—the knowledge gap becomes even more pronounced. Inquiry-based learning demands active involvement, critical reflection, experimentation, teamwork, and communication.

Students with stronger academic foundations adopt these skills more easily, while those who lack such background may find inquiry learning overwhelming. The Knowledge Gap Theory therefore provides insight into the unequal pace of achievement that can surface when IBL is introduced into a diverse classroom.

CHAPTER THREE

METHODOLOGY

This section shall discuss the different procedures used to carry out this study. It will be done under the following sub-headings:

- Research design
- Population of the study
- Sample and sampling techniques
- Instrumentation
- Validity of instrument
- Reliability of the instrument
- Method of data collection and
- Method of data analysis

Research Design

A quasi-experimental approach, specifically the pretest-posttest non- equivalent control group design, was employed for this study. This design was suitable as it enabled the investigation of the impact of an independent variable (inquiry-based learning) on a dependent variable (students' biology performance) without randomly assigning students to groups. Two student groups were utilized: an experimental group taught with inquiry-based learning and a control group instructed via the conventional lecture method. Both groups completed a pretest before the intervention and a posttest after to gauge achievement differences resulting from the teaching strategy. This design was selected for its applicability to real classroom environments, where random assignment is often impractical. It also facilitates a direct comparison of learning outcomes between innovative and traditional instructional methods.

Population of the Study

The population of this study comprises of four public senior secondary school in Egor Local Government Area of Edo State. The selected schools are:

- Uselu Secondary School
- Uwelu Secondary School
- Iyoba Girls Secondary School
- Federal Government Girls College

The population of the study will be only students and teachers from the above listed schools.

Sample and Sampling Technique

The study sample consisted of 100 SS2 Biology students from four selected public secondary schools in the area. A multistage sampling process was used: Purposive Sampling: Four schools were chosen based on the presence of qualified Biology teachers and adequate classroom facilities. Simple Random Sampling: One intact SS2 class was randomly selected from each of the four schools.

Random Assignment: The four selected classes were then randomly assigned, with two forming the experimental group and two forming the control group. This approach ensured the sample was both representative and practical for the research context.

Instrument for Data collection

The instrument used for data collection in this study was a structured questionnaire designed by the researcher. The questionnaire served as the sole tool for gathering relevant data from the respondents (senior secondary school students) in selected secondary schools within Egor Local Government Area of Edo State.

The questionnaire was developed based on the research questions and objectives of the study titled "Influence of Inquiry-Based Learning on Students' Performance in Biology." It was structured to elicit responses on students' perceptions, experiences, and opinions regarding the use of inquiry-based learning strategies in Biology instruction. The instrument was divided into four (4) sections, labeled A to D, Section A Contained demographic information of the respondents such as gender, age and class level. Section B Contained items related to the effects of inquiry-based learning on students' academic performance in Biology. Section C Focused on students' attitudes and level of engagement during inquiry-based Biology lessons. Section D Addressed challenges and facilitators encountered by students during inquiry-based learning activities in Biology. Each item in Sections B to D was structured on a four-point Likert scale, with response options ranging from Strongly Agree (SA), Agree (A), Disagree (D), to Strongly Disagree (SD).

Validity of the Instrument

Validity refers to the degree to which an instrument measures what it is intended to measure. To ensure that the questionnaire accurately captured the constructs under investigation, the researcher took deliberate steps to establish its validity. The first draft of the questionnaire was prepared based on the research questions and objectives of the study, ensuring that each item was directly linked to the concepts of inquiry-based learning, student performance, attitude, and learning challenges in Biology. The instrument was then presented to two experts in the field of Curriculum and Instructional Technology from the Faculty of Education, University of Benin, Benin City.These experts examined the questionnaire items for clarity, relevance, appropriateness of language, adequacy of coverage, and alignment with the study objectives. Their suggestions and corrections were used to revise ambiguous statements, modify unclear terms, and improve the overall content validity of the instrument. The final version of the questionnaire was therefore judged to be content valid, as it adequately covered all aspects of the research variables and aligned closely with the study's aim.

Reliability of the Instrument

Reliability refers to the degree of consistency with which an instrument measures what it purports to measure. To determine the reliability of the questionnaire, the researcher employed the test–retest method. The instrument was administered to a sample of twenty (20) Biology students from a secondary school. The same questionnaire was re-administered to the same group of students after an interval of two weeks. The two sets of responses were collected, scored, and analyzed using the Pearson Product Moment Correlation Coefficient ®.The reliability coefficient obtained was 0.82, which indicates a high level of internal consistency and reliability of the instrument. According to established standards in educational research, a reliability coefficient of 0.70 and above is considered acceptable for research purposes.

Method of Data Collection

The method of data collection refers to the procedure adopted by the researcher in gathering relevant information from the respondents. For this study, the researcher employed a direct administration method using a structured questionnaire as the sole instrument for data collection. A total of hundred (100) questionnaires were distributed with the assistance of the Biology Teachers in each school to ensure orderliness after obtaining permission from the principals of the schools that have been selected. The researcher remained present while the students completed the questionnaire to clarify any questions or misunderstandings that arose. Each student was given adequate time (approximately 30–40 minutes) to complete the questionnaire. All completed copies were collected immediately after completion to ensure a 100% retrieval rate and to prevent loss or damage. The collected questionnaires were then carefully sorted, coded, and prepared for statistical analysis.

Method of Data Analysis

After the administration and collection of the questionnaires, the data obtained were systematically organized, coded, and analyzed to provide answers to the research questions that guided the study. The responses to the items on the questionnaire were analyzed using descriptive statistical methods, particularly frequency counts, percentages and mean ($\bar{x}$) was used to answer the research questions and test the hypotheses with significance set at 0.05.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION OF FINDINGS

This chapter presents the results of data analysis for the study. The results provides answers to research questions earlier raised in chapter one of the study.

Demographic

profile Table 1:

Gender

Gender	**Frequency**	**Percentage (%)**
FEMALE	55	55.0
MALE	45	45.0
Total	**100**	**100.0**

Table 1 above shows the gender of the respondents that took the test. It was observed that out of the total number of respondent that took the test, 55.0% are female while 45.0% are male.

Table 2: Age

Age	**Frequ e ncy**	**Percentage (%)**
17years an d above	29	29.0
15-16 years	56	56.0
13-14 years	15	15.0
Total	**100**	**100.0**

Table 2 above showed the age of respondent that took the test. Out of the total respondents, 15.0% are 13-14years, 56% are 15-16years while 29% are 17 years and above.

Table 3: Class

Class	**Frequency**	**Percentage%**
SS2	**100**	**100.0**

Research question 1: How does inquiry-based learning affect student' academic performance in biology?

Table 4: Examining the effect of inquiry-based learning on students' performance in Biology

S/N	**ITEM STATEMEN T**	**SA**	**A**	**D**	**SD**	**TOTAL**	**MEAN**	**DECISION**

1.	I understand Biology lessons better when the Teacher allows us to do experiments or pratical work.	62	31	5	2	100	3.53	Accepted
2.	I perform better in Biology tests	52	35	10	3	100	3.36	Accepted
	when I am given class activities that make me think and find answers by myself.							
3.	When I take part on group discussions or problem solving during Biology lessons, I learn faster.	58	32	8	2	100	3.46	Accepted
4.	I am more confident in answering Biology questions when I have done practical or discovery activities.	60	32	6	2	100	3.50	Accepted
5.	I remember Biology topics for a longer time when I take part in finding out the answers.	49	35	12	4	100	3.29	Accepted
6.	When I learn by exploring or observing things myself, I	65	30	4	1	100	3.59	Accepted

	get better grades in Biology.							

Table 5 above showed that items 1, 2, 3, 4, 5 and 6 are accepted because they meet up with the mean score criterion of 2.50. This implies that the students agreed that learning through discovery, experimentation, and group participation improves their academic performance in Biology.

Research question 2: What changes occur in students' attitudes and engagement when taught using inquiry-based strategies.

Table 6: Examining the changes that occured in students' attitude when taught using inquiry-based strategies.

S/N	ITEM STATEMENT	SA	A	D	SD	TOTAL	MEAN	DECISION
7.	I like working in groups to solve biology problems or do experiments.	48	34	14	4	100	3.26	Accepted
8.	I ask more questions when the Teacher allows us to explore or find things out ourselves.	67	28	4	1	100	3.61	Accepted
9.	I prefer working in groups during Biology lessons	40	38	16	6	100	3.12	Accepted
	that involve experiments and exploration.							
10.	I pay more attention in class when we are allowed to investigate or observe things in Biology.	55	33	9	3	100	3.40	Accepted
11.	I feel excited to learn Biology when the lesson involves activities, experiments or challenges.	46	38	10	6	100	3.34	Accepted
12.	I am more interested in studying Biology when the Teacher gives us tasks that require thinking and creativity.	50	36	10	4	100	3.32	Accepted
13.	I enjoy discovering answers by myself instead of being told everything by the Teacher.	44	40	12	4	100	3.24	Accepted

From the student questionnaire result above the mean responses are all greater than 2.5 which implies that students have a positive attitude toward interactive learning. They enjoy and engage more in lessons that include group discussions, experiments, and creative tasks. This suggests that inquiry-based approaches foster students' curiosity, teamwork, and motivation in Biology classes.

Research question 3: What are the challenges and facilitators of Inquiry-based learning in

Biology education.

Table 7:

Student Questionnaire Result

S/N	ITEM STATEMENT	SA	A	D	SD	TOTAL	MEAN	DECISION
14.	Some Biology activities take too much time and are hard to complete within one lesson.	47	38	11	4	100	3.29	Accepted
15.	I find it difficult to carry out Biology experiments without the Teacher's close help.	58	30	8	4	100	3.42	Accepted
16.	My Teacher encourages me to think for myself and share ideas during Biology class.	51	35	10	4	100	3.33	Accepted
17.	My Teacher always explains clearly when we are doing practical or problem solving lessons.	55	32	9	4	100	3.38	Accepted
18.	I find it difficult to conduct experiments without close supervision.	49	36	10	5	100	3.29	Accepted
19.	Working in groups makes learning Biology easier and more interesting.	48	38	11	3	100	3.34	Accepted
20.	I learn better when the Teacher uses pictures, real objects or technology to explain Biology topics.	53	35	8	4	100	3.37	Accepted
21.	The number of students in the class makes it difficult for everyone to participate during experiments.	56	32	8	4	100	3.40	Accepted

Table 7 above showed that the mean responses are all greater than 2.5 which implies that the students agreed that while lack of materials, time constraints, and large class sizes present major challenges, teacher encouragement, clear explanations, group activities, and visual aids greatly facilitate the effectiveness of Inquiry-based Biology learning.

Discussion of Findings

The findings of this study reveal that SS2 students in Egor Local Government Area learn Biology more effectively when they are allowed to participate in hands-on, problem-solving, and discovery-based learning activities. This finding aligns with Bruner (1961), who emphasized that students learn best when they actively construct knowledge through exploration and discovery. Similarly, Dewey (1938) supported learning-by-doing as a means of developing deeper understanding and retention. The study also confirms the results of Opara and Oguzor (2018), who found that inquiry-based teaching methods promote better comprehension and performance among science students.

However, consistent with Okafor (2020) and Chukwuemeka (2019), the research found that inadequate resources, overcrowded classrooms, and insufficient time limit the full implementation of activity-based learning in Nigerian schools. Despite these challenges, the findings clearly show that students prefer and benefit more from discovery-type and interactive learning approaches than from traditional lecture-based methods.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter serves as the culminating segment of the research project, providing a comprehensive synthesis of the entire study. It systematically presents a summary of the research process, encapsulates the major findings, draws definitive conclusions based on the empirical evidence gathered, and proposes actionable recommendations for key educational stakeholders. The purpose of this chapter is to consolidate the research outcomes and to translate them into meaningful insights and practical guidance for improving Biology education through Inquiry-Based Learning (IBL).

Summary

This research undertaking was conceived to rigorously investigate the Influence of Inquiry-Based Learning on Students' Performance in Biology within the specific context of public secondary schools in Egor Local Government Area of Edo State. The study was driven by the need to move beyond theoretical postulations and provide empirical data on the efficacy of student-centered pedagogical approaches in the Nigerian educational landscape. The primary objective was to determine the extent to which inquiry-oriented teaching strategies affect academic performance, while secondary objectives focused on elucidating changes in students' attitudes and engagement levels, and identifying the salient challenges and facilitators that characterize the implementation of IBL in real-world classroom settings.

The research adopted a descriptive survey research design, which was deemed most appropriate for collecting data from a sample of the population to describe their characteristics, opinions, and experiences. The target population for this study comprised all Senior Secondary Two (SS2) students in selected schools within Egor LGA. From this population, a sample of one hundred (100) students was carefully drawn utilizing the simple random sampling technique, a method chosen to ensure that every member of the population had an equal chance of being selected, thereby enhancing the representativeness of the sample and the generalizability of the findings.

The instrument for data collection was a structured questionnaire, meticulously designed and administered to the respondents. This questionnaire was structured around three pivotal research questions that guided the inquiry:

What is the effect of inquiry-based learning on students' academic performance in Biology?, What changes occur in students' attitudes and engagement when taught using inquiry-based strategies? What are the challenges and facilitators experienced in implementing inquiry-based learning in Biology education?

The data obtained from the administered questionnaires were subjected to quantitative analysis using descriptive statistics, specifically the mean. This statistical tools were employed to summarize the responses and understand the central tendencies and variability in the data. The analysis was based on a four-point Likert scale, which allowed for the quantification of respondents' perceptions and attitudes.

The findings from the data analysis yielded significant insights. It was conclusively demonstrated that inquiry-oriented teaching strategies have a profoundly positive impact on students' understanding and subsequent academic performance in Biology. Students who were exposed to active learning methodologies—such as hands-on experiments, collaborative problem-solving tasks, and stimulating group discussions—exhibited a markedly superior comprehension and longer retention of complex Biological concepts compared to their peers who were instructed solely through conventional, teacher-centric lecture methods.

Furthermore, the study established that the implementation of inquiry-style lessons significantly positively influenced students' academic attitudes and behavioral engagement. Students reported increased levels of interest, intrinsic motivation, and a greater willingness to participate actively in classroom activities when the lessons were structured around principles of exploration, critical questioning, and personal discovery. However, the study also brought to light several impediments to optimal implementation. These challenges primarily revolved around infrastructural and logistical constraints, including limited laboratory facilities, overcrowded classrooms, insufficient time allocated for practical activities, and a shortage of essential instructional materials. On a positive note, the research identified key facilitators that can mitigate these challenges, such as the presence of supportive and enthusiastic teachers, the effective use of collaborative group work, and the strategic incorporation of real-life materials and examples to contextualize learning.

Based on the detailed data presentation and analysis conducted in Chapter Four, the major findings of this research study are comprehensively summarized as follows:

Impact on Academic Performance and Cognitive Outcomes:

· Inquiry-oriented learning strategies exert a statistically significant positive influence on students' academic performance in Biology. Students who participated in experimental and discovery-based lessons consistently demonstrated higher scores in standardized tests and terminal examinations.

· The methods associated with IBL were found to facilitate deeper cognitive processing, leading to enhanced long-term knowledge retention and a greater ability among students to apply abstract Biological concepts to concrete, real-life situations.

· A notable correlation was observed between active participation in practical activities and an increase in students' self-confidence regarding their ability to comprehend and excel in Biology.

Impact on Affective and Behavioral Domains:

Inquiry-based strategies were instrumental in effecting a substantial improvement in students' levels of engagement and intrinsic motivation during lessons. This was evidenced by observed behaviors such as a greater frequency of student-generated questions, more robust participation in classroom discussions, and a demonstrated propensity for collaborative learning.

The student-centered nature of IBL transformed the classroom dynamic, fostering an environment where learners were more invested and proactive in their educational journey.

Challenges to Effective Implementation:

The study identified a constellation of challenges that hinder the effective integration of IBL. Foremost among these is the pervasive inadequacy of laboratory equipment and essential teaching materials.

· Large class sizes were identified as a major constraint, making individualized attention and effective management of practical sessions difficult.

· The rigid structure of the school curriculum often resulted in time constraints, limiting the duration available for the open-ended exploration that IBL requires.

· A dependency on rote learning in previous educational experiences meant that some students initially exhibited a limited capacity for self-directed learning.

Facilitators for Successful Implementation:

· The role of the teacher was identified as critical. Teachers who provided clear explanations, continuous encouragement, and acted as facilitators were pivotal to the success of IBL activities.

· Pedagogical approaches that emphasized group work and peer collaboration were found to create a supportive learning environment and distribute cognitive load effectively.

· The use of real-life examples, local case studies, and visual aids served as powerful tools to bridge the gap between theoretical knowledge and practical application, making learning more relatable and enjoyable for students.

Conclusion

This research investigated the influence of inquiry-based learning (IBL) on students' performance in Biology within selected secondary schools in Egor Local Government Area, Edo State. The major goal was to explore how learner-centered, question-driven teaching methods affect students' academic achievement, motivation, and understanding when compared to conventional teacher-centered instruction. The study further aimed to identify obstacles and supportive factors that influence the successful application of inquiry-oriented strategies in secondary school Biology classrooms.

From the analysis of responses gathered from one hundred (100) SS2 students and the review of relevant literature, it became evident that the inquiry-based learning approach has a substantial positive effect on students' academic performance, engagement, and overall understanding of biological concepts. Students who participated in activities such as observation, questioning, experimentation, and group discussion demonstrated improved comprehension and retention of knowledge. These results support the constructivist view of learning, which holds that learners build knowledge through interaction with their environment rather than by passively receiving facts (Piaget, 1973; Vygotsky, 1978). In this context, Biology which is the scientific study of life—becomes more meaningful when students explore and discover biological phenomena themselves. Inquiry-based learning therefore transforms Biology lessons from abstract instruction into living experiences where learners act as investigators and knowledge creators rather than listeners.

The findings clearly indicate that inquiry-based learning promotes active learning. Instead of being passive recipients, students become engaged participants who observe, question, and experiment to uncover new ideas. This transformation aligns with Dewey's (1938) philosophy that meaningful education emerges through experience and reflection. When learners engage directly in scientific processes such as problem identification, data collection, and analysis, they acquire deeper conceptual understanding and practical competence. In Egor Local Government schools, such experiences not only improved academic results but also enhanced students' self-confidence and curiosity about the subject.

Furthermore, the study established that inquiry-oriented strategies positively affect students' attitudes and motivation toward Biology. Many respondents indicated that lessons became more interesting, enjoyable, and stimulating when they were encouraged to experiment, explore, and work collaboratively. These results are consistent with Bruner's (1961) theory of discovery learning, which emphasizes that self-directed discovery fosters stronger and longer-lasting learning outcomes. The students in this study expressed satisfaction when they were allowed to find answers through their own investigations rather than being given information directly. This level of engagement and enjoyment contributes to developing positive attitudes toward science, which in turn enhances academic achievement (Akinbobola & Afolabi, 2010; Okebukola, 2002).

Therefore, inquiry-based learning strengthens all domains of learning—cognitive, affective, and psychomotor. By investigating and experimenting, students apply knowledge rather than merely memorize it. For instance, when learners study photosynthesis or ecological systems through practical activities, they connect theoretical concepts with observable realities. This hands-on experience reinforces their comprehension and cultivates scientific reasoning and analytical skills, which are essential for lifelong learning and innovation. However, the research also revealed significant challenges affecting the effective use of inquiry-based learning in Nigerian secondary schools. A major issue identified was the lack of laboratory equipment and instructional materials. Several schools in Egor Local Government Area have inadequate facilities, making it difficult for students to participate in frequent experiments. This finding supports those of Eze (2015) and Okebukola (2005), who emphasized that limited resources and poor laboratory conditions continue to hinder science education in Nigeria. Inquiry-based instruction thrives on access to materials and tools that allow students to test hypotheses and make discoveries. Without such resources, teachers often revert to lecture-based methods.

Another challenge highlighted was large class sizes, which make it hard for teachers to manage student groups effectively or provide individual guidance during practical activities. When classrooms are overcrowded, participation and supervision suffer, reducing the benefits of inquiry-based approaches. Ogunleye (2011) similarly observed that large class sizes limit teachers' ability to deliver hands-on science lessons and to provide timely feedback to learners. In this study, many students mentioned that they could not actively participate in group experiments due to limited materials or teacher attention.

Despite these challenges, the study also identified several factors that support successful implementation of inquiry-based learning. These include effective teacher guidance, collaboration among students, and the use of real-life examples during instruction. Many respondents reported that they performed better when teachers encouraged them, explained clearly, and created opportunities for interactive discussions. This finding aligns with Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), which emphasizes that teachers play a vital role as facilitators who guide learners to higher levels of understanding through scaffolded support.

The implications of these findings for curriculum development and policy in Nigeria are significant. Although the national curriculum encourages active learning, its implementation remains largely theoretical (NERDC, 2013). To make Biology instruction more effective, curriculum developers should incorporate explicit inquiry-based objectives and ensure that experimentation is an integral part of daily classroom activities. Teachers should also be empowered to adapt their lessons to promote exploration, problem-solving, and discussion rather than rote memorization.

Teacher training is another essential element. Many Biology teachers lack sufficient knowledge or confidence in using inquiry-based methods. As Afolabi (2014) observed, teachers often rely on the teaching methods they experienced as students. Therefore, regular workshops, seminars, and professional development programs are needed to expose teachers to practical inquiry strategies, classroom management techniques for hands-on activities, and methods for assessing students' investigative skills.

The results of this research have wider implications beyond Biology. Inquiry-based learning reflects global trends in science education, emphasizing critical thinking, creativity, and problem-solving. These competencies are central to the 21st-century learning framework and are vital for preparing Nigerian students to compete in a globalized knowledge economy. Inquiry-oriented instruction enables learners to become innovators, independent thinkers, and lifelong learners—qualities necessary for scientific and technological advancement.

Moreover, the effectiveness of inquiry-based learning depends on recognizing students' developmental stages. According to Piaget (1973), adolescents are in the formal operational stage, capable of abstract and logical reasoning. Inquiry activities make use of this stage by engaging students in formulating hypotheses, analyzing data, and drawing evidence-based conclusions. Bruner's (1966) idea of a spiral curriculum also supports inquiry learning, as it encourages revisiting topics at deeper levels through progressive questioning and exploration.

Social interaction is another critical component of inquiry learning. Vygotsky (1978) emphasized that learning occurs through social collaboration and communication. The use of group discussions and cooperative investigations observed in this study demonstrates how social interaction helps students internalize concepts more effectively. Through peer learning and dialogue, students develop scientific reasoning and communication skills while building confidence in their abilities.

In the Nigerian context, adopting inquiry-based learning could help solve persistent problems such as poor performance in Biology in external examinations like WAEC and NECO. Many students underperform not because they lack intelligence but because they are taught through rote memorization, which fails to promote understanding (Abimbola & Abolade, 2010; Olatoye, 2012). Inquiry-based methods bridge this gap by enabling students to explore and apply biological principles through experiments and investigations. This active engagement leads to improved conceptual understanding and academic success.

On a broader level, the widespread adoption of inquiry-based learning would contribute meaningfully to national development. Quality science education is crucial for producing innovative thinkers and problem solvers who drive technological growth. Nigeria's quest for sustainable development requires a scientifically literate population capable of applying knowledge to real-world challenges. By fostering curiosity, analytical thinking, and creativity, inquiry-based learning prepares students to become contributors to national progress rather than passive consumers of knowledge.

To achieve this, collective responsibility is essential. Government agencies must provide adequate funding and infrastructure for science education. Educational policymakers should incorporate inquiry-based principles into teacher training programs, ensuring that all new teachers are equipped with the skills necessary for learner-centered instruction. Additionally, schools should maintain smaller class sizes where possible and provide well-equipped laboratories to support practical learning. Parents and communities should also encourage curiosity and hands-on exploration at home.

In summary, the findings of this research confirm that inquiry-based learning significantly enhances students' academic performance and engagement in Biology. The approach allows learners to construct knowledge through active participation, inquiry, and experimentation, leading to deeper understanding and longer retention. It promotes curiosity, independence, and confidence, thereby aligning with modern educational goals that emphasize critical thinking and problem-solving.

Nevertheless, the transition to inquiry-oriented instruction requires sustained effort, teacher competence, and adequate resources. Teachers must be well-trained and motivated, while schools must provide conducive environments for experimentation and discussion. Curriculum planners and policymakers must also align educational objectives with inquiry principles to ensure that teaching methods reflect 21st-century learning standards.

Ultimately, the success of Biology education—and indeed science education as a whole—depends on how effectively teachers can shift from "teaching about science" to teaching through science. Inquiry-based learning embodies this shift by allowing students to think, question, and act like scientists. When learners are given the freedom to observe, hypothesize, test, and evaluate, they develop critical thinking skills and intellectual curiosity that extend far beyond the classroom. This approach not only enhances academic performance but also prepares students to tackle real-life challenges creatively and confidently.

Therefore, inquiry-based learning should not be seen as a temporary innovation but as a transformative educational philosophy that connects knowledge to discovery, theory to practice, and learning to life. Its effective adoption in Nigerian secondary schools will go a long way in producing a generation of learners who are not just academically successful but also scientifically literate, innovative, and prepared to lead the nation toward sustainable growth and development.

Recommendations

From the findings and conclusions of this research on *"The Influence of Inquiry-Based Learning on Students' Performance in Biology in Egor Local Government Area of Edo State,"* a number of practical recommendations are suggested. These are intended to guide teachers, school authorities, curriculum planners, policymakers, and other stakeholders in improving the teaching and learning of Biology at the secondary school level.

The study revealed that inquiry-based learning (IBL) positively affects students' understanding, participation, and overall achievement in Biology. However, for the strategy to be implemented successfully, certain conditions must be met within schools and the educational system as a whole. The availability of adequate and functional science laboratories is crucial for effective inquiry learning. Many schools in Egor Local Government Area still operate without well-equipped laboratories. Therefore, the following actions are recommended:

- Government and education stakeholders should provide and upgrade Biology laboratories in public and private schools to promote hands-on exploration.
- Schools should ensure that essential tools, reagents, and visual aids are accessible to both teachers and students for experimental learning.
- Where resources are limited, teachers should make use of locally available materials to create improvised teaching aids that can serve the same purpose as standard laboratory tools.
- Monitoring and maintenance committees should be established at the school and district levels to ensure that laboratory facilities are properly utilized and preserved.

Teachers play a decisive role in the success of inquiry-based learning. Their ability to guide students through questioning, investigation, and reasoning determines how effective the strategy will be. Consequently:

- Ministries of Education should regularly organize seminars, refresher courses, and workshops to train Biology teachers on modern inquiry-oriented methods.
- Teacher education institutions should update their training curricula to include modules that emphasize scientific inquiry, project-based learning, and reflective teaching.

- Teachers should be encouraged to join professional associations such as the Science Teachers Association of Nigeria (STAN) to exchange ideas and share innovations.
- Experienced teachers should act as mentors to younger colleagues, providing guidance on lesson planning, experiment design, and student engagement techniques.

Large student populations often prevent the proper implementation of inquiry strategies. In overcrowded classrooms, teachers struggle to supervise experiments and give individual attention. To address this:

- The Ministry of Education should adopt policies that reduce teacher-to-student ratios, particularly in science classes.
- Schools should consider splitting large classes into smaller groups during practical sessions to ensure active participation.
- Additional qualified Biology teachers should be employed to ease teacher workload and promote better supervision during inquiry lessons.
- Schools can develop rotational laboratory schedules so that each group of students has adequate time and space to conduct experiments.

Smaller class sizes improve student engagement, safety during practical, and overall learning effectiveness.

For inquiry-based learning to become a permanent part of the educational system, it must be integrated into the national curriculum. This will ensure that all teachers follow a structured approach. Thus:

- The National Educational Research and Development Council (NERDC) should review the current Biology curriculum to include clear inquiry objectives and learning outcomes.
- Each topic should include suggested investigations or experiments that promote student discovery and critical thinking.
- National examinations should assess not only factual knowledge but also scientific skills.
- Textbooks and instructional materials should be written to align with these inquiry-based objectives.

Teachers need motivation to adopt more demanding and student-centered approaches like inquiry-based learning. Therefore:

- Authorities should reward innovative teachers who successfully apply inquiry strategies in their classrooms through awards, promotions, or bonuses.
- School management should allocate adequate planning time for teachers to design inquiry-based lessons.
- Teachers should be provided with digital tools, teaching aids, and internet access to support lesson preparation and classroom activities.
- A strong system of peer collaboration should be encouraged, where teachers share challenges and successful strategies.

Motivated teachers are more willing to experiment with new pedagogies that enhance student performance.

Inquiry learning emphasizes collaboration and student participation. To strengthen this:

- Teachers should design lessons that involve group projects, peer learning, and interactive problem-solving tasks.
- Students should be encouraged to ask questions, share ideas, and conduct experiments in groups.
- Schools should promote and give students platforms for showcasing their discoveries.
- Teachers should foster an atmosphere of mutual respect and curiosity, where mistakes are treated as learning opportunities.

This approach not only deepens understanding but also builds students' teamwork, communication, and leadership skills.

One common challenge of inquiry-based learning is that it can be time-consuming. To overcome this:

- Schools should increase the time allocated to science subjects, allowing for both theoretical and practical sessions.
- Teachers should plan their lessons carefully to ensure that inquiry activities are well-structured and time-efficient.
- Administrative duties that reduce teachers' instructional time should be minimized.

Efficient time management will allow teachers to conduct meaningful inquiry lessons without sacrificing curriculum coverage.

Government action is necessary for the long-term sustainability of inquiry-based education. Hence:

- The Ministry of Education should enact policies that make inquiry learning a mandatory teaching method in science subjects.
- Adequate budgetary allocation should be made for science laboratories, teacher training, and instructional materials.
- Educational inspectors should evaluate the extent to which schools implement inquiry learning and provide recommendations for improvement.
- Collaboration with non-governmental organizations (NGOs) and international bodies should be expanded to access technical and financial support.

Technology offers numerous tools that can enhance exploration and experimentation in Biology. Therefore:

- Schools should equip classrooms and laboratories with ICT facilities such as computers, projectors, and internet connectivity.

- Teachers should use digital simulations, virtual laboratories, and multimedia presentations to complement traditional experiments.
- Training should be organized to enable teachers and students to use technology responsibly and effectively in science learning.
- Students can also use technology to conduct research, present findings, and share results of their investigations.

Assessment should not be limited to written examinations. Inquiry learning requires evaluating process skills and attitudes. To achieve this:

- Teachers should employ continuous assessment methods such as portfolios, group reports, observations, and peer evaluations.
- Students should receive immediate and constructive feedback to guide their learning progress.
- Teachers should help students reflect on what they learned and how they can improve their inquiry skills.
- Schools should create assessment rubrics that measure curiosity, creativity, and reasoning abilities.

Regular feedback helps students identify their strengths and weaknesses while reinforcing positive learning behaviors.

The home and community environments also influence how well students embrace scientific inquiry. To strengthen external support:

- Parents should be sensitized to encourage curiosity and independent thinking among their children.
- Schools should host science fairs and open exhibitions to showcase student projects and attract community involvement.
- Partnerships with local industries, universities, and research institutes should be developed to expose students to real-world scientific work.

Finally, while this study provided meaningful insights, more research is necessary to deepen understanding of inquiry-based learning in Biology. Future researchers should:

- Conduct studies involving larger and more diverse student samples to compare regional outcomes.
- Examine the long-term academic and behavioral effects of inquiry learning on students.
- Investigate the teachers' perspectives on barriers and best practices for implementing inquiry learning.

REFERENCES

Abdi, A. (2014). The effect of inquiry-based learning method on students' academic achievement in science course. *Universal Journal of Educational Research, 2*(1), 37–41.

Abdulahi, **M. M., et al.** (2023). Inquiry-Based Learning in African Classrooms Journal of Science Education, 15(2), 45–60.

Federal Ministry of Education. (2022). WAEC Biology Performance Report. Abuja: FME Press.

Jiang, Z., et al. (2021). IBL and Science Achievement: A Meta-Analysis. Educational Research Review, 33, 100–115.

Abimbola, I. O. (1988). The problem of terminology in the study of students' conceptions in science. *Science Education, 72*(2), 175–184.

Achor, E. E., & Imoko, B. I. (2017). Inquiry-based learning and students' performance in science subjects in Benue State, Nigeria. *Journal of Science Education and Research, 5*(2), 112–123.

Adebayo, F. A. (2010). Effective teaching strategies in Nigerian secondary schools. *Journal of Educational Leadership, 3*(1), 44–59.

Adegoke, B. A. (2012). Impact of multimedia instruction on senior secondary students' achievement in physics. *European Journal of Educational Studies, 4*(3), 366–377.

Adegoke, E. A. (2014). Learner-centered methods in science classrooms in Nigeria. *Journal of Education and Practice, 5*(12), 87–95.

Adeyemi, T. O. (2016). Research methods and statistics in education. *Educational Research Journal, 8*(4), 221–232.

Afolabi, F., & **Akinbobola, A. O.** (2012). Constructivist problem-based learning in science education. *International Journal of Educational Research, 4*(2), 32–40.

Aina, J. K. (2014). Improving teaching and learning in science through scientific inquiry. *International Journal of Humanities and Social Science, 4*(6), 100–105.

Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher-student interactions and academic achievement in mathematics and science. *African Journal of Educational Research, 12*(1), 49–57.

Akinwole, O. A. (2015). Challenges of science education in Nigerian secondary schools. *Science Education Review, 7*(2), 25–33.

Akinyemi, S. (2011). Strategies for improving biology instruction in Nigerian secondary schools. *Journal of Science Education, 13*(4), 122–128.

Akinyemi, O., & Orukotan, K. (2014). Students' attitudes toward science in Nigerian schools. *Science Teachers Association of Nigeria Journal, 49*(1), 15–25.*

Akomolafe, M. J. (2013). Instructional methods and students’ academic performance. *Educational Thought, 3*(1), 39–47.

Alake, E. M., & Ogunseemi, O. O. (2013). Effects of guided inquiry on biology achievement of pupils. *Journal of Science Education and Practice, 5*(1), 20–27.

Ali, A. (2006). *Conducting research in education and the social sciences.* Tashiwa Networks.

Arends, R. I. (2012). *Learning to teach* (9th ed.). McGraw Hill.

Asikhia, O. A. (2010). Students' and teachers' perception of the causes of poor academic performance in Ota, Nigeria. *European Journal of Social Sciences, 13*(2), 229–242.

Ausubel, D. P. (1968). *Educational psychology: A cognitive view.* Holt, Rinehart & Winston.

Babalola, J. B. (2011). Practical strategies for improving student achievement in science. *Nigerian Journal of Science Education, 8*(1), 41–56.

Banchi, H., & Bell, R. (2008). The many levels of inquiry. *Science and Children, 46*(2), 26–29.

Barron, B., & **Darling-Hammond, L.** (2010). Teaching for meaningful learning: A review of research. *George Lucas Educational Foundation*, 1–41.

Bell, T., Urhahne, D., Schanze, S., & Ploetzner, R. (2010). Collaborative inquiry learning: Models, tools, and challenges. *International Journal of Science Education, 32*(3), 349–377.

Berg, C. A., & Bergendahl, V. C. (2010). The impact of inquiry-based learning on students' understanding. *Journal of Science Education and Technology, 19*(4), 420–429.

Bichi, S. S. (2002). Effects of constructivist instructional method on biology achievement. *Journal of Science Teachers Association of Nigeria, 37*(1), 20–30.*

Biggs, J., & **Tang, C.** (2011). *Teaching for quality learning at university* (4th ed.). McGraw Hill.

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*(1), 5–31.

Blumenfeld, P. C., et al. (1991). Motivating project-based learning. *Educational Psychologist, 26*(3), 369–398.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school.* National Academy Press.

Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review, 31*(1), 21–32.

Bybee, R. W. (2014). *The BSCS 5E Instructional Model: Creating teachable moments.* NSTA Press.

Cakir, M. (2008). Constructivist approaches to science teaching. *Eurasia Journal of Mathematics, Science & Technology Education, 4*(3), 223–232.

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research.* Rand McNally.

Carin, A. A., & Bass, J. E. (2005). *Teaching science as inquiry* (10th ed.). Pearson.

Chiappetta, E. L., & Koballa, T. R. (2015). *Science instruction in the middle and secondary schools* (7th ed.). Pearson.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE.

Daramola, F. O. (2006). *Principles and methods of teaching.* National Open University of Nigeria.

Deboer, G. E. (2006). Historical perspectives on inquiry teaching. *Handbook of Research on Science Education, 1*, 17–41.

Dewey, J. (1938). *Experience and education.* Collier Books.

Eggen, P., & Kauchak, D. (2013). *Educational psychology: Windows on classrooms* (9th ed.). Pearson.

Ekwueme, C. O., & Igwebuike, T. B. (2012). Improvisation in science teaching: A Nigerian perspective. *Journal of Education and Practice, 3*(6), 38–42.

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism. *Performance Improvement Quarterly, 26*(2), 43–71.

Etim, J. S. (2016). Classroom environment variables and students' academic achievement in science. *Nigerian Journal of Educational Research, 13*(2), 55–65.

Flick, L. B., & **Lederman, N. G.** (Eds.). (2006). *Scientific inquiry and nature of science.* Springer.

Fosnot, C. T. (Ed.) (2013). *Constructivism: Theory, perspectives, and practice.* Teachers College Press.

Fraser, B. J. (1998). Classroom environment instruments and their use. *Learning Environments Research, 1*(1), 7–33.

Friesen, S., & Scott, D. (2013). Inquiry-based learning: A review of the research literature. *Alberta Initiative for School Improvement.*

Garrison, D. R., & **Arbaugh, J. B.** (2007). Research on online learning. *Internet and Higher Education, 10*(3), 157–172.

Hake, R. R. (1998). Interactive-engagement vs. traditional methods. *American Journal of Physics, 66*(1), 64–74.

Harlen, W. (2013). Inquiry in science education. *Journal of Science Education, 2*(1), 1–15.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235–266.

Ifeakor, A. C., & **Okoli, J. N.** (2010). Resources for effective teaching of biology. *African Journal of Science Education, 5*(1), 75–89.

Jegede, O. J., & Okebukola, P. A. (1992). Student anxiety towards science. *Journal of Research in Science Teaching, 29*(2), 177–187.

Khalid, A., & Azeem, M. (2012). Constructivist classroom: An observational study. *Procedia - Social and Behavioral Sciences, 55*, 120–127.

Kilbane, C. R., & Milman, N. B. (2014). *Teaching models: Designing instruction for 21st-century learners.* Pearson.

Kolawole, E. B. (2010). *Research methodology and statistics in education.* Bolabay Publications.

Kuhlthau, C. C., Maniotes, L., & Caspari, A. K. (2015). *Guided inquiry design.* Libraries Unlimited.

Lederman, N. G., & Lederman, J. S. (2015). What is science inquiry? *Journal of Science Teacher Education, 26*(7), 593–597.

Mayer, R. E. (2004). Should there be a three-strikes rule against discovery learning? *American Psychologist, 59*(1), 14–19.

National Research Council. (2000). *Inquiry and the national science education standards.* National Academy Press.

Nwagbo, C. (2006). Effects of guided inquiry and expository methods on science achievement. *Journal of Science Teachers Association of Nigeria, 41*(1), 32–41.*

Nworgu, B. G. (2015). *Educational research: Basic issues and methodology.* University Trust Publishers.

Ogunleye, B. O. (2009). Science education in Nigeria. *Educational Studies Journal, 6*(2), 39–48.

Okebukola, P. A. (1997). Constructivism in Nigerian classrooms. *Journal of Science Teachers Association of Nigeria, 32*(1), 22–29.*

Okoye, R. O., & Okechukwu, I. (2012). Inquiry methods and achievement in biology. *Journal of Science and Technical Education, 7*(1), 51–67.

Olatoye, R. A. (2017). Guided inquiry and science achievement. *International Journal of Education, 10*(2), 55–66.

Opara, J. A. (2011). Inquiry-based instructional methods and process skills. *Journal of Science Education, 12*(3), 57–63.

Piaget, J. (1972). *The psychology of the child.* Basic Books.

Prince, M., & Felder, R. (2006). Inductive teaching and learning. *Journal of Engineering Education, 95*(2), 123–138.

Taber, K. S. (2014). *Science education: Issues and perspectives.* Routledge.

Taba, H. (1962). *Curriculum development: Theory and practice.* Harcourt Brace.

Tichenor, P. J., Donohue, G. A., & Olien, C. N. (1970). Mass media flow and knowledge gap. *Public Opinion Quarterly, 34*(2), 159–170.

Vygotsky, L. S. (1978). *Mind in society.* Harvard University Press.

Wellington, J., & Ireson, G. (2012). *Science learning, science teaching* (3rd ed.). Routledge.

Westbrook, J., Durrani, N., Brown, R., & Orr, D. (2013). *Pedagogy and teacher education in developing countries.* UKAID.

Wilson, J. M. (2008). Inquiry-based science education: What it means. *Science Education Review, 7*(1), 15–24.

Yager, R. E. (2000). The constructivist learning model. *Science Teacher, 67*(1), 44–47.

APPENDIX

UNIVERSITY OF BENIN

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY QUESTIONNAIRE

Dear Students,

This research questionnaire solicits information from you. It is designed to find out the Influence of Inquiry-based Learning on Students' Performance in Biology in Egor Local Government Area. Please answer the following questions honestly and as correctly as possible. Your responses will remain confidential and will only be used for research purposes.

Thanks for your anticipated cooperation.

Ayomide Esther OJESANMI

Researcher.

SECTION A: PERSONAL DATA

1. Age: ______
2. Gender: Male ( ) Female( )
3. Class Level: Senior Secondary 2 (SS2) ( )

SECTION B: ***Kindly use the following keys,where available,to indicate your chosen response to the following questionnaire item statement by ticking (√) appropriate box:***

Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD).

RESEARCH QUESTION 1*: Effect of Inquiry-based Learning on students' academic performance in Biology*

S/N		**ITEM STATEMENT**	**SA**	**A**	**D**	**SD**
1.		Inquiry-based learning helps me understand Biology concepts better.				
2.		I perform better in Biology tests when taught using Inquiry-based learning.				
3.		Inquiry-based lessons make me remember what I learned for a longer time.				
4.		I am more confident in answering Biology questions after Inquiry-based lessons.				
5.		Inquiry-based learning helps me apply Biology knowledge to real-life situation.				

6.		Inquiry-based learning has made me have more interest in studying Biology.				

RESEARCH QUESTION 2: What changes occur in students' attitudes and engagement when taught using Inquiry-based strategies.

S/N	ITEM STATEMENT	SA	A	D	SD
7.	Inquiry-based learning makes Biology lessons more fun and enjoyable.				
8.	I actively participate in class when the Teacher uses Inquiry-based learning.				
9.	I prefer working in groups during Biology lessons that involve experiments and exploration.				
10.	I ask more questions and share my ideas during Inquiry-based classes.				
11.	I collaborate better with my classmates during Inquiry-based activities.				
12.	I feel more motivated to study Biology after Inquiry-based lessons.				
13.	I enjoy discovering answers by myself instead of being told everything by the Teacher.				

RESEARCH QUESTION 3: ***What are the challenges and facilitators of Inquiry-based learning in Biology education?***

S/N	ITEM STATEMENT	SA	A	D	SD
14.	Inquiry-based learning requires a lot of time to complete activities.				
15.	Sometimes, there are not enough laboratory materials for Inquiry-based activities.				
16.	My teachers encourage us to use technology for biology assignments and projects.				
17.	Large class size makes it difficult for everyone to participate in Inquiry-based lessons.				
18.	I find it difficult to conduct experiments without close supervision.				
19.	The Teacher explains clearly during Inquiry-based lessons.				
20.	I receive encouragement from my Teacher during Inquiry-based activities.				
21.	Group work and discussion make Inquiry-based learning easier for me.				