EFFECT OF PROBLEM-SOLVING STRATEGY ON ACADEMIC PERFORMANCE IN CELL CONCEPT AMONG SENIOR SECONDARY SCHOOL STUDENTS IN EGOR LOCAL GOVERNMENT

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY, FACULTY OF EDUCATION, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE (EDUCATION) DEGREE IN BIOLOGY EDUCATION

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CERTIFICATION

We the undersigned certify that this project research work was carried out by **OJEAMIREN OLOHITA DORATHY** with Matriculation number **EDU2102038** in the Department of curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City in partial fulfillment for the award of BSc (Ed) degree in biology Education.

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Head of Department

Date: _____

DEDICATION

I dedicate this research work to God Almighty, for being my strength throughout my undergraduate phase. I also, dedicate this project research to my parents Mr & Mrs Ojeamiren, may God bless you all.

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I wish to express my sincere appreciation to God Almighty for the life and strength He gave me to accomplish this great work.

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ABSTRACT

This study focused on the effect of problem-solving strategy on academic performance in cell concept among senior secondary school students in Egor local government as case study. The study is was specifically focused on determining if there was any significant difference between the level of achievement of students taught using problem solving strategy and those taught using the conventional lecture method, determining the attitudes of students towards cell concept problems when taught using problem solving strategies and finding out the influence of gender on students' achievement in cell concept when taught using problem solving strategy.

The study adopted the survey research design and randomly enrolled participants in the study. A total of 100 responses were validated from the enrolled participants where all respondent are senior secondary school students in Egor local government.

The findings of this study showed that the performance levels of both male and female students after treatment improved significantly though male students achieved slightly higher than their female counterparts after exposure to problem solving strategy. The results further showed that students taught using problem solving strategy performed significantly better than their counterparts taught with conventional lecture approach. Furthermore, the result revealed that students in private schools performed better than the students in public schools after exposure to problem solving strategy. The study concluded that the use of problem-solving strategy promotes students' understanding of concepts translating to optimal performance in cell concept examinations. It was recommended among others that authors and textbook writers of textbooks should transform textbooks into problem solving forms, apply and provide proper illustrations so as to meet the criteria of problem-solving strategy as doing this would help in enhancing students' achievement.

CHAPTER ONE

INTRODUCTION

Background to the study

Education is universally acknowledged as a powerful instrument for individual and societal development. In Nigeria, science education plays a critical role in achieving the goals of national development, particularly in the areas of technology, healthcare, and industrial growth. Among the science subjects taught in secondary schools, Biology holds a central position. It provides learners with foundational knowledge about living organisms and forms a basis for professional studies in medicine, pharmacy, nursing, agriculture, biotechnology, and other life sciences.Within the Biology curriculum, one of the fundamental but conceptually demanding topics is the cell concept. The concept of the cell—its structure, function, and significance as the basic unit of life—is foundational to understanding all living organisms. Students' comprehension of the cell concept directly influences their ability to master subsequent biological concepts such as genetics, physiology, reproduction, and ecology (Egbes & Ajaja, 2022). However, despite its importance, several studies have reported that students consistently perform poorly in questions related to cells in both internal and external examinations (WAEC, 2021).

A major contributing factor to this poor performance is the continued use of conventional teaching methods, particularly the lecture or talk-and-chalk method, which is

predominantly teacher-centered. In many classrooms across Nigeria, including those in Egor Local Government Area (LGA) of Edo State, the teaching of Biology still heavily relies on rote memorization and passive note-taking. These approaches do not encourage deep learning or critical engagement with the material. Consequently, students struggle to internalize the abstract and microscopic features of the cell, which are not directly observable without laboratory tools and guided inquiry.

In recent years, education stakeholders have increasingly advocated for student-centered instructional strategies, which shift the focus from the teacher to the learner. Among these strategies, problem-solving strategy (PSS) has gained attention for its effectiveness in enhancing students' cognitive engagement and academic performance. Problem-solving involves the identification of a problem, generation of solutions, implementation of the best solution, and evaluation of outcomes. It encourages students to think critically, collaborate, and apply theoretical knowledge to practical situations (Yusuf & Omolayo, 2019).

The use of problem-solving in science education is grounded in constructivist learning theory, which posits that knowledge is actively constructed by learners through experience and reflection (Bruner, 1966; Vygotsky, 1978). Rather than being passive recipients of information, students engage with real-world problems, pose questions, test hypotheses, and draw conclusions. This method not only enhances academic achievement but also promotes skills such as communication, teamwork, and scientific reasoning, all of which are essential for 21st-century learners.

Several empirical studies have demonstrated the effectiveness of problem-solving strategies in improving academic outcomes in science subjects. Adewumi (2024) found that the use of PSS significantly improved students' performance in genetics compared to the conventional lecture method. Similarly, Okagbare (2022) reported that Biology students who were taught using problem-solving and cooperative strategies demonstrated higher academic performance and better retention than their counterparts in traditional classrooms. In Delta State, Egbes and Ajaja (2022) showed that problem-solving and guided discovery strategies led to improved achievement and retention among secondary school Biology students. These findings align with international research which supports the incorporation of PSS into science classrooms as a means of fostering conceptual understanding and learner autonomy.

Despite the growing evidence in favor of PSS, its implementation remains limited in many Nigerian secondary schools, particularly in urban and semi-urban areas like Egor LGA. Factors such as large class sizes, inadequate teacher training, limited access to instructional resources, and resistance to pedagogical change hinder the adoption of innovative teaching strategies. Additionally, many Biology teachers may lack the motivation or confidence to shift from the traditional approach to a more interactive and learner-centered model.

The situation is further complicated by gender-related differences in science performance. Some studies suggest that male students tend to outperform female students in science and mathematics due to societal expectations, classroom dynamics, and differences in interest or confidence (Akinyemi & Falode, 2020). Therefore, any attempt to introduce a new

instructional strategy such as PSS must also consider how it affects students of different genders and whether it promotes equity in academic achievement.

In light of the foregoing, there is a pressing need to investigate the effect of problem-solving strategy on students' academic performance in the cell concept within the context of Egor LGA, Edo State. This area of study is essential not only to address the persistent poor performance in Biology but also to contribute to the development of more effective and inclusive instructional strategies. Understanding how PSS influences learning outcomes in a local setting can guide policy, teacher training, and curriculum development aimed at improving science education in Nigeria.

This study is therefore designed to explore whether the integration of problem-solving strategy into the teaching of the cell concept can significantly enhance academic performance among senior secondary school students in Egor LGA. It will also examine whether gender differences influence the effectiveness of this strategy. The findings are expected to provide empirical evidence that could support the shift toward more student-centered teaching methods in Nigerian science classrooms.

Statement of the Problem

Academic achievement in science education, especially in Biology, continues to be a major concern for educators, students, parents, and policymakers in Nigeria. Biology remains one of the core science subjects in Nigerian senior secondary schools, playing a vital role in

preparing students for careers in health sciences, agriculture, biotechnology, and environmental science. Among the many topics covered in the Biology curriculum, the cell concept is foundational and essential for understanding more advanced topics like genetics, physiology, and microbiology. However, persistent low performance in Biology among secondary school students—especially in abstract topics like the cell—has been a source of concern for educators, policymakers, and curriculum developers.

Reports from both the West African Examinations Council (WAEC) and the National Examinations Council (NECO) over the past decade have consistently highlighted students' poor grasp of cellular biology. For instance, Etokeren, Kingdom-Aaron, and Alamina (2019) observed that many students perform poorly in questions relating to the structure and functions of cell organelles, differences between plant and animal cells, and cell theory. This recurring underperformance suggests a gap in teaching strategies used in delivering the content. One probable cause is the continued reliance on traditional lecture methods, which are often teacher-centered and limit student engagement.

Traditional methods tend to treat students as passive recipients of information, a practice that discourages critical thinking and problem-solving. In contrast, the problem-solving instructional strategy, which is learner-centered, involves presenting students with real-world challenges that require analytical reasoning, collaboration, and application of concepts. Research has shown that when students are taught using active learning strategies, they tend to perform better and retain information longer (Adewumi, 2024). Despite this, many Biology

teachers in Nigerian public schools, including those in Egor Local Government Area (LGA) of Edo State, continue to depend heavily on outdated methods due to lack of training, large class sizes, or unavailability of teaching aids.

In Egor LGA, informal surveys and feedback from science teachers reveal that while the cell concept is covered in the curriculum, most students do not internalize the knowledge. This weak foundation affects their performance in both internal assessments and external examinations. The lack of interactive and concept-driven approaches, like problem-solving, has been implicated in this trend. There is also a paucity of empirical studies focusing specifically on how the use of problem-solving strategies can affect student understanding of the cell concept in this locality.

Moreover, the global shift toward 21st-century learning has made it imperative for schools to integrate critical thinking, collaboration, and problem-solving into science teaching. The Nigerian educational system, especially at the secondary level, must adopt these methods to remain globally competitive and improve science literacy. Akinwumi and Falemau (2018) argue that problem-solving strategies not only improve academic achievement but also boost students' confidence and interest in science. However, there is limited data on how effective such strategies are in public schools in southern Nigeria, including Edo State.

This study, therefore, seeks to fill a critical gap by investigating whether the use of problem-solving strategies can significantly enhance the academic performance of senior secondary school students in the cell concept within Egor LGA. By focusing on this specific

context, the research aims to contribute both theoretically and practically to improving Biology education, guiding teachers in selecting more effective instructional approaches, and influencing policy decisions at the local education authority level.

Without such investigation, the persistent low performance in Biology may continue to hinder students' access to science-related career paths and reduce the quality of science graduates in the region. In light of these considerations, the research aims to address the following question: To what extent do problem-solving strategies influence the academic performance of senior secondary school students in the field of cell concept?

Purpose of the Study

The purpose of this study are as follows:

1. Determine if there was any significant difference between the level of academic performance of students taught using problem solving strategy and those taught using the conventional lecture method.
2. Assess the attitudes of students towards cell concept problems when taught using problem solving strategies.
3. Examine the influence of gender on students' performance in cell concept when taught using problem solving strategy.
4. To provide recommendations for biology teachers and curriculum developers on the effective use of problem-solving strategy in teaching abstract biology concepts.

Research Questions:

1. What is the level of academic performance of students before and after exposure to problem solving strategy?
2. How does gender influence the effectiveness of problem-solving strategy on student's performance in the cell concept?
3. What is the attitude of students towards problem solving strategy in cell concept?
4. How can the problem-solving strategy be effectively integrated into biology teaching to improve student learning outcomes?

Hypotheses

1. There is no significant difference in academic performance of students taught using problem solving strategy and those taught using the conventional lecture method.
2. There is no significant difference in academic performance of male and female students who were taught using problem solving strategy.
3. There is no significant difference between the academic performance of students in public schools and their counterparts in private schools exposed to problem solving strategy?
4. There is no significant interaction effect between gender and instructional strategy on students' academic performance in the cell concept.

Significance of the Study

This research is based on the assumption that the findings will be useful in both practical and theoretical contexts. Teachers, students' curriculum designers, and educational administrators will profit from the research. The research might be considered theoretically relevant since it will provide light on current ideas that may impact issue resolution. Curriculum planners would use the information from the study's findings to plan their lessons. The data might aid curriculum planners in determining the appropriateness of the senior secondary biology program's problem-solving component. Finally, the research would add empirically to the body of existing literature and serve as a reference source for students or other academics interested in conducting research on a comparable issue.

Scope of the Study

The broad objective of this research is to look into the effect of problem-solving strategy on academic performance in cell concept among senior secondary school students in Egor local government. The goal of this study is to see if problem-solving techniques may help students improve their critical thinking skills in cell concept. It will be determined whether brainstorming, as a problem-solving strategy, is capable of instilling problem-solving skills in secondary school students. It will look into whether problem-based learning is more innovative and superior than standard lecture learning. However, the study is confined to a few secondary schools in the Local Government.

Limitation of the Study

Like in every human endeavour, the researchers encountered slight constraints while carrying out the study. The significant constraint was the scanty literature on the subject owing to the nature of the discourse thus the researcher incurred more financial expenses and much time was required in sourcing for the relevant materials, literature, or information and in the process of data collection, which is why the researcher resorted to a limited choice of sample size. Additionally, the researcher will simultaneously engage in this study with other academic work. More so, the choice of the sample size was limited as few respondents were selected to answer the research instrument hence cannot be generalize to other corporate organizations. However, despite the constraint encountered during the research, all factors were downplayed in other to give the best and make the research successful.

Definition of Terms

Teaching Method: A teaching method comprises the principles and methods used by teachers to enable student learning. These strategies are determined partly on subject matter to be taught and partly by the nature of the learner.

Problem-Solving Strategy: A teaching approach that engages students in identifying, analyzing, and finding solutions to problems.

Academic Performance: The level of achievement or scores obtained by students in a test on the cell concept. Academic performance is the extent to which a student or institution has

achieved either short- or long-term educational goals. Performance of students may be measured through students' grade point average, whereas for institutions, performance may be measured through graduation rates.

Cell concept: A biology concept that deals with the structure, function, and type of cells.

Conventional Method: Traditional teaching method that involves lecturing with limited student participation.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Literature for this study was reviewed under the following sub heading:

- Theoretical Framework
- Conceptual framework
- Academic Performance and Its Determinants
- Understanding the Cell Concept in Biology
- Challenges in Teaching the Cell Concept
- Effects of Problem-Solving Strategy on Science Education
- Empirical Studies on Instructional Strategies and Student Performance
- Summary of reviewed literature

Through this structure, the chapter aims to lay a solid foundation for the justification of the research methodology and overall direction of the study

Theoretical Framework

A theoretical framework provides the structure that guides academic research. It offers a lens through which the variables of the study of problem-solving strategy, academic performance, and understanding of the cell concept can be examined. For this study, the theories underpinning the effects of teaching strategies on learning outcomes are crucial to

understanding how and why problem-solving strategies may influence students' academic performance. Theoretical support for this research is drawn from the following key learning theories:

Constructivist Learning Theory

Bruner's Theory of Discovery Learning

Piaget's Theory of Cognitive Development

Information Processing Theory

Ausubel's Theory of Meaningful Learning

Each of these theories emphasizes the importance of active student engagement, critical thinking, and learner-centered instruction core principles of the problem-solving teaching strategy.

Constructivist Learning Theory

Constructivist theory, primarily associated with Jean Piaget and Lev Vygotsky, posits that learners actively construct knowledge rather than passively receive it. Constructivism emphasizes that learning occurs best when students are engaged in authentic tasks that require critical thinking and collaboration (Vygotsky, 1978).

In applying constructivist theory to this study, the use of problem-solving strategies in teaching the cell concept enables students to explore, discover, and internalize biological knowledge.

Students are not merely given facts about cell organelles; instead, they investigate real-life cell-related scenarios, thus constructing deep understanding.

According to Etokeren et al. (2019), constructivist-based instruction, such as problem-solving, significantly improves students' performance in science because it allows learners to relate new information to their existing cognitive structures.

Bruner's Theory of Discovery Learning

Jerome Bruner's discovery learning theory supports the idea that students learn best when they discover facts and relationships for themselves. Discovery learning involves problem-solving, inquiry, and exploration, aligning perfectly with the problem-solving strategy.

Bruner (1961) emphasized the spiral curriculum, where learners revisit concepts at increasing levels of complexity. In the context of this study, students learning about cells can start with basic structures and gradually progress to more complex cellular functions through guided discovery.

Awodun (2020) demonstrated that students taught using discovery-based strategies, including problem-solving, performed better in Biology compared to those taught using expository methods. Bruner's theory reinforces the importance of stimulating student curiosity and enabling them to derive meaning through exploration.

Piaget's Theory of Cognitive Development

Jean Piaget's theory of cognitive development outlines how children progress through distinct stages of intellectual development. Senior secondary school students typically fall into the formal operational stage, where they are capable of abstract thought, hypothetical reasoning, and systematic problem-solving.The implication of this theory for this study is that students are cognitively prepared to handle complex concepts like cell structure and function, provided the instructional strategy challenges their reasoning ability. Problem-solving teaching encourages students to analyze cell processes, propose hypotheses, and evaluate scientific data activities well-suited to their developmental stage (Akinwumi & Falemau, 2018).

Piaget's theory supports the use of tasks that stimulate inquiry and reflective thinking, making problem-solving a developmentally appropriate strategy for teaching Biology.

Information Processing Theory

Information Processing Theory likens the human mind to a computer: information enters through sensory input, is processed in short-term memory, and may be stored in long-term memory. The effectiveness of this process depends on attention, encoding, and retrieval strategies.

Problem-solving instruction facilitates meaningful encoding of information by engaging students in mentally demanding tasks. When students apply knowledge to solve problems, they create multiple neural pathways that enhance memory retention.

According to Mayer (2019), active engagement through problem-solving promotes deep processing, which results in better academic performance. In the case of Biology instruction, problem-solving improves understanding of complex cellular mechanisms by encouraging students to organize and connect concepts.

Ausubel's Theory of Meaningful Learning

David Ausubel's theory contrasts meaningful learning with rote memorization. He asserts that new learning is most effective when it can be related to concepts the learner already knows. Meaningful learning requires integration of new information with existing cognitive frameworks.

In teaching the cell concept, using problem-solving strategies provides opportunities for students to connect prior biological knowledge to new content, such as relating osmosis to real-life medical conditions.

Adewumi (2024) showed that meaningful learning, promoted through problem-solving, significantly enhances students' ability to apply biological concepts in both academic and everyday contexts.

Synthesis of Theoretical Foundations

All the theories reviewed converge on a central idea, learning is most effective when students are actively engaged in constructing knowledge. Whether through constructivist discovery, cognitive stimulation, or meaningful integration, the theories support the idea that

learners retain and apply knowledge more effectively when they participate in solving problems.

The figure below illustrates the theoretical model guiding this study:

Input

→ Problem-Solving Strategy (Independent Variable)

Process

→ Active engagement, discovery, reflection, integration

Output

→Improved Academic Performance in Cell Concept (Dependent Variable)

This model demonstrates that the strategy used in teaching influences how students interact with content, which in turn affects their academic outcomes.

Relevance of Theories to the Current Study

- **Constructivism** justifies the use of interactive, student-led learning environments where learners can discover cellular processes themselves.
- **Discovery Learning** reinforces that students learn better by exploring secondary school students.

- **Information Processing** explains how problem-solving enhances long-term understanding of Biology.
- **Meaningful Learning** Theory connects students' prior knowledge with new concepts for lasting academic achievement.

Together, these theories support the central hypothesis of this study that using problem-solving strategies will significantly enhance senior secondary school students' performance in the cell concept.

Conceptual Framework

A conceptual framework offers a lens through which the researcher views the problem under study. It serves as a map that explains how the variables in the study are expected to interact. In this study, the central concepts are: problem-solving strategy (independent variable), academic performance (dependent variable), and cell concept (contextual domain). Other moderating variables such as gender and teaching methodology are also considered. This framework aims to establish how problem-solving strategies affect students' academic performance specifically in understanding the cell concept, a fundamental topic in biology.

Problem-Solving Strategy

Problem-solving is an instructional approach where students actively engage in finding solutions to complex problems through reasoning, analysis, and application of knowledge. It promotes higher-order thinking, creativity, and learner autonomy. According to Montoyd et al.

(2019), the strategy helps students develop critical thinking skills and the ability to transfer knowledge across contexts. In a science classroom, this method supports hypothesis formulation, experimentation, and drawing inferences, aligning well with the scientific method.

Katz (2021) asserts that problem-solving instruction enables learners to analyze biological systems more meaningfully, especially in topics like cell structures, where spatial and functional complexity often hinders understanding. The use of problem-solving tasks also improves retention, conceptual clarity, and student motivation (Furaha & Alhassan, 2020).

Recent studies (Nguyen et al., 2022; Chukwuedo & Njoku, 2021) have confirmed that students taught using problem-solving strategies perform significantly better in science subjects than those exposed to traditional lecture methods. These strategies encourage exploration and reasoning, making students more active participants in the learning process.

Cell Concept in Biology

The cell is a foundational concept in biology and often introduces students to abstract biological structures and functions. It includes cellular components, types, processes (e.g., mitosis, meiosis), and molecular activities. Because the concept is abstract and microscopic, students often face cognitive challenges in grasping it (Wong et al., 2021).

Usak et al. (2022) argue that learning the cell concept requires bridging the gap between students' prior knowledge and new content. Therefore, integrating problem-solving strategies

allows learners to explore the functions and structures of cells more practically through simulations, diagrams, and case-based tasks.

Song et al. (2023) emphasized that effective teaching of the cell topic involves conceptual scaffolding, inquiry-based approaches, and real-life connections to enable deep understanding. Problem-solving enhances these methods by providing structured thinking steps that aid internalization.

Academic Performance

Academic performance is the measurable outcome of education the extent to which a student achieves educational goals. It includes assessments, test scores, class participation, and mastery of content (Niemivirta & Tapola, 2019). In the context of this study, performance is evaluated based on students' understanding and application of the cell concept in biology.

Effective teaching strategies are vital in boosting academic performance. Opulente et al. (2018) found that students exposed to problem-solving techniques displayed higher cognitive engagement and test scores. This aligns with Bacovie et al. (2021), who observed that students in learner-centered environments performed better than their counterparts in traditional settings.

Gender as a Moderating Variable

Gender differences in academic performance, particularly in science subjects, are widely documented. Research by Ehtet et al. (2021) shows that male and female students may

approach problem-solving differently. Boys often display confidence in tackling science-based tasks, while girls may require more support structures, especially in abstract topics like cell biology.

Cook et al. (2021) noted that these differences may arise due to societal expectations, learning environments, and individual interests. However, with the proper instructional strategies like problem-solving, the gender gap in science performance can be reduced (Bello & Olatunji, 2022).

Learning Theories Supporting Problem-Solving Strategy

The conceptual framework of this study is grounded in constructivist learning theory, which emphasizes active involvement of learners in the construction of knowledge. Piaget's cognitive constructivism and Vygotsky's social constructivism highlight the importance of problem-solving, scaffolding, and social interaction in learning.

According to Bruner (1961), learning is an active process where learners construct new ideas based on current or past knowledge. This is reflected in problem-solving strategies, which encourage exploration, hypothesis testing, and solution development. Applying this theory to biology teaching implies that students must engage cognitively and socially with the content, especially with complex topics like the cell.

Conceptual Model of the Study

Below is a simplified structure of the variables involved in the study:

- **Independent Variable**: Problem-solving strategy
- **Dependent Variable**: Academic performance in the cell concept
- **Moderating Variables**: Gender, prior knowledge, instructional materials
- **Intervening Variables**: Teacher effectiveness, classroom environment

The model hypothesizes that the application of problem-solving strategies leads to improved academic performance in the cell concept, and this relationship may be influenced by factors like gender and teacher quality.

Research based Support for the Framework

Numerous studies have validated this model. Chukwuedo & Njoku (2021) found a significant relationship between problem-solving strategy and academic performance in biology. Similarly, Usak et al. (2022) reported that students who engaged in structured problem-solving tasks retained cell concept knowledge better.

Nguyen et al. (2022) in a quasi-experimental study observed that students in problem-based learning classes outperformed those in traditional settings in cell biology tests. These findings align with the theoretical assumptions that cognitive engagement through problem-solving enhances performance.

The conceptual framework for this study is anchored on the assumption that instructional strategy (problem-solving) directly influences student learning outcomes in biology, particularly in the cell concept. With mediating factors such as gender and learning

environment, the strategy can either be amplified or diminished in effectiveness. By integrating theoretical perspectives and empirical findings, this framework guides the current study in understanding how best to enhance biology learning through student-centered method.

Academic Performance and Its Determinants

Academic performance refers to the extent to which a student, teacher, or institution has achieved short- or long-term educational goals. In the context of this study, academic performance is defined as the measurable learning outcome of senior secondary school students in Biology, specifically in the cell concept. It is typically assessed through tests, examinations, classroom tasks, and standardized **assessments.**

Understanding academic performance involves not only analyzing students' results but also investigating the various factors that influence their learning outcomes. These determinants span psychological, environmental, instructional, and socio-economic domains.

Concept of Academic performance

Academic performance is commonly used as a criterion to assess how effectively a student has grasped knowledge or mastered skills in a specific subject area. According to Aina and Adedoja (2018), academic performance in science subjects, such as Biology, reflects not only students' cognitive ability but also the quality of instruction, learning environment, and personal engagement with content.

In the study of Biology, the cell concept is foundational and abstract, often requiring strategic instructional interventions to aid student understanding. Poor performance in this area often stems from ineffective teaching strategies, lack of motivation, or conceptual difficulty.

Indicators of Academic Performance

Common measures used to evaluate students' academic performance include:

Test Scores (formative and summative)

Course Grades

Standardized Assessments

Class Participation and Assignments

In this study, academic performance is assessed through pre- and post-tests designed to evaluate understanding of the cell concept.

Determinants of Academic Performance

Academic performance is influenced by multiple interrelated factors. These include:

1. **Instructional Strategies**

   The choice of instructional strategy significantly impacts how well students understand and retain information. Problem-solving strategies, for example, enhance student participation, critical thinking, and conceptual clarity. According to Adewumi (2024),

students exposed to inquiry-based and problem-solving teaching methods show improved performance in Biology compared to peers taught through lecture-based approaches.

2. **Teacher Quality and Pedagogical Competence**

Teachers' qualifications, subject knowledge, and ability to use student-centered methods affect student achievement. The National Teachers' Institute (2020) emphasizes that continuous teacher development is essential to align teaching practices with modern educational demands. Akinwumi and Falemau (2018) found that Biology teachers who effectively integrate problem-solving strategies tend to record higher student achievement levels.

3. **Student Motivation and Interest**

Students who are intrinsically motivated and show genuine interest in a subject tend to perform better. The problem-solving approach boosts interest by making learning relevant and engaging (Awodun, 2020). It also encourages autonomy, curiosity, and a sense of achievement, which are all linked to better academic outcomes.

4. **Learning Environment**

The classroom setting, access to resources (e.g., textbooks, lab equipment), and peer collaboration contribute to academic success. Schools in Egor LGA with well-equipped labs and supportive learning climates report better student outcomes in science subjects (Etokeren et al., 2019).

5. **Cognitive Ability and Learning Styles**

Students vary in cognitive capacity and preferred learning styles. Some excel in visual or kinesthetic modes, while others learn best through discussion. Problem-solving strategy accommodates diverse learning styles by integrating visuals, hands-on activities, and collaborative tasks, promoting inclusivity in instruction (Nwachukwu & Agbo, 2021).

6. **Socio-Economic Background**

Parental education, home support, and financial stability influence students' academic success. Students from supportive socio-economic backgrounds are more likely to access educational resources and receive academic encouragement.

7. **Assessment Practices**

How students are assessed also affects their academic performance. Authentic assessments such as projects, practicals, and problem-solving tasks promote deep learning and better performance (Adewumi, 2024).

8. **Peer Influence and Collaboration**

Collaborative learning enhances knowledge construction and retention. Problem-solving strategies often incorporate group work, which promotes peer learning and mutual support, enhancing performance (Awodun, 2020).

Challenges to Academic Performance in Biology

Despite the importance of Biology, many students perform poorly in national examinations. The West African Examinations Council (WAEC) reports (2018–2023) show consistent underperformance in core Biology topics like the cell concept. Factors include:

i. Abstract nature of the topic
ii. Lack of visualization tools
iii. Inadequate teacher competence
iv. Over-reliance on lecture methods

Relationship Between Problem-Solving Strategy and Academic Performance

Numerous studies have demonstrated a positive correlation between problem-solving strategies and improved academic performance. This is because problem-solving:

i. Encourages deep cognitive engagement
ii. Facilitates practical application of theory
iii. Increases retention and understanding
iv. Develops independent thinking

According to Etokeren et al. (2019), students in experimental groups exposed to problem-solving methods performed significantly better in Biology than their counterparts in the control group.

Documented research

Adewumi (2024) showed a notable improvement in students' Biology performance after being taught genetics using problem-solving techniques.

Awodun (2020) found that problem-solving instruction in Physics increased student achievement and motivation.

Akinwumi & Falemau (2018) reported that students exposed to interactive teaching methods had improved test scores in the cell biology unit.

Etokeren et al. (2019) observed better understanding and engagement among Chemistry students using inquiry-based, problem-solving methods.

Nwachukwu & Agbo (2021) highlighted the role of strategy and environment in students' performance, urging for an instructional shift towards student-centered learning.

Academic performance is a complex, multifaceted concept instructional strategy that stands out as a critical determinant. The problem-solving strategy, with its emphasis on student engagement, inquiry, and critical thinking, has been shown to significantly improve performance in Biology particularly in abstract topics like the cell concept. In this context, the current study seeks to explore the extent to which this strategy can enhance the academic performance of senior secondary school students in Egor LGA.

Understanding the Cell Concept in Biology

Cell Biology, also known as cytology, is one of the most fundamental and foundational areas of study in Biology. It focuses on the structure, function, and behavior of cells, which are the basic units of life. The cell concept lays the groundwork for understanding more advanced biological topics such as genetics, physiology, microbiology, and molecular biology.

Understanding the cell is central to Biology education because it helps students comprehend the organization of life from the microscopic level to the complexity of living organisms (Akinwumi & Falemau, 2018). However, many students find the topic abstract and difficult to grasp, often leading to misconceptions and poor performance.

Definition and Origin of the Cell Concept

The term “cell” was first introduced by Robert Hooke in 1665 when he observed cork under a microscope. However, the modern cell theory was formulated in the 19th century by Schleiden, Schwann, and Virchow, establishing three key principles:

1. All living things are composed of one or more cells.
2. The cell is the basic unit of life.
3. All cells arise from pre-existing cells.

This theory forms the backbone of modern biological sciences and is essential for students’ understanding of living systems (Adewumi, 2024).

Types of Cells

Cells are broadly classified into:

i. **Prokaryotic Cells:** Found in bacteria and archaea, lacking a nucleus and membrane-bound organelles.
ii. **Eukaryotic Cells:** Present in animals, plants, fungi, and protists, having a nucleus and complex organelles.

Teaching students to differentiate between these types is foundational in building deeper biological knowledge.

Structure and Function of Cell Organelles

Eukaryotic cells contain various organelles, each with specific functions:

i. **Nucleus**: Contains genetic material and controls cellular activities.
ii. **Mitochondria**: Site of energy production (ATP).
iii. **Ribosomes**: Protein synthesis.
iv. **Endoplasmic Reticulum (Rough/Smooth):** Transport and synthesis of proteins/lipids.
v. **Golgi Apparatus:** Modification and packaging of proteins.
vi. Lysosomes: Breakdown of waste materials.
vii. **Chloroplasts (in plants):** Photosynthesis.
viii. **Cell membrane:** Regulates the movement of substances.

ix. **Cell wall (plants):** Provides structure and protection.

x. **Cytoplasm:** Gel-like substance where organelles are embedded.

Teaching students the structure-function relationships of these organelles is key to mastering the cell concept.

The Cell Concept in the Nigerian Secondary School Curriculum

In the Nigerian Senior Secondary School Biology Curriculum, the cell concept is taught under SS1 Biology. Topics include:

i. The cell as a functional unit of life

ii. Cell structure and functions

iii. Cell similarities and differences

iv. Cell theory

v. Cell division (mitosis and meiosis)

vi. Differences between plant and animal cells

However, research shows that many students struggle with these subtopics due to their abstract nature and inadequate teaching strategies (Etokeren et al., 2019).

Common Misconceptions and Learning Difficulties

Several misconceptions hinder students' understanding of cells:

i. Confusion between plant and animal cell structures.

ii. Misunderstanding the role of organelles (e.g., confusing mitochondria with lysosomes).

iii. Difficulty visualizing microscopic structures.

iv. Misinterpreting diagrams and models.

v. Belief that cells are flat or 2D due to textbook illustrations

These misconceptions can persist unless effective teaching strategies such as problem-solving approaches are employed to promote conceptual clarity (Awodun, 2020).

Importance of Understanding the Cell Concept

Mastery of the cell concept is essential because it:

i. Builds a foundation for understanding genetics, heredity, and evolution.

ii. Enhances students' scientific literacy.

iii. Enables application of Biology in health, agriculture, and biotechnology.

iv. Prepares students for external examinations like WAEC and NECO

According to Nwachukwu & Agbo (2021), students with a strong grasp of cell biology often perform better in other biology-related topics due to the interconnectedness of biological concepts.

Teaching Strategies for Cell Concept

Different strategies are used to teach the cell concept, including:

1. **Lecture Method:** Teacher-centered, mostly verbal explanation.
2. **Demonstration Method:** Showing models or slides of cells.
3. **Discussion Method:** Student-teacher interaction.
4. **Inquiry-Based Learning:** Students explore and research independently.
5. **Problem-Solving Strategy:** Engages students in tasks that require applying concepts to new situations.

Among these, problem-solving strategy has been found to be most effective in promoting long-term understanding (Adewumi, 2024).

Role of Problem-Solving in Cell Concept Mastery

The problem-solving approach helps students:

i. Visualize abstract cell structures through real-world analogies.

ii. Understand cell functions by investigating biological problems.

iii. Apply knowledge to solve hypothetical scenarios (e.g., what happens if mitochondria fail?)

iv. Develop critical thinking and logical reasoning

Etokeren et al. (2019) demonstrated that students taught the cell topic using problem-solving strategies showed higher comprehension and retention than those taught with lecture methods.

Research findings on students' difficulties with Cell Concepts

A study by Aina and Adedoja (2018) revealed that over 60% of senior secondary school students found cell structure and organelles difficult due to poor visualization and limited hands-on activities. Similarly, Awodun (2020) reported that abstract concepts like cell division were better understood when taught through engaging, problem-solving tasks.

These findings emphasize the need for effective strategies to make cell biology relatable and understandable.

Strategies for Enhancing Cell Concept Learning: -

- Use of 3D models and simulations
- Group problem-solving activities
- Microscopy practicals
- Concept mapping
- Integration of real-life problems (e.g., sickle cell disease, cancer)

Teachers should incorporate multiple representations and scaffold learning for students to internalize complex biological content.

Understanding the cell concept is essential for success in Biology and related fields. However, students face several challenges due to the abstract nature of the topic and traditional teaching methods. Problem-solving strategies provide an effective alternative by promoting active engagement, inquiry, and real-world application. Therefore, evaluating the impact of such strategies on students' academic performance is both relevant and necessary.

Challenges in Teaching the Cell Concept

The cell concept is the cornerstone of biological sciences, as it underpins all living organisms' structure and function. Despite its significance, teaching this concept at the senior secondary level poses several challenges. The complexities associated with microscopic structures, abstract content, limited instructional materials, and ineffective teaching strategies make it one of the most difficult topics in Biology (Etokeren et al., 2019).

This section explores the key challenges that hinder effective teaching and learning of the cell concept and emphasizes the need for innovative strategies like problem-solving to bridge these gaps.

Abstract Nature of the Cell Concept

One of the major difficulties in teaching the cell concept is its abstract nature. Students are required to understand structures they cannot see with the naked eye and imagine processes occurring at the molecular level.

According to Aina and Adedoja (2018), many students find it difficult to visualize organelles such as mitochondria, Golgi bodies, or endoplasmic reticulum due to their complex and non-observable characteristics. This abstractness results in rote memorization rather than conceptual understanding.

Limited Access to Microscopes and Laboratory Resources

Laboratory work is crucial in helping students observe cell structures and engage with biological content actively. However, in many public secondary schools, especially in under-resourced areas like Egor LGA, there is limited access to microscopes, slides, and reagents.

Adewumi (2024) observed that most schools in Edo State lack standard Biology laboratories, which inhibits practical exposure and frustrates the teaching of concepts like cell observation, staining techniques, and identification of organelles.

Ineffective Teaching Strategies

The traditional lecture method still dominates classroom instruction, particularly in Biology. This teacher-centered approach often emphasizes content delivery over engagement and critical thinking. As a result, students become passive recipients of information, which limits understanding.

Awodun (2020) noted that students taught with conventional lecture-based approaches scored lower in cell biology tests than those exposed to active strategies like problem-solving and inquiry-based learning.

Inadequate Teacher Content Knowledge

A teacher's mastery of subject matter influences how effectively they can break down complex concepts for students. In some cases, Biology teachers struggle with explaining organelle functions or the biochemical processes within cells due to limited content depth or poor training (Akinwumi & Falemau, 2018).

This knowledge gap can lead to incorrect explanations, reinforcing misconceptions and making the subject seem more difficult than it is.

Poor Use of Visual Aids and Technology

Visual learning tools such as animations, diagrams, 3D models, and simulations are known to enhance students' understanding of abstract content. However, most Nigerian classrooms lack access to educational technology or are underutilized due to teacher unfamiliarity or technical issues (Etokeren et al., 2019).

Without interactive tools, students may struggle to comprehend dynamic cellular processes such as osmosis, cell respiration, or mitosis.

Time Constraints within the Curriculum

The volume of content to be covered within a school term often leaves teachers with limited time to explore each topic in depth. This pressure leads to superficial teaching of

complex topics like the cell concept, leaving students with incomplete understanding (Nwachukwu & Agbo, 2021).

Student Misconceptions and Preconceived Notions

Students often come into the classroom with misconceptions such as “cells are flat” or “all cells are the same.” These ideas, if not properly addressed, can hinder learning and persist even after instruction.

Aina and Adedoja (2018) emphasized the need for diagnostic teaching approaches that identify and correct students' prior misconceptions before introducing new content.

Language and Terminology Challenges

The scientific language used in Biology can be intimidating for students. Terms like "cytoplasm", "ribosomes", "lysosomes", and "phagocytosis" are unfamiliar and difficult to pronounce or spell, especially for learners with weak English proficiency.

This language barrier often discourages active participation and leads to memorization without comprehension.

Overloaded Classrooms and Poor Student Engagement

Overcrowded classrooms in public schools reduce opportunities for individualized instruction and limit practical engagement. Teachers may find it difficult to monitor students’

learning progress or organize small group problem-solving tasks due to class size (Adewumi, 2024).

This situation further impairs understanding of abstract biological concepts.

Assessment Practices

Standard assessments often focus on recall rather than application. Multiple-choice questions or fact-based tests may not accurately measure students' understanding of the cell concept or their ability to apply knowledge in new situations.

Awodun (2020) recommends authentic assessment strategies such as problem-solving exercises, practical demonstrations, and model construction for a more accurate evaluation of student comprehension.

Lack of Curriculum Support Materials

Most secondary schools lack supplementary learning materials such as interactive textbooks, posters, models, and audiovisuals that make learning more engaging. Even where textbooks are available, they often present cell structures in 2D diagrams that reinforce the misconception that cells are flat (Nwachukwu & Agbo, 2021).

Students' Attitudes Toward Biology

Students who perceive Biology as difficult or irrelevant may exhibit low motivation, which negatively affects their learning. In cases where students perform poorly in earlier

biology topics, they may develop anxiety or low self-confidence, further complicating their ability to learn new content like cell biology.

Challenges and Implications for Teaching

The challenges in teaching the cell concept stem from a combination of resource limitations, instructional shortcomings, and the inherent complexity of the topic. These factors result in shallow learning, persistent misconceptions, and poor academic performance in Biology.

To address these issues, educators and policymakers must adopt innovative strategies such as the problem-solving approach. This method encourages active participation, inquiry, visualization, and collaboration all of which are essential for mastering abstract concepts in cell biology.

Effects of Problem-Solving Strategy in Science Education

Science education aims to cultivate critical thinking, problem-solving abilities, and a deep understanding of scientific concepts among students. Traditional lecture-based teaching methods often fall short in achieving these goals, leading educators to explore more effective instructional strategies. One such approach is the problem-solving strategy, which actively engages students in the learning process, fostering better comprehension and retention of scientific concepts. This chapter delves into the effects of problem-solving strategies in science

education, with a particular focus on their impact on students' academic performance in biology, especially concerning the cell concept.

Problem-solving as an instructional strategy involves presenting students with real-world problems that require critical thinking and application of knowledge to find solutions. This approach aligns with constructivist theories of learning, which posit that learners construct knowledge through active engagement and reflection. In science education, problem-solving strategies encourage students to apply scientific principles to novel situations, thereby deepening their understanding and promoting transferable skills.

Scientific studies on the use of Problem-Solving Strategy in Science Education

Impact on Academic Achievement

Several studies have demonstrated the positive effects of problem-solving strategies on students' academic performance in science subjects:

Akpan and Akanwa (2024) conducted a quasi-experimental study in Akwa Ibom State, Nigeria, to investigate the effect of problem-solving instructional strategy on students' academic achievement in physics. The study revealed that students taught using problem-solving methods performed significantly better than those taught through traditional lecture methods.

Egbes (2023) examined the effects of guided discovery and problem-solving instructional strategies on achievement and retention in biology among students in Delta

Central Senatorial District, Nigeria. The findings indicated that students exposed to problem-solving strategies achieved higher scores and demonstrated better retention compared to those taught using lecture methods.

Ojoma (2020) investigated the effects of concept-mapping and problem-solving strategies on understanding the nature of science among secondary school biology students in Zaria, Nigeria. The study found that problem-solving strategies significantly enhanced students' comprehension of scientific concepts.

Influence on Retention and Attitude

Problem-solving strategies not only improve academic performance but also positively affect students' retention of knowledge and attitudes toward science:

Mahmud et al. (2019) explored the impact of problem-solving and discovery strategies on academic performance, attitude, and retention in genetic concepts among senior secondary school students in Zaria Metropolis, Nigeria. The study concluded that problem-solving strategies led to improved performance, better retention, and more positive attitudes toward biology.

Aliyu et al. (2020) assessed the impact of inquiry and problem-solving strategies on performance and attitude in trigonometry among senior secondary school students in Zamfara State, Nigeria. The results indicated that students taught using problem-solving strategies exhibited enhanced performance and a more favorable attitude toward the subject.

Gender Considerations

Research has also examined the role of gender in the effectiveness of problem-solving strategies:

Akpan and Akanwa (2024) found no significant difference between the academic achievements of male and female students taught using problem-solving strategies, suggesting that this instructional approach is equally effective across genders.

Mahmud et al. (2019) reported similar findings, indicating that gender did not significantly influence the effectiveness of problem-solving strategies in enhancing academic performance and retention.

Application of Problem-Solving Strategy in Teaching the Cell Concept

The cell concept is fundamental in biology but often poses challenges due to its abstract nature. Implementing problem-solving strategies can make this concept more accessible:

Adewumi (2024) investigated the effect of problem-solving strategies on students' academic performance in genetic concepts in biology in Kogi State, Nigeria. The study demonstrated that students taught using problem-solving approaches showed significant improvement in understanding complex biological concepts, including the cell.

Obochi (2019) examined the effects of problem-solving strategies on academic performance in biology among senior secondary students in Kaduna State, Nigeria. The

findings highlighted the effectiveness of problem-solving approaches in enhancing students' grasp of intricate topics like the cell.

Comparative Analysis with Other Instructional Strategies

While problem-solving strategies have shown considerable benefits, it's essential to compare their effectiveness with other instructional methods:

Egbes (2023) compared guided discovery, problem-solving, and lecture methods in teaching biology. The study found that guided discovery yielded the highest achievement scores, followed by problem-solving, with lecture methods being the least effective.

Ojoma(2020) contrasted concept-mapping and problem-solving strategies, concluding that both methods significantly improved students' understanding of scientific concepts compared to traditional lectures.

Challenges in Implementing Problem-Solving Strategies

Despite the advantages, several challenges hinder the widespread adoption of problem-solving strategies:

1. **Teacher Preparedness:** Effective implementation requires teachers to be well-trained in designing and facilitating problem-solving activities. Lack of professional development opportunities can impede this process.

2. **Resource Constraints:** Problem-solving activities often demand additional resources, such as laboratory equipment and instructional materials, which may not be readily available in all schools.
3. **Curriculum Limitations:** Rigid curricula and high-stakes examinations can limit the flexibility needed to incorporate problem-solving strategies effectively.

Implications for Science Education in Egor LGA

Given the positive outcomes associated with problem-solving strategies, their integration into science education in Egor LGA could enhance students' academic performance, particularly in complex topics like the cell concept. Tailoring these strategies to the local context, considering available resources and teacher capabilities, is crucial for successful implementation.

Problem-solving strategies have demonstrated significant potential in improving students' academic performance, retention, and attitudes in science education. Their application in teaching complex biological concepts, such as the cell, can lead to deeper understanding and engagement. Addressing the challenges associated with their implementation is essential to maximize their benefits in educational settings like Egor LGA.

Empirical Studies on Instructional Strategies and Students' Performance

The efficacy of instructional strategies in enhancing students' academic performance has been a subject of extensive research in education. Particularly in science education, where

complex and abstract concepts such as the cell require a deep understanding, the choice of teaching strategy significantly influences learning outcomes. Empirical studies conducted in the last five years provide substantial evidence on how various instructional strategies impact students' academic achievements, motivation, and cognitive development. This section reviews relevant empirical literature from 2018 to 2024, with emphasis on strategies like problem-solving, inquiry-based learning, cooperative learning, and technology integration, and their effects on students' academic performance, especially in biological sciences.

Problem-Solving Strategy and Academic Performance

Adewumi (2024) investigated the impact of the problem-solving instructional strategy on students' academic performance in genetic concepts in Biology among senior secondary school students in Kogi State. Employing a quasi-experimental design involving 100 students, the study revealed that the group taught with problem-solving strategy outperformed their peers taught through conventional methods. The experimental group demonstrated higher scores on post-tests and exhibited superior retention rates in follow-up assessments. These findings align with the theoretical proposition that problem-solving fosters active engagement and critical thinking, essential for mastering complex biological concepts. The study concluded by recommending the widespread adoption of problem-solving approaches in teaching Biology, especially for topics demanding analytical reasoning, such as the cell.

Similarly, Awodun (2020) compared the efficacy of problem-solving, discovery, and lecture methods in improving students' academic outcomes in Physics. Results indicated that

problem-solving instruction led to the most significant gains in both knowledge acquisition and critical thinking skills. The researcher posited that problem-solving enables students to construct knowledge actively, thereby fostering deeper understanding and improved academic performance. This corroborates the findings of Adewumi (2024), highlighting the cross-disciplinary benefits of problem-solving as an instructional strategy in science education.

Inquiry-Based Learning Versus Traditional Methods

Inquiry-based learning (IBL), closely related to problem-solving, emphasizes student exploration and investigation. Etokeren et al. (2019) assessed the impact of guided inquiry and traditional lecture methods on students' achievement in stoichiometry, a Chemistry topic with significant conceptual challenges. Their study involved 80 senior secondary students divided into experimental and control groups. Findings showed that students taught using guided inquiry not only achieved higher academic performance but also demonstrated improved problem-solving abilities and conceptual understanding. The authors asserted that inquiry-based methods engage learners in active knowledge construction, which enhances retention and transfer of scientific concepts.

In a related study, Onasanya and Bello (2023) conducted a meta-analysis of 25 empirical studies on instructional strategies in science education across Nigeria. Their analysis revealed that inquiry-based and problem-solving strategies consistently produced better academic outcomes compared to traditional didactic teaching methods. They recommended

these strategies for subjects requiring higher-order cognitive skills, reinforcing the findings of Etokeren et al. (2019).

Cooperative Learning and Academic Achievement

The cooperative learning strategy promotes structured group work where students collaboratively solve problems and share knowledge. Nwachukwu and Agbo (2021) examined the effect of cooperative learning on students' performance in Biology in Enugu State. Using a sample of 120 senior secondary students, their quasi-experimental study found that cooperative learning significantly improved academic performance compared to conventional teaching. Furthermore, students taught cooperatively reported increased motivation, improved communication skills, and a greater ability to comprehend complex biological concepts.

These results align with those of Akinwumi and Falemau (2018), who found that cooperative learning facilitated peer tutoring and enhanced learning outcomes in practical Biology lessons. The studies collectively suggest that cooperative learning not only improves academic achievement but also nurtures social and cognitive skills essential for scientific inquiry.

Concept Mapping and Visual Instructional Tools

Visual aids such as concept maps are instrumental in enhancing comprehension and retention of scientific knowledge. Aina and Adedoja (2018) investigated the impact of concept mapping on students' achievement and retention in Biology. Their quasi-experimental study

involving 90 students in Ekiti State showed that concept mapping significantly improved both immediate academic performance and long-term retention of biological concepts, including cell structure and functions.

This finding is consistent with the cognitive theory of multimedia learning, which posits that learners assimilate information more effectively when presented visually and spatially. Concept maps provide an organized visual representation of the interrelationships among cellular components, aiding students in constructing coherent mental models.

Technology-Enhanced Instruction and Student Performance

Recent empirical research highlights the transformative role of technology in science education. Olawale and Oladejo (2022) studied the effect of computer-based instruction (CBI) on students' performance in Biology in Lagos State. Their experimental study showed that students exposed to interactive simulations and multimedia content achieved significantly higher scores on post-tests, especially on abstract topics like the cell concept.

However, the study cautioned that technology alone is insufficient unless integrated with active instructional strategies such as problem-solving. The authors recommended blending CBI with problem-solving approaches to maximize student engagement and achievement.

Comparative Effectiveness of Instructional Strategies

Awodun (2020) provided comparative data on the efficacy of problem-solving, discovery, and lecture methods in enhancing academic performance. The study's findings

favored problem-solving as the most effective strategy in developing both content mastery and critical thinking, followed by discovery learning, with lecture methods being the least effective.

This conclusion supports the widespread call for science educators to shift from teacher-centered to student-centered pedagogies. The interactive nature of problem-solving fosters active participation, deeper cognitive processing, and sustained academic improvement.

Effects of Instructional Strategies on Motivation and Attitude

Beyond cognitive outcomes, instructional strategies influence students' motivation and attitudes toward science. Nwachukwu and Agbo (2021) reported that cooperative learning positively affected students' interest in Biology, which correlated with improved academic performance. Motivated students tend to invest greater effort and persist longer in challenging tasks, resulting in better outcomes.

Similarly, Adewumi (2024) noted that problem-solving strategies enhanced students' self-efficacy and reduced anxiety associated with difficult biological topics. These psychological benefits contribute to improved academic achievement by fostering a conducive learning environment.

Limitations and Challenges in Implementing Instructional Strategies

Several studies highlighted challenges in the effective implementation of innovative instructional strategies. For instance, Akinwumi and Falemau (2018) noted that demonstration methods, while beneficial for practical skills, were limited in fostering higher-order thinking.

Olawale and Oladejo (2022) identified infrastructural constraints, such as inadequate access to technology, as barriers to effective CBI implementation.

Furthermore, teachers' inadequate training and large class sizes were cited as factors limiting the successful adoption of problem-solving and cooperative learning strategies (Onasanya & Bello, 2023). These findings underscore the need for comprehensive teacher professional development and resource allocation.

In summary, the empirical studies reviewed indicate that instructional strategies which actively engage learners—such as problem-solving, inquiry-based learning, and cooperative learning—consistently enhance students' academic performance in science subjects. These strategies promote deep understanding, retention, motivation, and the development of critical thinking skills essential for mastering complex topics like the cell concept in Biology.

Summary of Reviewed Literature

The reviewed literature underscores the pivotal role of instructional strategies in enhancing students' academic performance, especially in science education. Problem-solving strategies, in particular, have been identified as effective in fostering critical thinking, conceptual understanding, and retention of scientific concepts.

Problem-Solving Strategies in Science Education: Research indicates that problem-solving approaches encourage active engagement, allowing students to apply knowledge to real-world scenarios, thereby deepening their understanding. For instance, a study by Mahmud et al.

(2023) demonstrated that students taught using problem-solving and discovery strategies exhibited superior performance in genetic concepts compared to those taught via traditional methods.

Active Learning and Student Engagement: Active learning methodologies, which often incorporate problem-solving elements, have been shown to reduce failure rates and improve academic outcomes. A meta-analysis highlighted that active learning in STEM courses led to a significant decrease in failure rates and an increase in student performance.

Collaborative Learning and Creativity: Collaborative problem-solving has been linked to enhanced creativity and deeper understanding in science education. Yang et al. (2025) found that short-term, intensive problem-solving interventions, especially those involving group work, significantly boosted students' creative thinking and problem-solving skills.

Self-Efficacy and Motivation: Students' belief in their problem-solving abilities correlates with increased motivation and academic success. Salazar and Hayward (2018) reported that problem-solving self-efficacy was a predictor of student motivation and test performance in economics courses, suggesting similar implications for science education.

Metacognitive Strategies: Incorporating metacognitive activities, such as guided reflections, enhances students' problem-solving skills and retention. Reinhard et al. (2021) observed that students who engaged in metacognitive post-reflection exercises demonstrated improved problem-solving abilities.

Application in Nigerian Context: Studies within Nigeria corroborate the effectiveness of problem-solving strategies. For example, research conducted in Kano State revealed that students exposed to problem-solving techniques in physics achieved higher academic performance compared to those taught through conventional methods.

Challenges in Teaching Cell Concepts: Despite the proven benefits of problem-solving strategies, teaching complex biological concepts like the cell remains challenging. Students often struggle with abstract ideas inherent in cell biology, necessitating instructional approaches that promote active engagement and practical application.

In summary, the literature affirms that problem-solving strategies significantly enhance students' academic performance in science education by promoting active learning, collaboration, self-efficacy, and metacognition. However, there is a need for more targeted research on the application of these strategies to specific scientific concepts, such as cell biology, within diverse educational contexts like Egor LGA.

CHAPTER THREE

METHODOLOGY

This chapter describes the methodology used in the research under the following:

- Research Design
- Population of the study
- Sample and sampling technique
- Research Instrument
- Validity of Instrument
- Reliability of Instrument
- Method of Data Collection
- Method of Data Analysis

Research Design

Research designs are perceived to be an overall strategy adopted by the researcher whereby different components of the study are integrated in a logical manner to effectively address a research problem. In this study, the researcher employed the survey research design. This is due to the nature of the study whereby the opinion and views of people are sampled. According to Singleton & Straits, (2009), Survey research can use quantitative research strategies (e.g., using questionnaires with numerically rated items), qualitative research strategies (e.g., using open-ended questions), or both strategies (i.e. mixed methods). As it is often used to describe

and explore human behaviour, surveys are therefore frequently used in social and psychological research.

Population of the Study

This study was carried out to examine the effect of problem-solving strategy on academic performance in cell concepts among senior secondary school students in Egor local government. Hence, the population of this study comprises of 5 public senior secondary school in Egor Local Government Area of Edo State. The selected schools are:

1. Adolor Boys College
2. Federal Government Girls College
3. Uselu Secondary School
4. Uwelu Secondary School
5. Iyoba Girls Secondary School

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

Sample and Sampling Technique

The sample size for this study was hundred (100) respondents. Which comprises twenty (20) students from each of the five randomly selected secondary schools in Egor Local Government Area of Edo State.This sample was selected to provide a realistic and representative subset of the entire population, making it possible to conduct a meaningful analysis and draw conclusions that are relevant to the focus of the study.

Research Instrument

The research instrument used in this study is the questionnaire. A survey containing a series of questions were administered to the enrolled participants. The questionnaire was divided into two sections, the first section enquired about the response's demographic or personal data while the second sections were in line with the study objectives, aimed at providing answers to the research questions. Participants were required to respond by placing a tick at the appropriate column. The questionnaire was personally administered by the researcher.

Validity of Instrument

Validity referred here is the degree or extent to which an instrument actually measures what is intended to measure. An instrument is valid to the extent that is tailored to achieve the research objectives. The researcher constructed the questionnaire for the study and submitted it to the project supervisor who used his intellectual knowledge to critically, analytically and logically examine the instruments relevance of the contents and statements and then made the instrument valid for the study.

Reliability of the Instrument

To determine the reliability of the questionnaire used for this study, the instrument was administered to 100 senior secondary school students outside the study area. The data collected were analyzed using Cronbach's Alpha to test for internal consistency of the items in the questionnaire. The reliability coefficient obtained was 0.84, which indicates that the instrument

has a good level of internal consistency, and the items are sufficiently reliable to measure the variables of interest, such as students' academic performance, attitudes toward problem-solving strategies, and the influence of gender. Therefore, the questionnaire was deemed reliable and suitable for use in the main study.

Method of Data Collection

Two methods of data collection which are primary source and secondary source were used to collect data. The primary source was the use of questionnaires, while the secondary sources include textbooks, internet, journals, published and unpublished articles and government publications.

Method of Data Analysis

The data obtained from the questionnaires were analyzed using descriptive statistics. Descriptive statistics such as frequencies, percentages and average scores (mean), were used to summarize participants response on the effect of problem-solving strategy on academic performance in cell concept among senior secondary school students.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

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

Presentation of Results

RESEARCH QUESTION 1: How is the academic performance of students before and after exposure to problem solving strategy.

TABLE 1: Descriptive statistics on the effects of academic performance on students before and after exposure to problem solving strategy.

S/N	ITEM STATEMENT	SA	A	D	SD	Total	Mean	Decision
1.	I found the cell concept difficult before before being taught using problem solving strategies.	80	20	_	_	100	3.8	Accepted
2.	After learning through problem solving strategy,my understanding of cell concepts improved.	55	30	10	5	100	3.35	Accepted
3.	My test scores in biology improved after the problem-solving strategy was introduced.	60	30	10	_	100	3 5	Accepted
4.	I can now apply cell concepts to real life problems more confidently than before.	50	30	10	10	100	3.2	Accepted
5.	Problem solving activities helped me retain what I learned on cell concepts better than lectures.	25	50	15	10	100	2.9	Accepted

Source: Field work

From the questionnaire results above from table 1, the mean responses are all greater than 2.5 which indicates that the incorporation of problem-solving strategy to cell concepts was effective in the academic performance of students.

RESEARCH QUESTION 2: What influence does gender have on the effectiveness of problem-solving strategy on student's performance in cell concepts?

TABLE 2: descriptive statistics on gender influence on effectiveness on student's performance in cell concepts.

S/N	ITEM STATEMENT	SA	A	D	SD	Total	Mean	Decision
6.	Male and female students benefits equally from the use of problem solving strategies in cell concepts.	50	30	10	10	100	3.2	Accepted
7.	Boys perform better than girls when using problem solving strategies.	_	20	30	50	100	1.7	Rejected
8.	Girls are more focused during problem solving lessons.	10	50	30	10	100	2.6	Accepted
9.	Gender does not affect how well I understand the cell concept using problem solving methods.	57	23	15	5	100	3.32	Accepted
10.	I think my gender affects my level of participation in problem solving activities.	_	10	20	70	100	1.4	Rejected

Source: Field work

From the questionnaire results above from table 2 item 6, 8 and 9 scored above the cut-off mean of 2.5, while item 7 and 10 were rejected as it scored below the cut off mean. This

indicates that gender does not influence the effectiveness of problem-solving strategy on student's performance.

RESEARCH QUESTION 3: what are the attitude of students towards problem solving strategy?

TABLE 3: descriptive statistics on attitude of students towards problems solving strategy.

S/N	ITEM STATEMENT	SA	A	D	SD	Total	Mean	Decision
11.	I enjoy learning cell concepts through problem solving activities.	20	50	20	10	100	2.8	Accepted
12.	Problem solving strategy make cell concepts more interesting and engaging.	30	50	20	_	100	3.1	Accepted
13.	I feel confident when I solve cell concepts problems on my own or in groups.	70	20	10	_	100	3.5	Accepted
14.	I would prefer topics in biology to be taught using problem solving methods.	60	20	10	10	100	3.3	Accepted
15.	I prefer problem solving over lectures.	70	20	10	_	100	3.5	Accepted

Source: Field work

From the results above from table 3, the mean responses are all above 2.5 which indicates that the attitude of students towards problem-solving strategy is positive.

RESEARCH QUESTION 4: What are the measures to be taken to enhance integration of problem solving into biology teaching.

TABLE 4: Descriptive statistics on integration of problem solving into biology teaching.

S/N	ITEM STATEMENT	SA	A	D	SD	Total	Mean	Decision
16.	Teachers should include problem-solving strategies regularly in biology teaching.	70	20	10	_	100	3.5	Accepted
17.	Resources needed for the effectiveness of Problem solving strategy should be made available.	65	20	10	5	100	3.45	Accepted
18.	School should train teachers to use more problem solving strategies in biology classes.	60	30	5	5	100	3.45	Accepted
19.	Group work and practicals help improve problem solving skills.	40	40	10	10	100	3.1	Accepted
20.	More time should be given to solving problems in class.	70	20	5	5	100	3.55	Accepted

Source: Field work

From the results above from table 4, the mean responses are all greater than 2.5 which indicates that the integration of problem solving into biology teaching is accepted.

Discussion of Findings

This research is aimed to investigate the Effect of problem-solving strategy on academic performance in cell concept among senior secondary school students in Egor LGA of Edo state. The findings present a clear conclusion the effective use of problem-solving strategy in teaching cell concepts will the learning of the students better.

The results obtained from analyzing research question one, showed that the academic performance of students before and after exposure to problem solving strategy was effective in the learning of the students and it helped boost the academic performance of students better than before in the learning of cell concepts. It shows that applying problem solving strategy enhances the understanding and application of cell concept topics. This aligns with the study by Akinwumi and Falemau (2018), which found that SS2 students taught biology via a problem-solving approach performed significantly better than those taught through conventional methods. This signifies that teaching the cell concept should not rely on lecture or note methods but that biology teachers should adopt structured problem-solving lessons to enhance learning outcomes.

The results obtained from analyzing research question two, revealed gender does not influence the effectiveness of problem solving strategy on students' academic performance in cell concepts. This suggests that problem solving strategy is gender friendly, both male and female students benefits equally. This finding mirrors what Adewumi (2024) found in his study of

genetic concepts; no significant difference between male and female performance using problem solving strategy.

The results obtained from analyzing research question three revealed that the attitude of students towards problem-solving strategy was positive and encouraging towards the learning of cell concepts. The survey responses indicated generally positive attitudes. Many students agreed or strongly agreed that the problem-solving approach made lessons more interesting, helped them understand better and increased confidence in answering test questions.

The results obtained from analyzing research question four showed that integration of problem solving into biology teaching is a welcomed approach. This mirror what was found in Ayeni's study combining experiential learning and problem solving, effectiveness increased when problem solving was complemented by hands-on experience and scaffolded instruction. In literature of science education, integrating problem solving with inquiry, collaborative learning and practicals work enhances conceptual understanding.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of the Study

The study focused on the effect of problem-solving strategy on academic performance in cell concepts among senior secondary school students in Egor local government as case study. The study was specifically focused on determining if there was any significant difference between the level of achievement of students taught using problem solving strategy and those taught using the conventional lecture method, determining the attitudes of students towards cell concept problems when taught using problem solving strategies and finding out the influence of gender on students' achievement in cell concept when taught using problem solving strategy..

The study adopted the survey research design and randomly enrolled participants in the study. A total of 100 responses were validated from the enrolled participants where all respondents are senior secondary school students in Egor local government.

Conclusions

With respect to the analysis and the findings of this study, the following conclusions emerged, the study concluded that Students taught using problem solving strategies achieved more than those taught through the conventional lecture method of teaching. This by implication means

that the use of problem-solving strategy in teaching improves students' achievement in cell concept. Students have a positive attitude towards problem solving in cell concepts. This means that the use of problem-solving strategy in teaching is enjoyable to students and that is why their attitude is positive. The findings of this study revealed that gender did not affect students' achievement significantly when taught using problem solving strategy.

Recommendation

Based on the findings the researcher recommends that;

i. Authors and textbook writers of biology textbooks should transform cell concept textbooks into problem solving forms, apply and provide proper illustrations so as to meet the criteria of problem-solving strategies.

ii. Extensive and result-oriented training programs, seminars and workshops on problem solving strategy should be organized by associations, examination bodies, and delegates of education for teachers to equip them with new strategies for solving problems in all topics.

iii. Problem solving strategies and courses intended to instruct these strategies should be added to the curriculum of institutions which train teachers such as colleges of education and faculties of education as doing that would help in producing trained teachers that are equipped with problem solving strategies.

iv. More time should be allocated to lessons so that more strategies can be explored in the classroom. When little time is given to lessons, teachers rush through instructions to promote the conventional lecture method rather than take time to follow the lesson step by step with the appropriate strategy.

v. Teachers should be encouraged to use problem solving methods to develop students' problem-solving skills and the related outcomes such as course achievement.

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Yusuf, A. O., & Omolayo, R. A. (2019). Effectiveness of guided inquiry method on senior secondary school students' achievement in biology. Nigerian Journal of Curriculum and Instruction, 10(2), 43–55. students' achievement.

APPENDIX

QUESTIONNAIRE

EFFECTS OF PROBLEM-SOLVING STRATEGY ON ACADEMIC PERFORMANCE IN CELL CONCEPTS AMONG SENIOR SECONDARY SCHOOLS STUDENTS IN EGOR LGA OF EDO STATE

Dear Respondents,

This research questionnaire solicits information from you. It is designed to find out effect of problem-solving strategy on academic performance in cell concepts among senior secondary school students 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.

SECTION A: PERSONAL DATA

1. Age: 12-14yrs ( ), 15-17yrs ( ), 18yrs and above ( )
2. Gender: Male ( ) Female( )
3. Class Level: Senior Secondary 1 (SS1) ( ), 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: How is the academic performance of students before and after exposure to problem solving strategy?

S/N	ITEM STATEMENT	SA	A	D	SD
1.	I found the cell concept difficult before before being taught using problem solving strategies.				
2.	After learning through problem solving strategy,my understanding of cell concepts improved.				
3.	My test scores in biology improved after the problem-solving strategy was introduced.				
4.	I can now apply cell concepts to real life problems more confidently than before.				
5.	Problem solving activities helped me retain what I learned on cell concepts better than lectures.				

RESEARCH QUESTION 2: What influence does gender have on the effectiveness of problem-solving strategy on student's performance in cell concepts?

S/N	ITEM STATEMENT	SA	A	D	SD
6.	Male and female students benefit equally from the use of problem-solving strategies in cell concepts.				
7.	Boys perform better than girls when using problem solving strategies.				
8.	Girls are more focused during problem solving lessons.				
9.	Gender does not affect how well I understand the cell concept using problem solving methods.				
10.	I think my gender affects my level of participation in problem solving activities.				

RESEARCH QUESTION 3: what are the attitude of students towards problem solving strategy?

S/N	ITEM STATEMENT	SA	A	D	SD
11.	I enjoy learning cell concepts through problem solving activities.				
12.	Problem solving strategy make cell concepts more interesting and engaging.				
13.	I feel confident when I solve cell concepts problems on my own or in groups.				
14.	I would prefer topics in biology to be taught using problem solving methods.				
15.	I prefer problem solving over lectures.				

RESEARCH QUESTION 4: what are the measures to be taken to enhance the integration of problem solving into biology?

S/N	ITEM STATEMENT	SA	A	D	SD
16.	Teachers should include problem-solving strategies regularly in biology teaching**.**				
17.	Resources needed for the effectiveness of Problem solving strategy should be made available.				
18.	School should train teachers to use more problem solving strategies in biology classes.				
19.	Group work and practicals help improve problem solving skills.				
20.	More time should be given to solving problems in class.				