THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY IN THE LEARNING OF CELL STRUCTURES AND FUNCTIONS IN BIOLOGY IN SECONDARY SCHOOLS IN OREDO LOCAL GOVERNMENT AREA IN EDO STATE

CHAPTER ONE

INTRODUCTION

Background of the Study

Computers are becoming increasingly important. High speed, large memory, dependability, less manual work, and faster information access are only a few of the qualities that have made computers popular in many spheres of human endeavor. Every day, people all around the world are mechanizing operations that were formerly completed by hand in offices, homes, and factories. The basis for the lightning-fast global transmission of information is the computer. A computer is a fast electrical gadget that can store, process, and retrieve data. When given instructions, usually via software applications, it may carry out a variety of functions. The term "information and communication technology" (ICT) describes how data is stored, processed, transmitted, and altered using computers, software, networks, and other electronic devices. It includes a broad range of tools and methods for managing and using data in a variety of settings, including communication, education, business, and entertainment. It covers the computer's hardware as well as its software. There has never been a greater use of computers in the classroom. It is clear that in order to meet the demands of any industry, people need to be proficient in information and communication technologies. Higher education institutions are responding by giving students access to computers and training in ICT capabilities.

Biology is a subject that is studied widely. Biology's inclusion in the curriculum may improve students' lives and the communities in which they live. The national education strategy, which

prioritizes preparing students for higher education as a main aim of secondary education, calls for the implementation of ICT for biology instruction in all senior secondary schools in developing countries like Nigeria.

A subfield of biology known as "cell biology" is concerned with the structure, behavior, and function of cells as well as how they interact with one another and their surroundings. The structural and functional unit of life is the cell in biology. The first biologist to discover cells was Robert Hooke. Every living thing is made up of cells. They might have one or many cells. The fundamental unit of all living things is the cell. The components of complex cells in an organism carry out a variety of tasks. Our bodies are made up of different sized and shaped cells. The smallest level of structure in all living forms is the cell. A cell's structure is made up of several parts, each of which plays a unique role in executing vital biological operations. The cytoplasm, nucleus, cell wall, cell membrane, and cell organelles are some of these elements. Numerous cellular organelles, each with a distinct purpose to carry out essential life activities, are found within cells. Each organelle is structurally unique. Complex relationships between unknown and abstract ideas are a part of biology. When it comes to cell architectures, students frequently struggle to understand biological concepts and attempt to acquire them by memorizing without really grasping them (Kilic & Salam, 2014). Images, animations, 3D models, and other visual aids can be used by computers to display information (Wang Q. 2017).

Problem Statement

One such tactic to improve students' comprehension and academic performance is the use of information and communication technology (ICT) in biology instruction, specifically in relation to cell structure and function. However, biology student performance is still a challenge in

several senior secondary schools in Edo State's Oredo local government region, even with the availability of ICC facilities. This repurposes issues of how ICT affects local senior high school students' understanding of cell structure and function in biology.

In particular, it is uncertain if using ICT improves students' comprehension, memory, and application of topics related to cell structure and function. The purpose of the study is to find out how information and communication technology affects biology classes in senior secondary schools in Edo State's Oredo local government region.

Purpose of the Study

The main purpose of the study is to evaluate the impact of Information and Communication Technology in the learning of Cell Structures and Functions in Biology in Senior Secondary School in Oredo local government area of Edo State.

Specifically for this study, the purposes are:

1. To determine the obstacles encountered by students when utilizing ICT for studying cell structures and functions in Biology.

2. Assessing the effectiveness of Information and Communication Technology (ICT) tools in enhancing students' understanding of cell structures and functions.

3. Exploring the role of ICT in promoting student engagement and interest in the study of cell biology.

4. Investigating how ICT integration impacts students' academic performance and retention of cell biology concepts.

5. Examining the implications of ICT-based learning approaches for curriculum development and teaching strategies in the senior secondary school biology education.

Research Questions

1. what difficulties do students encounter when utilizing ict for learning cell biology in secondary school?

2. What is the effect of ICT Integration of students understanding of cell structure and function in secondary schools?

3. What are the effects of ict-based learning approaches on students' academic performance and retention of cell biology concepts?

Significance of the study

The findings of this study will provide a guideline for biology educators, researchers, instructors, students, and professionals to determine the appropriate approach for integrating information and communication technology in learning about cell structures and functions.

Scope of the study

The study covered some selected secondary schools in Oredo LGA of Edo state; and it is limited to finding the impact of information and communication technology in the learning outcome of students on cell structures and functions in biology.

This research will examine how information and communication technology impact the learning process of cell structures and functions. The scope of the study includes examining the utilization of ICT tools specifically for learning about cell structures and functions in Biology within secondary school settings.

Definition of terms

Impact: Having a strong effect on something,

Information and communication technology (ICT): Used to handle information and aid communication

Cell: The smallest basic unit of life that is responsible for all life processes

Learning: Acquisition of knowledge or skills through study, experience or being taught.

Computer: A device the accept information and processes data.

Biology: A natural science discipline that studies living things.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter consists of a number of previous reviews that are relevant to the subject matter and primary goals of this research. It also includes the theoretical framework, which offers details on the learning objectives of the cell functions and structures that will be employed in the study. The following subheadings will be used to describe this:

The idea behind cell structures

A component of the cell structure

The roles that cell structure plays

The Information and Communication Technology Concept

Information and Communication Technology's Significance

Information and Communication Technology's Difficulties

The influence of information and communication technology on the study of biological cell structures and functions

An overview of relevant literature

The idea of cell structure

The fundamental structural and functional unit of life is a cell. It is an organism's smallest unit capable of performing all life-sustaining functions, including metabolism, reproduction, and stimulus response. Although cells might differ in size, structure, and function, they all have

three things in common: cytoplasm, genetic material (DNA or RNA), and a cell membrane. There are two primary types of cells: eukaryotic cells, which have a nucleus and membrane-bound organelles, and prokaryotic cells, which do not. Because of their intricate internal structure, cells are able to perform a variety of tasks that are essential to life. Important elements of cell structure consist of:

Cytoplasm: In eukaryotic cells, the gel-like material that fills the gap between the cell membrane and the nucleus is called cytoplasm. Water, salts, and organic molecules including proteins, carbohydrates, lipids, and nucleic acids make up the majority of it. Specialized structures known as organelles are suspended inside the cytoplasm. These organelles carry out particular tasks that are essential to the cell's survival and proper operation. The cytoskeleton, a network of protein filaments that supports structure, aids in maintaining cell shape, and promotes cell division and mobility, is also found in the cytoplasm.

The cell membrane

One essential part of every cell is the cell membrane, sometimes referred to as the plasma membrane. It shields and supports the cell. It regulates the flow of materials into and out of the cells. It divides the cell from the outside world. Proteins and other molecules are encased in a phospholipid bilayer, which makes up the majority of its composition. Each and every cell has a cell membrane. The exterior layer of a cell that encloses all other organelles, including the cytoplasm and nucleus, is called the cell membrane. Another name for it is the plasma membrane. It is a porous membrane by structure, meaning that some chemicals can enter and exit the cell through its pores. In addition, the cell membrane guards against leaking and harm to the cellular component. It creates the wall-like structure that separates a cell from its

environment and from two other cells. Because they are stationary, plants have well-adapted cell structures that shield them from the elements. This function is reinforced by the cell wall.

The nucleus

Eukaryotic cells have a membrane-bound organelle called the nucleus, which acts as the cell's command center. It has chromosomes, which are structures made up of DNA (deoxyribonucleic acid), the genetic substance of the cell. The nuclear envelope, a double membrane that envelops the nucleus, has holes that control the flow of chemicals between the nucleus and the cytoplasm. Among the nucleus's primary roles are:

Genetic material storage and protection: Chromosomes, the cell's genetic material, are found in the nucleus. The instructions needed to synthesize proteins and control biological functions are encoded in DNA. The nuclear envelope controls the DNA's accessibility to cellular machinery and aids in protecting it from harm.

Transcription: Enzymes known as RNA polymerases convert certain DNA sections into RNA (ribonucleic acid) inside the nucleus. This process, called transcription, is the initial stage of both protein synthesis and gene expression.

Ribosome Assembly: Ribosomal RNA (rRNA) is generated and joined with proteins to create ribosomal subunits in the nucleus, which is also the location of ribosome biogenesis. After being exported to the cytoplasm, these subunits come together to form useful ribosomes that are involved in the synthesis of proteins.

Cellular Reproduction: Two daughter nuclei are created as the nucleus goes through a sequence of processes during cell division, including DNA replication and chromosomal segregation.

Each daughter cell acquires a full complement of genetic information thanks to this process, which is known as mitosis.

The cell wall

The most noticeable component of the plant's cell structure is the cell wall. It is composed of pectin, cellulose, and hemicellulose. It can only be found in plant cells. It shields other parts of the cell, including the plasma membrane. The outermost layer of plant cells is called the cell wall. It encircles the cell membrane in a stiff and inflexible manner. It gives the cells stability and form and shields them from harm and mechanical shocks.

Organelles

Eukaryotic cells have specialized structures called organelles that carry out certain tasks essential to the survival, development, and reproduction of the cell. Every organelle contributes to the general structure and operation of the cell with its own distinct structure and function. The mitochondria, golgi apparatus, lysosome, endoplasmic reticulum, chloroplast (plant), vacuole, and others are some of the main organelles.

Types of Cell Structure

All living things are composed of cells. The fundamental components of a house may be compared to the cells that make up an organism's body. Cell structure may be divided into two major types.

Prokaryotic cells, also known as prokaryotes, are single-celled organisms devoid of membrane-bound organelles and a genuine nucleus. They are distinguished by their simple cell structure and are members of the kingdoms Bacteria and Archaea. In prokaryotic cells, DNA, the genetic

material, is usually found in an area known as the nucleoid that is not membrane-bound. From harsh settings like hot springs and deep-sea vents to more typical settings like dirt and human bodies, prokaryotes are renowned for their flexibility and diversity of habitats. Prokaryotes include things like bacteria and archaea.

Eukaryotic cells, or eukaryotes, are creatures with cells that have membrane-bound organelles and a real nucleus. These creatures, which comprise a diverse spectrum of living forms like plants, animals, fungi, and protists, are classified under the category Eukarya. Eukaryotic cells are more compartmentalized and complicated than prokaryotic ones, with specialized structures carrying out certain tasks inside the cell. DNA, the cell's genetic material, is arranged into chromosomes and stored in the nucleus. Organelles with specific functions, including mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, and chloroplasts in plant cells, are also found in eukaryotic cells.

Cell Functions

Major tasks that are necessary for an organism's growth and development are carried out by cells. The following are some of the key roles of cells:

1. Offer Structure and Support

Every living thing is composed of cells. They serve as the foundation for all living things. The primary elements that serve to provide the organism support and structure are the cell wall and the cell membrane. The skin, for instance, is composed of many cells. Vascular plants have xylem, which is composed of cells that give the plants structural support.

2. Permits the Transportation of Materials

The cells import a variety of nutrients in order to perform a number of internal chemical reactions. Through both active and passive transport, the waste generated by the chemical reactions is removed from the cells. Along the concentration gradient, small molecules like ethanol, carbon dioxide, and oxygen permeate the cell membrane. We call this passive transport. Through active transport, which uses a lot of energy from the cells to move the materials, the larger molecules diffuse across the cell membrane.

3. Facilitates Reproduction

Through the processes of meiosis and mitosis, a cell facilitates reproduction. The process by which a parent cell divides to produce daughter cells is known as mitosis. Daughter cells undergo meiosis and become genetically distinct from their parent cells.

4. Encourage Development

In the process of mitosis, the parent cell divides into the daughter cells. Thus, the cells multiply and facilitate the growth in an organism.

Plant Cell

A plant cell is a type of eukaryotic cell that is found in plants and some algae. Plant cells have many traits with other eukaryotic cells but also have several unique structures and organelles that allow them to carry out specific duties relating to photosynthesis, support, and storage.

Animal Cell

An animal cell is a type of eukaryotic cell found in animals, including humans. Animal cells share many characteristics with other eukaryotic cells but also have some unique structures and

organelles that enable them to carry out specialized functions related to movement, signaling, and communication.

Difference between Plant Cells and Animal Cells

Plant cells contain chloroplasts, responsible for photosynthesis and containing chlorophyll. Animal cells do not have chloroplasts.

Plant cells have a rigid cell wall made of cellulose outside the cell membrane, providing structural support. Animal cells lack a cell wall.

In plant cells, there is a larger vacuole in comparison to the animal cells.

Plant cells often have a fixed rectangular or cuboidal shape due to the cell wall, while animal cells are more flexible and can take various shapes.

Animal cells have centrioles, important in cell division (save in higher plants). Plant cells generally lack centrioles.

The concept of Information and Communication Technology

The importance of education for the progress and advancement of any society cannot be overstated. Any variables impacting schooling within a culture might have substantial repercussions. It serves as a vital metric of societal development, particularly for emerging nations trying to bridge the gap with more sophisticated ones. In today's period of globalization and liberalization, education has emerged as a critical instrument for enabling nations to compete effectively and achieve beneficial outcomes. ICT has now become a major part of educational growth globally, and a society's capacity to adopt and successfully employ ICT will profoundly

affect its success and development. Recent improvements in transportation and communication technology, such as fax machines, satellite TV, cable, and the internet, have led to the decreasing of global boundaries and the mixing of national cultures.(Akintola, 2014). ICT is dramatically impacting the way kids study. Schools in the Western World invested a lot for ICT infrastructures over the previous twenty years, and students use computers more regularly and for a far greater range of applications (Abe, 2015). Several research suggest that pupils utilizing ICT facilities typically exhibit better learning gains than those who do not utilize, (Akiniyi, 2017).

Information and Communication Technology covers computers, the internet etc, and is commonly utilized in education. ICT is seen as a potent instrument for educational reform. According to Akiniyi (2005), learning is a continuous process in which students deviate from conventional methods by changing their expectations via information seeking. They should eventually be prepared to investigate new opportunities for learning.

The Challenges of Information and Communication Technology

The obstacles of integrating Information and Communication Technology (ICT) in secondary school comprise different hurdles that influence both instructors and students. Some of these problems include:

1. Limitations of the Infrastructure

Effective technology integration in schools is severely hampered by inadequate ICT infrastructure, which includes antiquated hardware, constrained bandwidth, and erratic internet connections. Teachers find it difficult to use cutting-edge teaching strategies and give pupils access to digital learning opportunities when they lack adequate technology tools.

2. Technology Access

Many secondary schools lack adequate access to ICT resources including computers, internet connectivity, and instructional software, especially those in rural or economically challenged areas. This restriction makes it more difficult for students to interact with digital learning resources and for teachers to integrate technology into their lesson plans.

3. The Digital Divide

A digital gap occurs when some pupils have more exposure to ICT materials and abilities than others due to differences in access to technology. This disparity can impede children' academic progress and future possibilities while exacerbating already-existing educational inequities.

4. Support and Training for Teachers

Many secondary school teachers lack the assistance and training they need to integrate ICT technologies into their lesson plans. Teachers' capacity to use technology for teaching and to provide students with interesting learning experiences is hampered by a lack of professional development opportunities and continuous assistance.

5. Curriculum Coherence

It takes careful preparation and alignment with educational standards and objectives to include ICT into the curriculum. However, it can be difficult for teachers, especially those who have little experience incorporating ICT into their teaching techniques, to make sure that technology-enhanced learning activities are purposeful and pertinent to topic areas.

6. Citizenship and Digital Literacy

In the digital age, encouraging pupils to be digitally literate and to use technology responsibly is crucial. However, in order to adequately educate pupils to negotiate the intricacies of the digital world, tackling topics like information literacy, digital citizenship, and online safety calls for specialized curricular materials and teacher training.

7. Financial Restraints (Expense)

Schools frequently lack the funding necessary to invest in digital instructional materials, teacher training programs, and ICT infrastructure. Without sufficient financing, educational institutions could find it difficult to stay up with technology developments and give all students fair access to high-quality ICT-enabled instruction.

Information and communication technology's effects on biology students' understanding of cell structures and functions

Information and communication technology (ICT) has had a profound influence on biology students' understanding of cell shapes and functions, transforming how they obtain information, visualize difficult ideas, and interact with the material.

According to Adamu (2018), ICT provides a platform for students to investigate biological ideas, address problems, and come up with answers during the learning process.

1. Information Availability

Students can access a wide range of materials through ICT, such as databases, scientific publications, textbooks, and instructional websites. Comprehensive information about cell

shapes and functions is available on platforms such as Google Scholar, PubMed, and educational websites like Khan Academy and Coursera, enabling students to get a deeper grasp of the subject outside of the traditional classroom (Schunk, 2012).

2. Encourage self-directed and student-centered learning.

Adamu (2014) asserts that pupils are more actively using computers for worthwhile endeavors. They actively access, choose, organize, and evaluate facts and information to create new knowledge rather than being passive recipients. Biology students, in particular, show improved competence in utilizing data and information from many sources through the use of information and communication technology (ICT) in the classroom. Additionally, they have an enhanced capacity to assess the caliber of educational resources critically.

3. Create an Innovative Learning Space

ICT helps students gain new knowledge in various subject areas (Agagu, 2014). ICT offers more imaginative answers to many learning issues. For instance, reading aloud exercises in a reading class frequently employ e-books. Using computers, laptops, iPads, or personal digital assistants (PDAs), learners can easily access texts of all levels, from basic to advanced. A reading-aloud interface, pertinent vocabulary-building exercises, games pertaining to vocabulary acquisition and reading skills, and other features may be included with these e-books. As a result, ICT includes specially created applications that offer creative solutions to a range of learning requirements.

According to Koc (2015), biology students can collaborate, share, and communicate at any time and from any location by utilizing ICT. For example, a teleconferencing classroom could invite students from all over the world to convene concurrently for a discussion on a particular topic.

They might be able to develop concepts, analyze issues, and investigate ideas. They might also be able to assess ICT learning solutions. ICT helps biology students focus on higher-level concepts rather than less important tasks. Students not only learn together, but also share a variety of learning experiences with one another to express themselves and reflect on their learning. It also provides more opportunities for students to develop critical (higher-order) thinking skills based on a constructive learning approach. ICT-assisted learning and the development of critical thinking abilities were found to be statistically significantly correlated in Adamu's 2019 study. Students who are exposed to ICT for longer periods of time may develop more sophisticated critical thinking abilities. As a result, it is highly recommended that schools incorporate technology into all subject areas and learning levels. When this is done, students can use technology to achieve higher cognitive levels in particular learning environments.

4. Boost the caliber of instruction and learning

Aboderin (2018) emphasizes three key attributes essential for fostering effective teaching and learning using ICT: autonomy, proficiency, and creativity. By using ICT to take charge of their education, students can become more autonomous and improve their capacity for both solo and group work. Teachers can delegate tasks for group or peer completion, facilitating collaborative learning experiences where students can leverage existing knowledge to build upon and develop confidence through experimentation and learning from errors.

Serhan (2019) observed that ICT empowers educators to craft personalized materials, granting them greater authority over course content compared to conventional classrooms. Regarding capability, as students gain confidence in their learning methods, they enhance their ability to effectively apply and transfer knowledge when utilizing new technology.

Summary of Related Literature

In summary, according to Abe (2012), ICT provides students with additional time to delve deeper into the concepts of Biology beyond mere mechanical understanding of course content. Its utilization also enhances the teaching and learning processes in biology. Abe's study findings reveal that sometimes, the dynamic between teacher and learner shifts with the integration of information technology, fostering students' confidence as they assist teachers in resolving technical issues in the classroom. Consequently, ICT transforms the traditional teacher-centered approach, necessitating educators to pragmatically customize and adapt their instructional materials. While ICT brings about positive changes in the teaching and learning of biology, existing literature also highlights various barriers categorized from the perspectives of students, teachers, administrators, and ICT infrastructure.

CHAPTER THREE

RESEARCH METHODOLOGY

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

- Research Design
- Population of the Study
- Sample and Sampling Techniques
- Research Instrument
- Validity of the InstruInstrument Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis

Research Design

The study utilized a cross-sectional research design to collect data from individuals within the chosen population using the likert form questionnaire. This approach is aimed to assess the present condition of the subject matter within the local government area.

Population of the Study

The study's target population includes 1500 students enrolled in public schools within the Oredo local government area of Edo State, which comprises of; Adesuwa Girls Grammer School, Edokpolo Grammar School, Ihogbe College, Immaculate Conception College, Oredo Girls School. A sample that represents these populations will be selected to conduct the investigation.

Sample and Sampling Techniques

size the Taro Yamane formula,

Sample size= N/ (1+N (e) ^{2})

Where N= population of the study

e = degree of expected error

Sample size =316

For this study, a sample size of 316 biology students from public schools in the Oredo local government will be chosen using the simple random sampling technique.

Research Instruments

The primary tool utilized for data collection in this study were questionnaires developed by the researcher. The questionnaire, titled "Impact of Information and Communication Technology in the Learning of Cell Structures and Functions in Biology," was used for this purpose.

The choice of this instrument was promoted by its reliability and validity of the answers. This is so because there is little interaction between the researcher and the respondents, which may influence the responses to the questionnaire's questions. The questionnaire was divided into section A-E.

A. Gathered information concerning the background of both professionals and paraprofessionals.

B. Gathered information regarding the effectiveness of information and communication technology resources.

C. Contained information regarding the effectiveness of information and communication technology.

D. Sought information on the factors hindering the application of information and communication technology in the learning of cell structure and functions in Biology.

E. Gathered information on the extent to which information and communication technology is being utilized in the learning of cell structure and functions in Biology.

Validity of the Instrument

The expert judgement approach was used to validate the research instrument. In this context, I provided copies of the draft instrument to my project supervisor and two additional experts in the Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, Nigeria, for review of the items. Afterward, their recommendations were considered before the final copy of the instrument was produced and utilized.

Reliability of the Instrument

To assess the instrument's reliability, the test-retest method was employed. Accordingly, 20 copies of the instrument were given to respondents not included in the target population. Following a two-week interval, the same respondents were given the instrument again for comparison. Afterward, their responses on both occasions were collected and analyzed using the Pearson Product Moment Correlation Coefficient Statistical method to establish its reliability index, which was calculated as 0.75.

Method of Data Collection

The researcher directly distributed the questionnaire to participants at the chosen institution. Any unclear items were clarified for the participants. To prevent predetermined responses and bias, the participants were not notified in advance of the researcher's visit.

Method of Data Analysis

All data were analyzed using descriptive statistics of mean, frequency and standard deviation Raw data figures were converted into percentages and interpreted. Data was analyzed using Statistical Package for Social Sciences (IBM SPSS) version 25 The level of significance was set at $p<0.05$.

CHAPTER FOUR

ANALYSIS OF DATA 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: what difficulties do students encounter when utilizing ict for learning cell biology in secondary school?

Table one: Distribution on difficulties student encounter when utilizing ICT for learning cell biology in secondary school.

S/N	Item	SA	A	D	SD	Mean	Std	Remarks
1	Technical issues often disrupt my use of ICT for learning cell biology	179	137	0	0	3.57	0.496	Accepted
2	Access to ICT resources for learning cell biology is limited in my school	237	79	0	0	3.75	0.434	Accepted
3	I feel confident in navigating and using ICT tools for learning cell biology	257	59	0	0	3.81	0.390	Accepted
4	Finding reliable online resources for learning cell biology is challenging	218	39	59	0	3.50	0.791	Accepted
5	I receive sufficient guidance and support from teachers in utilizing ICT for learning cell biology	79	178	59	0	3.06	0.659	Accepted
6	I perceive ICT to be as effective as traditional methods (e.g textbook, lectures) for learning cell biology	148	168	0	0	3.47	0.50	Accepted
7	Utilizing ICT for learning cell biology enhances my understanding of the subject matter	276	40	0	0	3.87	0.33	Accepted

With a mean score of 3.57 and a standard deviation of 0.496, table 1 above demonstrates that respondents agree with items 1, 2, 3, 5, 6, and 7: Technical problems frequently interfere with my use of ICT for studying cell biology. With a mean score of 3.75 and a standard deviation of 0.434, my school has restricted access to ICT resources for learning cell biology. With a mean score of 3.81 and a standard deviation of 0.390, I am comfortable navigate and use ICT resources to understand cell biology. Considering the mean score of 3.50 and standard deviation of 0.791, it is difficult to find trustworthy online resources for learning cell biology. With a mean score of 3.06 and a standard deviation of 0.659, I am able to use ICT to learn cell biology with adequate direction and help from my lecturers. With a mean score of 3.47 and a standard deviation of 0.50, I believe that ICT is just as successful as conventional teaching techniques (such as textbooks and lectures) for learning cell biology. My comprehension of cell biology is improved by using ICT to study the topic; my mean score was 3.87, with a standard deviation of 0.33. As a result, items 1, 2, 3, 5, 6, and 7 were approved as they all achieved the 2.50 mean standard score.

Research Question 2: What is the effect of ICT Integration of students understanding of cell structure and function in secondary schools?

Table two: Distribution on the way ICT integration influence students understanding of cell structure and function in cell biology.

S/N	Item	SA	A	D	SD	Mean	Std	Remarks
1	The use of ICT helps me visualize complex cell structure and function more effectively	129	187	0	0	3.41	0.492	Accepted
2	Collaborative activities facilitated by ICT tools improve my engagement with cell structure and function learning materials	137	179	0	0	3.43	0.496	Accepted
3	Using ICT in cell structure and function lessons help me stay focused and interested in the subject matter	98	218	0	0	3.31	0.463	Accepted
4	Access to online resources such as videos and interactive websites, enhances my understanding of cell structure and function concepts	188	128	0	0	3.59	0.492	Accepted
5	ICT tools like virtual simulations make learning about cell structure and function more interactive and engaging	168	148	0	0	3.53	0.500	Accepted
6	The availability of ICT resources motivates me to explore cell structure and function topics outside of class time	257	59	0	0	3.44	1.171	Accepted
7	Integrating ICT into cell structure and function lessons makes learning more enjoyable for me	218	39	0	59	3.32	1.158	Accepted

With a mean score of 3.41 and a standard deviation of 0.492, table 2 demonstrates that respondents agree with items 8, 9, 10, 11, 12, 13, and 14—that using ICT makes it easier for me to visualize complicated cell structure and function. With a mean score of 3.43 and a standard deviation of 0.496, collaborative activities enabled by ICT technologies enhance my engagement with cell biology learning materials. With a mean score of 3.31 and a standard deviation of 0.463, I find that using ICT in cell structure and function lectures keeps me engaged and attentive. With a mean score of 3.59 and a standard deviation of 0.492, having access to online resources like interactive webpages and movies improves my comprehension of cell structure and function. With a mean score of 3.53 and a standard deviation of 0.500, ICT tools such as virtual simulations enhance the interactive and captivating nature of learning about cell structure and function. With a mean score of 3.44 and a standard deviation of 1.171, the availability of ICT resources encourages me to research cell biology issues outside of class. With a mean score of 3.32 and a standard deviation of 1.158, including ICT into courses on cell structure and function enhances student enjoyment. As a result, the items 8, 9, 10, 11, 12, 13, and 14 were approved as they all met the 2.50 mean standard score.

Research Question 3: What are the effects of ICT-based learning approaches on students' academic performance and retention of cell biology concepts?

Table three: Distribution on the effects of ICT-based learning approaches on students' academic performance and retention of cell biology concepts?

S/N	Item	SA	A	D	SD	Mean	Std	Remarks
1	The use of ICT-based learning approaches enhanced my understanding of cell biology concept	128	188	0	0	3.41	0.492	Accepted
2	ICT-based learning approaches made learning cell biology more engaging and interactive	79	237	0	0	3.25	0.434	Accepted
3	The multimedia content in ICT-based learning helped me grasp complex cell biology topics better.	79	237	0	0	3.25	0.434	Accepted
4	The availability of online resources through ICT-based learning platforms improved my retention of cell biology concepts	128	129	59	0	3.22	0.739	Accepted
5	Collaborative learning facilitated by ICT tools enhanced my understanding of cell biology	90	226	0	0	3.28	0.452	Accepted
6	ICT-based learning approaches provided timely feedback, helping me identify areas of improvement in cell biology	138	178	0	0	3.44	0.497	Accepted
7	Overall, I believe ICT-based learning approaches positively impacted my academic performance in cell biology	207	109	0	0	3.66	0.476	Accepted

With a mean score of 3.41 and a standard deviation of 0.492, table 3 above demonstrates that respondents agree with items 15, 16, 17, 18, 19, 20, and 21 that the adoption of ICT-based learning methodologies improves comprehension of cell biology topics. With a mean score of 3.25 and a standard deviation of 0.434, ICT-based learning methods make studying cell biology more dynamic and interesting. With a mean score of 3.25 and a standard deviation of 0.434, the multimedia information in ICT-based learning aids in a better understanding of complicated cell biology issues. With a mean score of 3.22 and a standard deviation of 0.739, the online materials

made available by ICT-based learning platforms helped me retain cell biology topics better. Cell biology knowledge is improved by collaborative learning enabled by ICT technologies, as evidenced by the mean score of 3.28 and standard deviation of 0.452. With a mean score of 3.44 and a standard deviation of 0.497, ICT-based learning strategies gave me immediate feedback that helped me pinpoint my areas of improvement in cell biology. I think that, all things considered, ICT-based learning strategies improved my academic achievement in cell biology, as evidenced by my mean score of 3.66 and standard deviation of 0.476. As a result, items 15, 16, 17, 18, 19, 20, and 21 were approved as they met the 2.50 mean standard score.

Discussion of Findings

The results of the first study question show that there are few ICT resources available in schools for teaching cell biology, and technical problems frequently prevent students from using ICT for this purpose. Additionally, it shows that students are comfortable utilizing and navigating ICT technologies for cell biology education, although it might be difficult to locate trustworthy online resources for cell biology education. Additionally, it shows that students believe ICT to be just as effective as traditional methods for learning cell biology, that teachers provide adequate guidance and support for students using ICT to learn cell biology, and that using ICT to learn cell biology improves students' comprehension of the subject. These results are consistent with the research of Rahman, A., & Scaife, J. (2016), which found that students encounter a number of obstacles while utilizing ICT to study cell biology, such as technical issues, a lack of ICT proficiency, and decreased participation.

The second research question's findings show that using ICT in cell biology lessons keeps students engaged and focused, that collaborative activities made possible by ICT tools enhance learners' engagement with cell biology learning materials, and that ICT use helps students

visualize complex cell biology concepts more effectively. Additionally, it shows that virtual simulations and other ICT tools make learning about cell biology more dynamic and interesting, that having access to online resources like videos and interactive websites improves learners' comprehension of cell biology concepts, and that having access to ICT resources encourages me to research cell biology topics outside of the classroom. Finally, it shows that learning becomes more pleasurable when ICT is incorporated into cell biology classes. These results are consistent with a research by Pandita, A., & Kiran, R. (2023), which found that by creating engaging and encouraging learning environments, ICT integration had a major impact on student involvement and interest in studying cell biology.

The results of the third study question show that using ICT-based learning strategies improves comprehension of cell biology topics and makes the subject more interesting and participatory. The availability of online resources through ICT-based learning platforms enhanced the learner's memory of cell biology ideas, and the multimedia material in ICT-based learning aids in the better understanding of complicated cell biology themes. Additionally, research shows that ICT-based learning methodologies offer prompt feedback, assisting the learner in identifying areas for cell biology development, and that collaborative learning enabled by ICT tools improves comprehension of cell biology. Finally, it shows that ICT-based learning strategies have a favorable effect on students' academic achievement in cell biology. These results are consistent with a research by Ben Youssef, A. (2022) that found that the use of ICT tools in classrooms encourages active learning and makes it easier for students to understand complex ideas, which improves academic performance and retention rates.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of the study was to ascertain how information and communication technologies affected senior secondary schools in the Oredo local government area's biology curriculum regarding cell shapes and functions. To direct the investigation, four research questions were posed.

Using the random selection approach, the study's sample size consisted of 316 biology students from public senior secondary schools in the Oredo local government.
The questionnaire served as the main instrument for gathering data. The demographic data of the respondents was provided in Section A of the questionnaire. The purpose of Section B was to collect information on the different research topics and other matters that were thought to be essential to the accomplishment of this investigation. The validity and reliability of the instrument were evaluated. The project supervisor and two additional professors from the Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, assessed the validity of the instrument. The test-retest method was used to assess the instrument's reliability, and the Pearson Product Moment Correlation Coefficient reliability index came out to be 0.75. Descriptive statistics, such as the mean and standard deviation, were used to examine the gathered data.

Conclusions

The following conclusions were drawn when the data was analyzed and the results were obtained:

For learning cell biology, students face challenges such technological problems, locating trustworthy online materials, and restricted access to ICT resources. Learning becomes more engaging, dynamic, fun, and efficient when ICT is used into cell biology classes.

Learners' academic performance is positively impacted by ICT-based learning strategies. Students would be better prepared for future professions in scientific and technology sectors if biology curricula in secondary schools incorporated ICT-based learning methodologies. Suggestions

In light of the study's findings, the following suggestions were put forth:

1. To help students troubleshoot and quickly resolve technological difficulties, technical support should be developed.

2. To encourage students' enthusiasm in learning, ICT resources should be made available to them.

3. Teachers should make sure that the ICT-based learning strategies they use have a good effect on students' academic achievement.

4. To improve immersive and interactive learning, ICT technologies have to be incorporated into the biology curriculum.

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APPENDIX

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY

FACULTY OF EDUCATION

UNIVERSITY OF BENIN,

BENIN CITY.

QUESTIONNAIRE

Dear Respondent,

This questionnaire is intended exclusively for research purposes. The researcher is conducting a study on the topic: the impact of information and communication technology in the learning of cell structures and functions in biology in secondary schools in Oredo Local Government Area In Edo State.
You are requested to please complete the questionnaire as honestly as possible; all information provided by you shall be treated in confidence.

Thanks, in anticipation.

SECTION A (DEMOGRAPHIC)

Instruction: Please tick (✓) the option that best suit your opinion.

1. Educational Qualification: Secondary School Certificate ( ) OND/NCE ( ) HND/University Degree ( ) Masters ( ) PHD ( )

SECTION B

INSTRUCTION: Kindly tick (✓) where necessary using the following

Keys

Key: SA (Strongly Agree) = 4

A (Agree) =3

D (Disagree) =2

SD (Strongly Disagree) =1

RQ 1	WHAT DIFFICULTIES DO STUDENTS ENCOUNTER WHEN UTILIZING ICT FOR LEARNING CELL BIOLOGY IN SECONDARY SCHOOL?							
S/N	**Item**	**SA**	**A**	**D**	**SD**	**Mean**	**Std**	**Remarks**
1	Technical issues often disrupt my use of ICT for learning cell biology	179	137	0	0	3.57	0.496	Accepted
2	Access to ICT resources for learning cell biology is limited in my school	237	79	0	0	3.75	0.434	Accepted
3	I feel confident in navigating and using ICT tools for learning cell biology	257	59	0	0	3.81	0.390	Accepted
4	Finding reliable online resources for learning cell biology is challenging	218	39	59	0	3.50	0.791	Accepted
5	I receive sufficient guidance and support from teachers in utilizing ICT for learning cell biology	79	178	59	0	3.06	0.659	Accepted
6	I perceive ICT to be as effective as traditional methods (e.g textbook, lectures) for learning cell biology	148	168	0	0	3.47	0.50	Accepted
7	Utilizing ICT for learning cell biology enhances my understanding of the subject matter	276	40	0	0	3.87	0.33	Accepted

RQ 2	WHAT IS THE EFFECT OF ICT INTEGRATION OF STUDENTS UNDERSTANDING OF CELL STRUCTURE AND FUNCTION IN SECONDARY SCHOOLS?							
S/N	**Item**	**SA**	**A**	**D**	**SD**	**Mean**	**Std**	**Remarks**
8	The use of ICT helps me visualize complex cell structure and function concepts more effectively	129	187	0	0	3.41	0.492	Accepted
9	Collaborative activities facilitated by ICT tools improve my engagement with cell structure and function learning materials	137	179	0	0	3.43	0.496	Accepted
10	Using ICT in cell structure and function lessons help me stay focused and interested in the subject matter	98	218	0	0	3.31	0.463	Accepted
11	Access to online resources such as videos and interactive websites, enhances my understanding of cell structure and function concepts	188	128	0	0	3.59	0.492	Accepted
12	ICT tools like virtual simulations make learning about cell structure and function more interactive and engaging	168	148	0	0	3.53	0.500	Accepted
13	The availability of ICT resources motivates me to explore cell structure and function topics outside of class time	257	59	0	0	3.44	1.171	Accepted
14	Integrating ICT into cell structure and function lessons makes learning more enjoyable for me	218	39	0	59	3.32	1.158	Accepted

RQ 3	WHAT ARE THE EFFECTS OF ICT-BASED LEARNING APPROACHES ON STUDENTS' ACADEMIC PERFORMANCE AND RETENTION OF CELL BIOLOGY CONCEPTS							
S/N	**Item**	**SA**	**A**	**D**	**SD**	**Mean**	**Std**	**Remarks**
15	The use of ICT-based learning approaches enhanced my understanding of cell biology concept	128	188	0	0	3.41	0.492	Accepted
16	ICT-based learning approaches made learning cell biology more engaging and interactive	79	237	0	0	3.25	0.434	Accepted
17	The multimedia content in ICT-based learning helped me grasp complex cell biology topics better.	79	237	0	0	3.25	0.434	Accepted
18	The availability of online resources through ICT-based learning platforms improved my retention of cell biology concepts	128	129	59	0	3.22	0.739	Accepted
19	Collaborative learning facilitated by ICT tools enhanced my understanding of cell biology	90	226	0	0	3.28	0.452	Accepted
20	ICT-based learning approaches provided timely feedback, helping me identify areas of improvement in cell biology	138	178	0	0	3.44	0.497	Accepted
21	Overall, I believe ICT-based learning approaches positively impacted my academic performance in cell biology	207	109	0	0	3.66	0.476	Accepted