UNDERGRADUATE STUDENTS' PERCEPTION OF THE USE OF ICT IN THE TEACHING OF TAXONOMY IN BIOLOGICAL SCIENCES

BY

ORIABURE FAVOUR
EDU1902995
B.Sc. (Ed) Biology

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY
FACULTY OF EDUCATION
UNIVERSITY OF BENIN
BENIN CITY.

MAY, 2024

UNDERGRADUATE STUDENTS' PERCEPTION OF THE USE OF ICT IN THE TEACHING OF TAXONOMY IN BIOLOGICAL SCIENCES

BY

ORIABURE FAVOUR
Mat. No. EDU1902995
B.Sc. (Ed) Biology

A PROJECT REPORT SUMMITED TO THE DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY, UNIVERSITY OF BENIN IN PARTIAL FULFILMENT OF THE REQUIREMENT OF THE AWARD OF BACHELOR OF SCIENCE EDUCATION (B.Sc.ED) IN BIOLOGY

MAY, 2024

CERTIFICATION

We, the undersigned, certify that this work was done by ORIABURE FAVOUR in the Department of Curriculum and Instructional Technology (CIT), Faculty of Education, University of Benin, Benin City.

_____ _____

DR. (MRS.) N. V. DAVID-EGBENUSI **DATE**
(SUPERVISOR)

_____ _____

DR. (MRS.) A.H. OYAKHIROME **DATE**
(PROJECT COORDINATOR)

_____ _____

DR. F. O. IDEHEN **DATE**
(HEAD OF DEPARTMENT)

DEDICATION

This project work is dedicated to God Almighty my creator and source of knowledge. He has been the source of my strength throughout this program and on His wings only have I soared.

ACKNOWLEDGEMENTS

The success and final outcome of this project required a lot of guidance and assistance from many people and the researcher is extremely fortunate to have got this all along the completion of her project work. Whatever she has done is only due to such guidance and assistance and she would not forget to thank them.

The researcher respect and thank her supervisor, Dr. (Mrs.) N. V. David-Egbenusi, for her support and guidance which made the researcher complete her project on time. The researcher is extremely grateful to her for providing such a nice support and guidance even though she had busy schedules managing other affairs.

Worthy also of appreciation is her Head of Department, Dr. F. O. Idehen, and her course advisers since 100 level; Mr Festus Idiaghe, Dr. Mrs Eromosele, Dr. Pedro Ikhureye and Mrs Ada, who have been supportive throughout this academic race thank you for the support. The researcher wish to also express her gratitude to all the Professors and other Lecturers in the Department of Curriculum and Instructional Technology and the Faculty, especially those who have impacted knowledge in one form or the other. Among them is Dr. O. Osagiobare, from the Department of Educational Foundations, thank you for your show of concern and encouragement.

The researcher would not forget to mention her parents Mr. and Mrs. Rufus Oriabure, and her siblings for their unwavering love, encouragement and motivation. Their belief in her capabilities has been a source of inspiration, and she is grateful for their constant support during this endeavour.

Finally, the researcher wants to thank her friends Segun Gbenga Olatunji, Ighoroje Faith, Okoro Nebechi and others who contributed ideas and perspectives that enriched the project, displayed appreciation for her work and motivated her to continue her work.

Thank you everyone for shaping this project and enhancing her learning experience.

TABLE OF CONTENT

LIST OF TABLES

ABSTRACT

The University of Benin has identified several factors influencing the integration of ICT in teaching taxonomy. This research aims to assess the ICT skills of undergraduate students at the University of Benin who are studying taxonomy, their regular utilization of ICT tools for assignments, coursework, and academic activities, as well as the determinants impacting the adoption of ICT in the teaching and learning of taxonomy.

A descriptive survey research design was utilized, and the study was guided by four formulated research questions. The research was conducted at the University of Benin in Edo State, Nigeria. A total of 150 undergraduate students were selected from three departments at the University of Benin: Plant Biology and Biotechnology (50 students), Animal and Environmental Biology (50 students), and Curriculum and Instructional Technology (50 students). The sampling technique employed was simple random sampling. . Data collected were analysed using mean.

The findings indicated noteworthy and favourable factors influencing the utilization of ICT in the teaching and learning of Taxonomy. The results also show that poor internet connectivity in classrooms and hostels is the primary barrier hindering the successful integration of ICT in teaching and learning within Nigeria's higher education system. Irregular power supply in class; irregular power supply in hostel; limited access to useful, relevant, and appropriate hardware and software; inadequate maintenance of ICT equipment. In today's globalized context, students in higher education institutions in Edo State, Nigeria, may face challenges in competing internationally if they lack sufficient ICT skills. It is imperative that Nigerian universities incorporate information and communication technology effectively into teaching and learning processes. The researcher recommends that the Nigerian government should prioritize the integration of ICT in education by supporting state governments in funding ICT initiatives in institutions, ensuring that all departments are networked. Additionally, they recommend collaboration between wealthy individuals, non-governmental organizations, community-based organizations, and other agencies with the state government to provide staff training on ICT, thereby facilitating its full integration into teaching and learning. Staff training and development programs such as seminars, conferences, and workshops could enhance ICT literacy among institutional staff.

CHAPTER ONE

INTRODUCTION

Background to the study

There is no doubt that Information and Communication Technology (ICT) is a tool that can be applied to all aspects of human endeavour including teaching and learning. In the past two decades, Information and Communication Technology (ICT) has progressively gained a prominent role in teaching and learning. Technology use in education has brought social and digital improvement to both students and academics involved in the use of educational technologies (Lopes, 2014). Information Communication Technology (ICT) is treated as a crucial tool to endorse a different way of teaching that should be used to promote students' problem-solving skills, promote participation, communication, and continuous learning (Abdullah & Ward, 2016). Most countries have made huge public investments in the purchase and maintenance of ICT related educational devices. It is crystal clear that the modern-day classroom needs are very different from the conventional classroom needs. However, as the world moved rapidly to digital media and information, its role is becoming increasingly important and will continue to grow and develop in the 21st century. It has significantly brought waves of transformations, which is visible in education industry.

Technology will play an important role in supporting effective learning in the classroom, if both students and teachers are able to use the technology properly. With technology, learning systems or learning methods that were previously still traditional will be shifted to modern and more innovative when coupled with creativity of teachers in teaching students in the classroom. Therefore, the students' perception towards the use of ICT in the teaching of Taxonomy is very important to be researched. The reason is because the success of using ICT in improving students' knowledge in Taxonomy depends on the abilities and policies of the student themselves by making use of the technology they can access both at school and outside of school. ICT will help students and teachers in teaching and learning activities, assist teachers in the preparation of their teaching materials and make the class more appealing.

Different learners have different peculiarities and traits which in one way or another influences their learning. ICT based active learning gives a solution to this challenge, that is, it gives an opportunity for learning beyond the aforementioned barriers. The same applies for traditional classroom settings where it is easier for teachers to notice lack of participation among extroverts and it becomes difficult to identify the same among introverts. However, computer aided learning, that is the ICT integrated learning, has proven to motivate learning and learning

engagement for both introvert and extrovert students. ICT, including computers, is commonly believed to promote coactive learning, provide more information, and through simulation, make complicated learning experiences easier to comprehend. To further validate the use of ICT in learning, Twinning (2001) emphasized that teachers have the responsibility to assist students to become more open to ICT equipment. This may help students to build capacities like technology proficiency, information proficiency and visual proficiency, which have become essential skills for citizens in an Information Age (MBESC, 1996); the implication hence being to build the skills which will be used to understand the curriculum and enhance students' attitudes to learning. Robyler (2003:45) attests the advanced ICT move into education by pointing out the modification in teaching and learning practices of such a nature that, when teachers employ technology in their teaching, it results in students' "cooperative learning, shared intelligence, problem solving and developing higher order skills" (Gulbahar, 2008:32). These constituents may make up the basic building blocks towards the learning achievement of many students.

Hoyle (1993) states that the introduction of ICT into education was hailed as a major catalyst of the long dreamed-about education evolution. The application of ICT in learning dates back to the early 1960s (Offir, Golub & Friedel, 1993 in Katz, 2002:2) with the introduction of Computer Assisted Instruction (CAI). Jones

and Knezek (1993:246) reveal that the initiation of ICT in education is a "major vehicle to improve the efficiency" of the educational process and broadening its effectiveness connotes that educational technology must direct learners through the curriculum, learning strategies and curriculum assessment practices. Flecknoe (2002) also denotes that the ICT helps students to study. This involves the application of web-based teaching, internet facilities, ICT skills programmes, simulations and generic tools such as word processing, Excel, presentations and databases which are all designed to provide students with wider knowledge than they would have had with reliance on what the teacher knows.

The quality of learning outcomes depends on the interaction between the teaching styles and methods used by the teacher to create suitable learning environment (Entwistle, 1998). Research has shown that the use of a wide variety of resources and concepts advances students' interests in biology and aid the learning of complex concepts such as those experienced in taxonomy.

Statement of the Problem

If educational technology is seen as a "major catalyst of a long dreamed educational revolution" (Hoyle, 1993:9) and "a vehicle for educational efficiency" (Jones & Knezek, 1993:246) beneficial effects on students should be apparent in educational institutions. Rather, the apparent trend in our educational institutions

is, amongst others, low turnout (Garnett & Pelser, 2007) associated with poor student work(assignments, tasks, projects and research papers), plagiarism and reliance on the teacher for resources.

The inception and uptake of ICT in countries with developing economies have become rampant and is growing. Notwithstanding the perceived advantages of ICT, these countries continue to tackle ICT system challenges such as internet connection, poor ICT framework, deficient monetary allocation, and lack of policy employment (Hadullo, 2018). Students who are mostly from schools with lack of Information Communication Technology face difficulties in adapting and using ICT for their studies (Bansilal). The application of ICT remains restricted and can be treated as incompetent due to inadequacy of appraisal from its users. As the predominant users of this platform (ICT), the perceptions of 400 level biological science students would be substantial in assessing the platform's effectiveness. Nonetheless, there is not much investigation that envelops and defines the factors impacting CIT efficiency in higher institutions in a developing country like Nigeria. Therefore, it is important for this study to be launched, to increase the uses of ICT and by that, promote intellectual achievement of students in the Nigerian higher institution.

Research Questions

In order to attain the aim of this study, the following research questions were raised to guide the investigation:

1. How can the use of ICT in Taxonomy education be improved to better meet the needs of students?
2. What are the most commonly used ICT tools in the teaching of Taxonomy, and how are they being used?
3. What are the perceived benefits and challenges of using ICT in Taxonomy education?
4. How can ICT be used to make Taxonomy more engaging and effective?
5. Do students who have positive attitude towards ICT also have better academic performance in Taxonomy?

Purpose of the Study

The purpose of this study is to examine the perception of undergraduate student on the use of ICT in the teaching of Taxonomy in Biological Science.

The objectives of this study are:

- To find out how the use of ICT in Taxonomy education can be improved to better meet the needs of students.

- To identify the most common ICT tools used in Taxonomy education and how they are being used to support teaching and learning.
- To investigate the perceived benefits and challenges of using ICT in Taxonomy education from the perspective of students.
- To explore how ICT can be used to make Taxonomy more engaging and effective.
- To investigate if students who have positive attitude towards ICT also have better academic performance in Taxonomy.

Significance of the Study

The suggested study is significant in many ways in that to the best of the researcher's knowledge the study is a first of its kind in Biological sciences. Also, the study projects identifying key factors that impact on the cogency of ICT among undergraduate students in biological science. The research findings could bring insight into diverse ICT tools that students and universities management could endorse in the institution. Moreover, the outcomes could guide students and universities culmination on the barriers to successful ICT usage and propose how to best use ICT productively. The findings will also be of significant benefit to lecturers.

The study's findings will be extremely helpful to lecturers as it can improve teaching effectiveness. By understanding students' perceptions, lecturers can adapt their teaching approaches to better meet students' needs. It can also lead to the creation of new ICT-based teaching materials and resources, supporting lecturers in their teaching practices.

The institution will also benefit from the study's findings since the research can inform the development of effective ICT-integrated teaching methods, enhancing the overall quality of teaching. Also, by understanding students' perceptions, the university can create a more engaging and interactive learning environment, leading to increased student satisfaction and retention.

Additionally, the study's conclusions will benefit students greatly as students will develop essential skills in using ICT tools, enhancing their employability and preparedness for a digitally driven workforce. Also, ICT-based learning can facilitate interactive and visual learning, improving students' comprehension and retention of complex Taxonomy concepts.

The research data could admonish the university administration to itemize ICT as a way of intensifying technology proficiency for students by further equipping academics with a unique approach to enhance the transfer of knowledge to students.

Scope and Delimitation of the Study

This study examines undergraduate students' perception of the use of ICT in the teaching of taxonomy in Biological science. This study is delimited to 400 level undergraduate students offering Taxonomy in biological sciences in the University of Benin, Benin City, Edo State.

Definition of Terms

To ensure clarity and understanding, the following key terms used in the study will be defined:

- **Communication:** the imparting or exchanging of information by speaking, writing, or using some other medium.
- **Technology**: Refers to the application of scientific knowledge, tools, techniques, and systems to create solutions, improve efficiency, and meet human needs.
- **ICT (Information and Communication Technology):** This refers to a wide range of technological tools, devices, and resources that facilitate the storage, retrieval, manipulation, and transmission of information. ICT includes computers, tablets, interactive whiteboards, educational software, online resources, and other digital technologies used for teaching and learning purposes.

- **Perception:** the way in which something is regarded, understood, or interpreted.
- **Impact:** a marked effect or influence.
- **Information:** facts provided or learned about something or someone.
- **Taxonomy:** the branch of science concerned with classification, especially organisms.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In contemporary education, it appears that technology is driving change swiftly. As a consequence of this rapid transformation, insufficient focus is placed on investigating the novel methods of teaching and learning enabled by Information Communication Technology. It is thus unsurprising that scholars like McConnell (2006:172) advocate for further research to examine how students engage in new ICT learning environments. This chapter is concerned with the review of literature related to the study. The review is done under the following sub-headings:

- Introduction to Taxonomy and its Importance in Biological Sciences
- The Concept of Information and Communication Technology (ICT)
- Overview of Existing ICT Tools and Resources for Taxonomy Education
- ICT in Education
- Role of Information and Communication Technology (ICT) in Education
- Benefits of ICT Integration in Taxonomy Teaching
- Challenges and Limitations of Using ICT in Taxonomy Education
- Strategies for Effective Integration of ICT in Taxonomy Instruction

- Summary

Introduction to Taxonomy and its Importance in Biological Sciences

Taxonomy is the branch of biology concerned with the classification, identification, and naming of organisms. It provides a systematic framework for organizing the vast diversity of life on Earth, allowing scientists to study and understand the relationships between different species and their evolutionary history. Taxonomy involves both the theory and application of organizing organisms into categories. The term "classification" carries dual meanings: it refers to both the end result produced by taxonomists and the process of organizing populations and groups of populations (taxa) at various levels using inductive methods (Mayr, 1969). Identification, on the other hand, entails assigning individuals to pre-existing taxa using deductive methods.

Taxonomy serves as the foundation for all significant inquiries into biodiversity, pest control, medicine, bio prospecting, fisheries, quarantine, defence, and other fields. Prior to commencing any form of investigation, it is crucial to accurately identify the organism under study. This is paramount because the correct scientific designation of the organism serves as a functional identifier, allowing access to a wealth of information pertaining to that organism, including past research findings.

This facilitates easy retrieval and reference to relevant information (Narendran, 2000).

The following are importance of taxonomy:

- Taxonomy is essential for understanding the structure and function of ecosystems.
- Taxonomy provides a systematic way to organize and categorize the immense diversity of living organisms.
- Taxonomy helps scientists understand the evolutionary relationships between different species.
- Taxonomy plays a crucial role in agriculture by helping to identify crop pests, disease vectors, and beneficial organisms.
- Taxonomy provides the framework for organizing and classifying the vast diversity of life on earth.

The Concept of Information and Communication Technology (ICT)

The term "information and communication technology" (ICT) encompasses a broad spectrum of activities involving the manipulation, transmission, storage, and retrieval of data. It encompasses computer-based tools utilized by employees to manage an organization's information and communication needs. According to research by Owolabi and Adegoke (2007), ICT encompasses computer hardware, software, networks, as well as various auxiliary devices such as video, audio, and

photography equipment, which convert different forms of media into a common digital format. Salman (2003) emphasizes that a diverse array of electronic tools and techniques are employed in ICT to collect, store, process, present, transmit, and disseminate information globally, facilitating access and usage by professionals worldwide for economic and national development purposes. Despite varying interpretations, the core concept of ICT lies in the integration of computer, telecommunications, and human resources for global information exchange. Modern ICTs are profoundly reshaping our lifestyles and work environments, extending their revolutionary impact beyond business and society into education, where their integration is crucial for ensuring educational quality and preparing students for future job demands (Okolo, 2005).

Overview of Existing ICT Tools and Resources for Taxonomy Education

ICT tools are the latest devices and concepts used in Information and Communication Technology that can be used for different purpose (e.g. computers, laptops, desktops, data projectors, and interactive teaching box). They are used in education process as assets for enrichment of the learning process. The use of Information and Communication Technology (ICT) in taxonomy education has greatly expanded in recent years, providing a wide range of tools and resources to enhance learning experiences for students. Existing ICT tools and resources

encompass a wide range of digital platforms, software applications, and online repositories designed to facilitate learning and exploration in the field of taxonomy. Below is a summary of current ICT tools and resources for taxonomy education:

1. **Mobile Apps:** Mobile applications provide convenient access to taxonomic information and resources on smartphones and tablets. These apps may include field guides, species identification tools, and educational games to engage students in taxonomy learning outside the classroom. Examples include iNaturalist, seek by iNaturalist, and PlantSnap.
2. **Online Courses and Tutorials:** online courses and tutorials offer self-paced learning opportunities for students interested in taxonomy. These resources may cover various aspects of taxonomy, including species identification, classification systems, and evolutionary relationships. Examples include Coursera, edX, and Khan Academy.
3. **Educational Websites and Portals:** educational websites and portals offer curated collections of taxonomic resources, lesson plans, and learning materials for students. These platforms may include multimedia content, interactive quizzes, and downloadable resources to support taxonomy education. Examples include the Tree of Life Web Project, the Biodiversity

Heritage Library, and the National Centre for Biotechnology Information (NCBI).

4. **Virtual Museums and Collections:** Virtual museums and collections offer online access to digitized specimens and artifacts, allowing students to explore taxonomic specimens remotely. These platforms often include high-resolution images, specimen metadata, and interactive features for studying biodiversity. Examples include the Smithsonian National Museum of Natural History's Virtual Collection and the Natural History Museum's Digital Collections.
5. **Digital Identification Tools:** Digital identification tools use interactive keys, images, and multimedia resources to help students identify organisms. These tools enable users to navigate through taxonomic characteristics and make species identifications based on visual cues. Examples include Lucid Key and DELTA (Description Language for Taxonomy).

These ICT tools and resources enhance traditional teaching methods and provide valuable opportunities for students to explore, learn, and engage with taxonomy in new and innovative ways.

ICT in Education

Computers are increasingly integral across various industries, including education, where students are exposed to ICT. Students utilize ICT for diverse purposes such as knowledge acquisition, problem-solving, and skill development. A new generation of learners, termed New Millennium Learners (NMLs), raised in an ICT-rich environment, tend to resort to the internet for queries. This study aimed to demonstrate that this new generation is inclined towards teaching methods incorporating ICT. However, achieving universal primary education access, as targeted by the Millennium Development Goals (MDGs) and Education for All (EFA) initiatives by 2015, remains a challenge for many countries like Nigeria due to teacher shortages, infrastructure, and resource inadequacies. Governments employ ICT to enhance instructional objectives and education quality, allowing students' needs to steer the learning process, facilitated by teachers rather than dictated to them.

In the United States, findings suggest that ICT has the potential to transform schooling, raising performance standards while potentially reducing costs. ICT facilitates a personalized pedagogy focused on individual student needs, contrasting with the mass production approach of traditional pedagogy. This study evaluates the impact of ICT integration as a teaching method on biology

performance. Leveraging ICT for personalized learning can yield stronger outcomes, empowering students to pursue knowledge autonomously, enabling asynchronous learning, and providing access to abundant content-rich resources. Given ICT's pivotal role in the global economy, educators advocate for sustained investment in ICT-based learning resources and infrastructure. The study aims to underscore the role of multimedia-integrated ICT in enhancing academic performance.

While ICT adoption continues to advance in developed countries, Africa and other developing regions lag behind. However, South Africa shows promising progress in integrating ICT into schools. Kenya recognizes ICT's crucial role in education for global economic participation and growth. The Ministry of Education emphasizes the necessity of ICT literacy for workforce preparedness and economic competitiveness. Strategies include resource mobilization, curriculum digitalization, pilot school selection for demonstration, and ICT integration in teacher training. Kenya's education sector leads in ICT integration, with initiatives such as e-learning content development and curriculum digitization. Notably, private schools in Kenya prioritize ICT integration, unlike public schools, where it's often absent. Customized digital content aligned with local curriculum and

language is deemed essential for effective ICT integration in education, urging stakeholders to address this need.

Role of Information and Communication Technology (ICT) in Education

Information Communication Technology (ICT) assumes various functions within higher education. Hugo (2010) expresses concern that technology is now an integral part of our reality, necessitating students, educators, parents, institutions, governmental bodies, and stakeholders to adjust and embrace its integration into daily life. Globally, higher education establishments are increasingly compelled to incorporate new educational technologies alongside traditional instructional methods. These functions encompass preparing graduates and citizens for the demands of the knowledge-based economy (MBESC, 1999 and MOE, 2005, 2007), serving as a catalyst for re-evaluating teaching methodologies (Flecknoe, 2002), and serving as a means to enhance and refine the quality of learning (Wagner, 2001, Garrison and Anderson, 2003).

The effective utilization of ICT has the power to revolutionize teaching and learning methods, resulting in a fundamental change in both content and instructional approaches. ICT possesses the capability to overcome geographical and spatial limitations. Its integration into education has significantly enhanced the overall quality of learning. There is a widespread belief that incorporating ICT

will contribute to making education more accessible and cost-effective. With the growing influence of ICT, education will become more inclusive, thereby improving the availability of quality educational services even to students residing in the most remote areas of the country. The evolving landscape of ICT, with its interactive, learner-centric approach, has fundamentally transformed the education process, including delivery and dissemination methods. The innovative use of technology by learners fosters knowledge sharing and enhances their abilities to adapt to rapid changes. However, the pace of technological advancement is so swift that what was cutting-edge a few years ago is now obsolete. It is imperative that we seize ICT-related opportunities and not let them slip away.

Currently, Information Communication Technologies (ICT) are exerting influence across all facets of human existence. They are assuming prominent roles in workplaces, commerce, academia, and leisure activities. Furthermore, many individuals acknowledge ICTs an agents of transformation, precipitating shifts in work environments, information management, educational methodologies, research practise, and access to communication technologies. In the digital age, the integration of ICT into educational settings is crucial, affording students the opportunities to cultivate and apply essential 21st-century competencies. ICT enhances both the delivery and reception of instruction, underscoring its

significance for educators in fostering conducive pedagogical environments. Through ICT, instructors can present instructional material in an engaging manner, catering to learners across diverse educational levels. Information and Communication Technologies (ICTs), exemplified by the internet and interactive multimedia, are evidently pivotal points for future educational endeavours and warrant adept integration into formal instructional practices. The roles enacted or possibly enacted by ICT in higher education encompass the following:

- Technological devices such as mobile phones, iPods, and laptops provide opportunities for creating adaptable and immersive learning environments. These versatile and immersive environments afford flexibility in the time, location, method, and speed of both teaching and learning processes (Van der Westhhuizen in Gravett & Geyser, 2004:157-159). Ehrmann (2002) posits that ICT represents the means to enhance the outcomes of higher education. Both his argument and that of Van der Westhhuizen (in Gravett & Geyser, 2004) are rooted in the belief that ICT offers self-paced, interactive, and resource-rich learning experiences, with a distinct aim to enhance the quality, efficiency, and affordability of education within universities and colleges.

- ICT enhances interaction among students and facilitates communication between students and instructors. According to D'Andrea and Gosling (2005), as student enrolment grows, educators encounter challenges in maintaining personal interactions with their students, making effective utilization of ICT imperative for addressing this issue.
- ICT presents opportunities to improve the quality of teaching and learning by offering and utilizing learning materials and technologies that align with the subjects and requirements of various students (Moran & Myringer in Donnelly & McSweeney, 2009). Higher education institutions are confronted with a wide array of student demographics, encompassing differences in background, culture, religion, language, enrolment status (full or part-time), employment status, international origin, and disabilities. It appears that ICT is the predominant approach adopted by many universities and colleges to address the diverse needs of their student population.
- ICT is employed for the administration and management of higher education institutions worldwide. According to Laurillard (1994), ICT offers convenient and cost-effective means for departments, faculties, colleges, and universities to communicate with students both on and off campus. Lewicki

(2000:197) views ICT opportunities as a means for colleges and universities to enhance communication quality with students and staff.

Apart from the aforementioned functions, D'Andrea and Gosling (2005:134) highlight attributes of modern educational technologies, suggesting their potential to enhance the achievement of learning outcomes in higher education:

- Increased engagement with educational resources, whether with or without an instructor.
- Learning asynchronously from various locations.
- Enhanced adaptability in where learning takes place.
- Enhanced availability of diverse search tools and learning resources.
- Increased student self-direction and self-reliance.

The advancement of information technology is crucial for ensuring quality education, as it plays various roles such as motivating learners, enhancing basic skills, and providing technology-oriented teacher training. When utilized effectively, information communication technology transforms curricula and fosters learner-centred environments. Teachers employ ICT to introduce students to new pedagogical approaches and facilitate access to educational resources. ICT has become increasingly integral to the education system, prompting educational institutions, administrators, and teachers to reassess their roles, teaching methods,

and future objectives. The integration of ICT presents fresh challenges in achieving quality education for learners. According to Tinio (2002), ICTs have the potential to boost accessibility and enhance the pertinence and excellence of education in developing nations. They significantly ease the acquisition and assimilation of knowledge, presenting unparalleled prospects for improving educational frameworks in these regions.

According to Watson (2001), ICTs have transformed contemporary work practices and are now revolutionizing educational systems. Consequently, if schools continue to impart outdated skills and technologies to students, they may not be adequately prepared for the future. This underscores the importance of giving global recognition and attention to ICTs. For example, ICTs play a crucial role in achieving one of the Millennium Development Goals (MDGs), which is achievement of universal primary education in 2015. As ICTs offer greater flexibility for students and teachers to tailor learning and teaching to individual needs, there is a growing expectation for schools to adapt to this technological innovation accordingly.

Benefits of ICT Integration in Taxonomy Teaching

The integration of Information and Communication Technology (ICT) into taxonomy teaching has revolutionized the way educators engage students in the

study of classifying and naming organisms. Within the realm of biology, taxonomy stands to benefit significantly from the incorporation of ICT tools and resources. This note aims to explore the myriad benefits of ICT integration in taxonomy teaching, shedding light on how technology can enhance pedagogical approaches, engage students, and deepen understanding of biological diversity.

1. ICT offers students a platform to ask questions, access search features, utilize simulation and gaming tools, all of which bolster cognitive abilities. The teacher's presence does not intimidate students, "even shy students have the opportunity to voice out" (Van der Westhuizen in Gravett & Geyser, 2004:170).
2. Information available on the internet can be exchanged among peers within the same group through email. Students belonging to comparable groups can engage in synchronous communication using chat rooms, video conferencing, or audio conferencing.
3. ICT allows students to access institution, faculty, or subject websites to contribute comments on topics of interest or group discussions. Likewise, students can review posts made by peers in similar groups on various subjects. The internet offers diverse formats, including text, graphics,

animation, video, and sound, catering to students with diverse learning abilities and physical limitations.

Challenges and Limitations of Using ICT in Taxonomy Education

In contemporary society, the utilization of ICT is increasingly widespread, particularly in the realm of education (Rezaee, Jafari, & Kazemzadeh, 2006). The global advancement driven by science and technology hinges greatly on the quality of education (Jaffer, Ng'ambi, & Czerniewicz, 2007). In Nigeria, the integration of ICT into education has undeniably impacted and improved learning processes, albeit with accompanying challenges. These challenges pose as hindrances or barriers to the adoption of ICT, similar to those encountered in renowned higher institutions worldwide. Several factors are influencing the effective integration of ICT usage in Nigeria, including the following:

- **Unreliable Power Provision:**

  In Nigeria, the unreliable supply of electricity poses the most significant challenge to the growth and advancement of numerous industries, hindering Nigeria's progress as uninterrupted electricity remains elusive. This deficiency severely impedes the effective integration of ICT in Nigerian tertiary institutions, as well as across various industries, as electricity is indispensable for the operation of ICT tools and electronic devices (Azuh &

Modebelu, 2014). Another study emphasizes the critical role of proper infrastructure, including reliable electricity, for the utilization of computers (Aduwa-Ogiegbaen & Iyamu, 2005). The acquisition, deployment, and management of information technology resources and services for teaching are contingent upon a stable supply of electricity (Osakwe, 2012).

Looking at it from a different perspective, resources that could have been allocated to purchasing ICT devices for schools are instead being diverted towards acquiring costly alternatives like diesel generators or solar panels, which presents its own set of challenges. Furthermore, the inadequate maintenance of infrastructure has led to poor conditions in schools at all levels. This deficiency in maintenance makes it challenging for schools to ensure sufficient lighting, consequently leading to decreased productivity among students who need to study at night and researches who rely on electricity.

- **Lack of Proficiency in Using Computers:**

  A significant proportion of staff members in Nigerian tertiary institutions lack proficiency in ICT, which is concerning given the prevailing digital age (Idowu, Esere, & Iruloh, 2017). While some lectures may have received training in computer applications, without consistent practice, their skills

may deteriorate over time Anene, Imam, & Odumuh, 2014). The prevalence of ICT illiteracy in today's era poses a substantial threat to establishments, particularly educational institutions, where reliance on ICT is pervasive across activities (Anene, Imam, & Odumuh, 2014). It is noteworthy that ICT holds greater importance in tertiary institutions compared to most organizations, with academic staff requiring ICT skills for tasks such as student assessments, exam management, administrative duties, and website development (Beda et al., 2012). Many lecturers in Nigerian tertiary institutions have limited or no prior experience with computers, leading to feelings of discomfort and apprehension when faced with technology-related tasks (Ajegbelen, 2016).

- **Expensive Internet Data and Electronic Services:**

  The significant expenses associated with internet data and electronic services pose a key challenge to the implementation of ICT in Nigerian tertiary institutions. This issue extends to the international level, where the American government profits substantially from developing countries by providing minimal internet connectivity while exerting strong control over ICT infrastructure. Consequently, this impedes the effective deployment and utilization of ICT in these nations, including Nigeria. Within Nigeria

specifically, exorbitant internet data costs and steep tariffs imposed by international internet providers primarily focused on profit-making further hinder ICT deployment. Additionally, challenges such as high costs for acquiring and maintaining ICT systems, lack of technical support, reliance on unlicensed software, and outdated hardware and software systems are obstacles faced by lecturers in higher institutions. (Adapted from Tongia & Subrahmanian, 2006; Balasubramanian et al., 2009).

- **Inadequate Amenities:** Another significant obstacle impeding the integration of ICT in Nigerian tertiary institutions is the absence of adequate facilities (Alturise & Alojaiman, 2013). This becomes apparent when comparing Nigerian tertiary institutions to those in developed countries, where basic office equipment and technologies such as computers, printers, fax machines, photocopiers, binders, and projectors are often lacking, particularly in Colleges of Education. The scarcity of these fundamental resources contributes to the challenges hindering the adoption of ICT in Nigerian tertiary institutions, as effective functioning in the modern era of ICT necessitates access to such facilities. Beyond academic training, these office gadgets and technologies are crucial for preparing students for future professional endeavors in office and corporate

environments. Adeosun's study (2010) further illustrates that the absence of ICT resources and inadequate infrastructure hinders the complete implementation of ICT in Nigerian tertiary institutions.

- **Online and Digital Security:** Nigeria's negative reputation regarding internet fraud and usage sadly deters many responsible citizens from participating in electronic transactions or online activities (Harijith, Ebenezer, & Natarajan, 2014). This trend stems from the pervasive issue of youth unemployment, which drives some young individuals to resort to cybercrimes as a means of survival. However, under the current administration, the government is actively addressing these concerns by implementing initiatives like the Central Bank of Nigeria's BVN registration exercise across all banks. The aim is to combat financial fraud and create new employment opportunities to mitigate youth unemployment. Nonetheless, the lingering stigma of past experiences continues to influence the perceptions of both responsible citizens and foreigners, tarnishing the reputation of Nigerian tertiary institutions, particularly colleges of education, and posing a significant obstacle to the adoption of ICT.

Consequently, many individuals may approach dealings with Nigerians with caution due to the misconception that all Nigerians are associated with fraudulent activities, which is untrue. According to Caperna (2010), the presence of unscrupulous elements engaging in fraudulent internet activities and electronic transactions presents a challenge to the deployment of ICT in Nigerian tertiary institutions, especially colleges of education. To address these concerns and restore confidence in electronic transactions, the government is collaborating with the Nigerian Universities Commission to enhance the security of universities' electronic activities and internet transactions through the establishment of federal ICT centers in each university nationwide. As highlighted by Robinson et al. (2010), this initiative involves equipping each university's ICT centre with the necessary resources to combat cybercrimes effectively, ensuring the security and privacy of information.

In conclusion, while ICT offers numerous benefits for taxonomy education, including access to diverse resources and interactive learning opportunities, its integration is not without challenges. Addressing these difficulties requires a strategic approach, including investment in infrastructure, careful curation of online resources, and the development of digital literacy skills

among students and educators. Moreover, striking a balance between ICT and traditional teaching methods is crucial to ensure a comprehensive and effective taxonomy education experience.

Strategies for Effective Integration of ICT in Taxonomy Instruction

Technology integration is the use of technology resources in daily classroom practices, and in the management of a school. Successful technology integration is achieved when the use of technology is:

- Routine and transparent
- Accessible and readily available for the task at hand
- Supporting the curricular goals, and helping the students to effectively reach their goals

The utilization of technology for educational purposes has garnered considerable attention across all educational institutions in Nigeria (Afshari, et al., 2009). The emergence of new technologies has prompted the exploration of integrating ICT into teaching and learning practices in Nigeria (Gabriel et al., 2014). This progression highlights the potential benefits that ICT offers to higher education institutions including improved access to quality learning resources and enhanced instructional delivery methods by educators. The effective integration of ICT in the curricula with the intent of positively influencing teaching and learning has

been in a state of development over the past 20 years (Dockstader, 1999). This can be realized through changing the way people access, gather, analyse, present, transmit, and simulate information.

Universities prioritize integrating ICT as a significant goal, yet despite having infrastructure and professional development in place, there seems to be minimal activity in classrooms. Ongoing research explores the effectiveness of ICT in teaching. Salvador (2006) notes that proficient teachers prioritize cultivating information, communication, interpersonal, and self-directional skills. However, the challenge lies in deliberately ad strategically integrating these learning skills. Educators can establish learning environments where content resonates with students' lives, facilitate real-world interactions, and engage students in authentic learning experiences with peers, teachers, and knowledgeable adults. ICT enables learning beyond the confines of the classroom, fostering open learning opportunities essential in a knowledge-based society. Continuous provision of both hardware and software is crucial for supporting learners in schools.

Pierson (2001) emphasized that educational reform should not solely focus on increasing the number of machines in classroom but also on developing teaching strategies that complement the integration of technology into a curriculum. A critical concern for universities is determining which technologies and

applications teachers should learn. The question of what aspects of technology to teach is complex. Some argue that it is crucial for universities to help teachers understand the broader implications of technological advancements on their perspectives and lifestyles. Thus, universities should teach teachers about ICT both as content and instructional tools. Strategies for effectively integrating ICT into taxonomy instruction include:

- **Digital Taxonomic Databases:** utilize online databases and digital repositories of taxonomic information to provide students with access to a vast array of species descriptions, classifications, and distribution data.
- **Interactive Identification Tools:** Incorporate interactive tools and apps that allow students to identify organisms using keys, images, and other multimedia resources, enhancing their understanding of taxonomy concepts.
- **Virtual Specimen Collections:** Integrate virtual specimen collections and digital museums to provide students with opportunities to explore taxonomic diversity through high resolution images, 3D models, and detailed specimen information.
- **Virtual Field Trips:** Organize virtual field trips to botanical gardens, natural history museums, and biodiversity hotspots using virtual reality

(VR) technology or interactive webinars, allowing students to explore taxonomic diversity first-hand.

- **Multimedia Presentation:** Encourage students to create multimedia presentations, videos, and digital posters to demonstrate their understanding of taxonomy concepts, species classifications, and evolutionary relationships.

In conclusion, effective integration of Information and Communication Technology (ICT) into taxonomy instruction holds immense potential for enhancing learning experiences and fostering deeper understanding of biological diversity. By leveraging digital tools, online resources, and interactive platforms, educators can create engaging and immersive learning environments that cater to diverse learning styles and promote active student participation. From virtual specimen collections to online collaborative projects and simulation software, ICT offers numerous opportunities for students to explore taxonomy concepts, practice classification skills, and engage in authentic scientific inquiry. Moreover, by connecting taxonomy instruction with real-world applications, students can develop a deeper appreciation for the relevance of taxonomy in addressing global challenges and contributing to scientific knowledge.

Summary of Literature Reviewed

The review of literature was presented under Introduction to Taxonomy and its Importance in Biological Sciences, The Concept of Information and Communication Technology (ICT), Overview of Existing ICT Tools and Resources for Taxonomy Education, ICT in Education, Role of Information and Communication Technology (ICT) in Education, Benefits of ICT Integration in Taxonomy Teaching, Challenges and Limitations of Using ICT in Taxonomy Education, Strategies for Effective Integration of ICT in Taxonomy Education and Summary of Literature Reviewed.

According to the Introduction to Taxonomy and its Importance in Biological Sciences, Taxonomy is the branch of biology concerned with the classification, identification, and naming of organisms. It provides a systematic framework for organizing the vast diversity of life on Earth, allowing scientists to study and understand the relationships between different species and their evolutionary history. Taxonomy involves both the theory and application of organizing organisms into categories. The term "classification" carries dual meanings: it refers to both the end result produced by taxonomists and the process of organizing populations and groups of populations (taxa) at various levels using inductive methods (Mayr, 1969).

As per the notion of Information and Communication Technology (ICT), a diverse array of electronic tools and techniques are employed to collect, store, retrieve, process, present, transmit, and disseminate information globally, facilitating access and utilization by professionals worldwide, regardless of time, place, or method, with the aim of fostering economic and national progress (Salman, 2003). While ICT may be conceptualized in various ways, its core essence lies in the integration of computer, telecommunication, and human resources to enable global information exchange.

Under the Overview of Existing ICT Tools and Resources for Taxonomy Education, ICT tools are the latest devices and concepts used in Information and Communication Technology that can be used for different purpose (e.g. computers, laptops, desktops, data projectors, and interactive teaching box). They are used in education process as assets for enrichment of the learning process. The use of Information and Communication Technology (ICT) in taxonomy education has greatly expanded in recent years, providing a wide range of tools and resources to enhance learning experiences for students. Existing ICT tools and resources encompass a wide range of digital platforms, software applications, and online repositories designed to facilitate learning and exploration in the field of taxonomy.

Regarding ICT in Education, A new generation of learners, termed New Millennium Learners (NMLs), raised in an ICT-rich environment, tend to resort to the internet for queries. This study aimed to demonstrate that this new generation is inclined towards teaching methods incorporating ICT. However, achieving universal primary education access, as targeted by the Millennium Development Goals (MDGs) and Education for All (EFA) initiatives by 2015, remains a challenge for many countries like Nigeria due to teacher shortages, infrastructure, and resource inadequacies.

According to Role of Information and Communication Technology (ICT) in Education, The effective utilization of ICT has the power to revolutionize teaching and learning methods, resulting in a fundamental change in both content and instructional approaches. ICT possesses the capability to overcome geographical and spatial limitations. Its integration into education has significantly enhanced the overall quality of learning. There is a widespread belief that incorporating ICT will contribute to making education more accessible and cost-effective. With the growing influence of ICT, education will become more inclusive, thereby improving the availability of quality educational services even to students residing in the most remote areas of the country. The evolving landscape of ICT, with its

interactive, learner-centric approach, has fundamentally transformed the education process, including delivery and dissemination methods.

Regarding Benefits of ICT Integration in Taxonomy Teaching, Within the realm of biology, taxonomy stands to benefit significantly from the incorporation of ICT tools and resources. This note aims to explore the myriad benefits of ICT integration in taxonomy teaching, shedding light on how technology can enhance pedagogical approaches, engage students, and deepen understanding of biological diversity. ICT offers students a platform to ask questions, access search features, utilize simulation and gaming tools, all of which bolster cognitive abilities. The teacher's presence does not intimidate students, "even shy students have the opportunity to voice out" (Van der Westhuizen in Gravett & Geyser, 2004:170).

Under the Challenges and Limitations of Using ICT in Taxonomy Education, In Nigeria, the integration of ICT into education has undeniably impacted and improved learning processes, albeit with accompanying challenges. These challenges pose as hindrances or barriers to the adoption of ICT, similar to those encountered in renowned higher institutions worldwide. In Nigeria, the unreliable supply of electricity poses the most significant challenge to the growth and advancement of numerous industries, hindering Nigeria ' s progress as uninterrupted electricity remains elusive. This deficiency severely impedes the

effective integration of ICT in Nigerian tertiary institutions, as well as across various industries, as electricity is indispensable for the operation of ICT tools and electronic devices (Azuh & Modebelu, 2014). Another study emphasizes the critical role of proper infrastructure, including reliable electricity, for the utilization of computers (Aduwa-Ogiegbaen & Iyamu, 2005). The acquisition, deployment, and management of information technology resources and services for teaching are contingent upon a stable supply of electricity (Osakwe, 2012).

Regarding Strategies for Effective Integration of ICT in Taxonomy Education, The emergence of new technologies has prompted the exploration of integrating ICT into teaching and learning practices in Nigeria (Gabriel et al., 2014). This progression highlights the potential benefits that ICT offers to higher education institutions including improved access to quality learning resources and enhanced instructional delivery methods by educators. The effective integration of ICT in the curricula with the intent of positively influencing teaching and learning has been in a state of development over the past 20 years (Dockstader, 1999). This can be realized through changing the way people access, gather, analyse, present, transmit, and simulate information. Universities prioritize integrating ICT as a significant goal, yet despite having infrastructure and professional development in place, there seems to be minimal activity in classrooms.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter gives a rundown of the research procedures used in the study. This chapter is presented under the following sub-headings:

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

Research Design

The descriptive survey design will be used for this study. The choice of using this design originates from its ability to describe a research topic. It is also a useful means for fact finding and it is an acknowledged method of obtaining social facts and opinions for the purpose of enabling the researcher to make rationalization concerning his population of study from the result obtained from the sample

selected. It also provides appropriate methodology for investigating human behaviours, perception and opinions.

Population of the study

The population for this study involved two hundred and fifty (250) four hundred level (400L) students in Biological Sciences offering Taxonomy in the University of Benin. Animal and Environmental Biology (AEB) 60, Plant Biology and Biotechnology (PBB) 60 and Curriculum and Instructional Technology (CIT) 80.

Sample and Sampling Procedure

A total of one hundred and fifty (150) respondents were selected and used for this study. This represented sixty percent of the total population of four hundred level (400L) students in Biological Sciences offering Taxonomy in the University of Benin. The Simple Random Sampling (SRS) procedure was used in the study to select fifty students from the department of Animal and Environmental Biology (AEB), fifty students from the department of Curriculum and Instructional Technology (CIT) and fifty students from the department of Plant Biology and Biotechnology (PBB).

Research Instrument

For a research to be termed good, it is required that data are collected from a sample using an instrument that is valid and reliable.

The study will collect data with the aid of a close-ended questionnaire titled Undergraduate Students' Perception of the use of ICT in the Teaching of Taxonomy in Biological Sciences (USPITTBS). The USPITTBS is made up of two sections; "A and B''. The section A of the instrument will collect the demographic data of the respondents while the section B comprised of four (4) research questions. Question one has four (4) items, question two has five (5) items, question three has ten (10) items and question four has five (5) items . in total, section B has 24 attitude items with response structured into the Modified Likert format of four scaled response mode of Strongly agree (SA), Agree (A), Strongly disagree (SD) and Disagree. Other scaled response mode used are Very often, Often, Sometimes, Rarely, Not at all, Excellent, Good, Poor, No capability.

Validity of the Instrument

In order to ascertain the extent to which the instruments used clearly measured what the researcher intend to measure, a copy of the questionnaire items was taken to specialists in Curriculum and Instructional technology in the Faculty of Education, University of Benin and then finally to the Researchers' Project Supervisor for vetting who adequately studied, modified and corrected, where by the final face and content validation of the questionnaire items was obtained. The first draft contained thirty five (35) items, which were later modified to twenty

four (24) items after merging some and weeded out some. Eleven (11) items were removed. It was therefore satisfied for the study.

Reliability of the Instrument

To determine the reliability of the instrument, the test-re-test procedure was adopted for the USPITTBS. Fifteen (15) copies of the instrument were administered to the respondents who were not part of the target population. After a time lag of two weeks the instrument was re-administered on the same group of respondents. Thereafter, their responses on the two occasions will be collated and correlated.

Method of Data Collection

In order to collect data for this study, a closed-ended questionnaire was distributed to the sample. The questionnaire was personally administered with the assistance of my course mate. The face-to-face method of administration of the questionnaires facilitates the completion and subsequent retrieval of the questionnaires. The meeting point with respondents took place at the classrooms.

Method of Data Analysis

The data will be analysed using simple descriptive statistics for easy presentation and interpretation. The data collected from respondents will be analysed using Mean score where items with a mean of 2.50 and above were accepted and items with less than 2.50 were rejected.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter is concerned with the analyses of data and presentation of results and the discussion of findings. The chapter is presented in two subheadings as follows:

- Presentation of Results
- Discussion of Findings

  Data collected are presented and analysed with respect to the research questions that guided this study. Raw scores were used in preparing the frequency distribution table weighted under Strongly agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, Strongly disagree (SD) = 1. The mean was used in answering the research questions that guided the study.

Discussion of field and survey finding

Table 1: Socio-Demographic characteristics of respondents

Demographic variable	Grouping	Frequency	Percentage (%)
Course Area	AEB	50	33.3%
	PBB	50	33.3%
	CIT	50	33.3%
	Total	**150**	**100%**
Sex	Male	51	34%
	Female	99	66%
	Total	**150**	**100%**

Source: Field Survey, 2024

Table 1. Above, shows the socio-demographic characteristic of the respondents in terms of Course Area and sex. The above table reveals that 50 (33.3%) respondents in each of the three Course Areas (Animal and Environmental Biology, Plant Biology and Biotechnology and CIT) filled the questionnaire. From the table, Fifty One 51 (34%) were male while Ninety Nine 99 (66%) were females.

Research Questions 1. What purpose and how frequently do you use ICT in the study of Taxonomy?

Table 2: **Descriptive Statistics on the purpose and frequency of ICT usage in the study of Taxonomy.**

Purpose	**Very Often**	**Often**	**Sometimes (a few times a month)**	**Rarely (once in several months)**	**Not at all**	**N**	**Mean**
To find and acquire information on Taxonomy.	50 (33.3%)	43 (28.6%)	23 (15.3%)	17 (11.3%)	17 (11.3%)	150	3.6
To use and manipulate existing information on Taxonomy using existing information.	26 (17.3%)	36 (24%)	35 (23.3%)	24 (16%)	29 (19.3%)	150	3.0
To compose, compile, produce new information on Taxonomy.	28 (18.6%)	38 (25.3%)	23 (15.3%)	26 (17.3%)	35 (23.3%)	150	2.9
To exchange and	30	26	29	32	33	150	2.9

to transmit information on Taxonomy with other students using E-mail and internet.	(20%)	(17.3%)	(19.3%)	(21.3%)	(22%)

According to the results shown in the above table 2, 77.2% of respondents accepted using ICT To find and acquire information on Taxonomy, To use and manipulate existing information on Taxonomy using existing information (64.6%), To compose, compile, produce new information on Taxonomy (59.2%), To exchange and to transmit information on Taxonomy with other students using E-mail and internet (56.6%). Conclusively all items were above the cut off mean of 2.5 and therefore accepted to use ICT in the study of Taxonomy.

Research Questions 2. Please indicate your level of skills in the use of computer applications for the study of taxonomy.

Table 3: **Descriptive Statistics on the level of skills in the usage of computer applications for the study of taxonomy.**

COMPUTER APPLICATION SKILLS	Excellent	Good	Poor	No capability	N	Mean
I am able to use word processor to create, edit and format documents on taxonomy.	57 (38%)	66 (44%)	17 (11.3%)	10 (6.6%)	150	3.1
I am able to use presentation tools (PowerPoint) in learning taxonomy.	49 (32.6%)	76 (50.6)	15 (10%)	10 (6.6%)	150	3.0
I am able to use applications (word	52	72	14	12 (8%)	150	3.0

processing, spreadsheet, PowerPoint) for learning taxonomy.	(34.6%)	(48%)	(9.3%)			
I can use various applications to do assignments, research and projects on taxonomy.	65 (43.3%)	73 (48.6%)	9 (6%)	3 (2%)	150	3.3
I am able to use email to collaborate on group assignments and projects with other students and exchange information on taxonomy.	52 (34.6%)	68 (45.3%)	19 (12.6%)	11(7.3%)	150	3.0

According to the results shown in the above table 3, 82% of respondents said that they are able to use word processor to create, edit and format documents on taxonomy. They are able to use presentation tools (PowerPoint) in learning taxonomy (83.2%), They are able to use applications (word processing, spreadsheet, PowerPoint) for learning taxonomy (82.6%), They can use various applications to do assignments, research and projects on taxonomy (91.9%), They are able to use email to collaborate on group assignments and projects with other students and exchange information on taxonomy (79.9%). Conclusively all items were above the cut off mean of 2.5 and therefore accepted to be the level of skills in the use of computer applications for the study of taxonomy.

Research Questions 3. Rank the items below to indicate your level of agreement or disagreement with the following Information Communication Technologies (ICT).

Table 4: Descriptive Statistics on the level of agreement or disagreement with the usage of some ICT tools.

ITEM	SA	A	SD	D	N	Mean
Learning taxonomy with ICT requires highly developed study skills and strategies.	41 (27.3%)	81 (54%)	11 (7.3%)	17 (11.3%)	150	2.9
I would like to study taxonomy with a computer even if it is complicated.	52 (34.6%)	77 (51.3%)	5 (3.3%)	16 (10.6%)	150	3.1
Audio-visual materials do not improve my learning of taxonomy.	6 (4%)	21 (14%)	80 (53.3%)	43 (23.6%)	150	1.9
Video materials can improve my learning of Taxonomy.	97 (64.6%)	48 (32%)	2 (1.3%)	3 (2%)	150	3.5
I prefer learning taxonomy with traditional education method rather than with ICT.	6 (4%)	23 (15.3%)	57 (38%)	64 (42.6%)	150	1.8
Using the internet alone to study taxonomy is acceptable to me.	25 (16.6%)	43 (28.6%)	24 (17%)	58 (38.6%)	150	2.2
ICT does not improve my learning of taxonomy.	___ (0%)	12 (8%)	80 (53.3%)	58 (38.6%)	150	1.6
Learning taxonomy with ICT brings reality in the classroom.	83 (55.3%)	41 (27.3%)	21 (14%)	5 (3.3%)	150	3.3

Availability and access to ICT provide more opportunities to enhance my learning of taxonomy.	93 (62%)	54 (36%)	2 (1.3%)	1 (0.6%)	150	3.5
ICT allows for effective sharing of information on taxonomy.	93 (62%)	51 (34%)	2 (1.3%)	4 (2.6%)	150	3.5

According to the results shown in the above table 4, 81.3% of respondents said that Learning taxonomy with ICT requires highly developed study skills and strategies. They would like to study taxonomy with a computer even if it is complicated (85.9%), Audio-visual materials do not improve my learning of taxonomy (18%), Video materials can improve my learning of Taxonomy (96.6%), They prefer learning taxonomy with traditional education method rather than with ICT (19.3%), Using the internet alone to study taxonomy is acceptable to me (45.2%), ICT does not improve my learning of taxonomy (8%), Learning taxonomy with ICT brings reality in the classroom (82.6%), Availability and access to ICT provide more opportunities to enhance my learning of taxonomy (98%), ICT allows for effective sharing of information on taxonomy (96%). Conclusively all items except items 3, 5, 6 & 7 were above the cut off mean of 2.5 and therefore accepted to be the level of agreement or disagreement with the usage of some ICT tools.

Research Questions 4. Rank the items below choosing either SA, A, SD or D to indicate your level of agreement or disagreement with the following barriers to Technology usage in learning taxonomy.

Table 5: Descriptive Statistics on the level of agreement or disagreement with the barriers to the usage of Technology in learning taxonomy.

Barriers to Technology Usage	SA	A	SD	D	N	Mean
Limited access to useful, relevant, and appropriate hardware and software.	76 (50.6)	64 (42.6%)	6 (4%)	4 (2.6%)	150	3.4
Unavailability of electrical power supply in classrooms and hostels.	69 (46%)	55 (36.6%)	9 (6%)	17 (11.3%)	150	3.1
Poor internet connectivity in classrooms and hostels.	80 (53.3%)	58 (38.6)	7 (4.6%)	5 (3.3%)	150	3.4
Lack of interest of students in technology usage.	33 (22%)	38 (25.3%)	38 (25.3%)	41 (27.3%)	150	2.4
Inadequate maintenance of ICT equipment.	74 (49.3%)	63 (42%)	6 (4%)	7 (4.6%)	150	3.3

According to the results shown in the above table 5, Limited access to useful, relevant, and appropriate hardware and software (93.2%), Unavailability of electrical power supply in classrooms and hostels (82.6%), Poor internet connectivity in classrooms and hostels (91.9%), Lack of interest of students in technology usage (47.3%), Inadequate maintenance of ICT equipment (91.3%). Conclusively all items except item 4 were above the cut off mean of 2.5 and therefore accepted to be the barriers to Technology usage in learning taxonomy.

Discussion of Findings

The response to research question one suggests the purpose and frequency of ICT usage in the study of Taxonomy. It was observed that University of Benin students use ICT to find and acquire information on Taxonomy, compose, compile, and produce new information on Taxonomy, to exchange and to transmit information on Taxonomy with other students using E-mail and internet. It was also acknowledged that students constantly use ICT tools for assignments and schoolwork.

The response to research question two demonstrates the level of skills in the usage of computer applications for the study of taxonomy. It was therefore concluded that the level of ICT skills of University of Benin undergraduate students in biological science studying taxonomy is good and as a matter of fact most students studying taxonomy do have basic ICT skills because they are effectively taught taxonomy with the use of ICT tools.

The outcome of study question three demonstrates the level of agreement or disagreement with the usage of some ICT tools. The findings showed that video materials can improve the learning of Taxonomy, ICT allows for effective sharing of information on taxonomy, Availability and access to ICT provide more opportunities to enhance the learning of taxonomy. It was also observed that using

the internet alone to study taxonomy is not acceptable to the University of Benin undergraduate students in biological sciences.

The outcome of study question four demonstrates the barriers to the usage of Technology in learning taxonomy. The factors acting as barriers to ICT usage in learning Taxonomy are irregular power supply in class, irregular power supply in hostel, poor internet connectivity in classrooms and hostels, limited access to useful, relevant, and appropriate hardware and software, Inadequate maintenance of ICT equipment. According to the survey carried out, it was also observed that lack of interest of students in technology usage is not a barrier to the usage of technology in learning Taxonomy.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes and concludes the results of objectively tested research topics. It also provides extensive suggestions on how the conclusions of the research can enhance academic performance. The conclusions are drawn from the outcomes of the research, pertinent studies, and existing literature. This investigation took place within the Biological Sciences departments at the University of Benin.

Summary

This study examined how students perceive the integration of ICT in teaching taxonomy within the field of Biological Sciences. Its main aim was to determine whether the utilization of ICT impacted students' academic achievements. During the process, four research topics were formulated to guide the study. The data for the study was collected through a meticulously crafted questionnaire. In total, fifty students each were deliberately selected from three departments at the University of Benin: Plant Biology and Biotechnology (PBB), Animal and Environmental Biology (AEB), and Curriculum and Instructional Technology (CIT).

The study utilized a sample of students from four departments. Descriptive statistical methods such as frequency distribution, mean, and simple percentage were employed in analysing the data for this study. Based on the analysis,

University of Benin students use ICT to find and acquire information on Taxonomy, compose, compile, and produce new information on Taxonomy, to exchange and to transmit information on Taxonomy with other students using E-mail and internet. The level of ICT skills of University of Benin undergraduate students in biological science studying taxonomy is good and as a matter of fact most students studying taxonomy do have basic ICT skills because they are effectively taught taxonomy with the use of ICT tools. In the University of Benin, students generally hold favourable attitudes towards the incorporation of ICT resources in genetics instruction, which significantly boosts their academic performance.

Conclusion

The study's findings illustrated that integrating ICT into higher education can enhance student performance by fostering greater interest in learning, facilitating collaborative networking, and optimizing instructional delivery. Students generally displayed optimism, although some acknowledged encountering obstacles and barriers that hindered them from fully utilizing the systems. The results show that poor internet connectivity in classrooms and hostels is the primary barrier hindering the successful integration of ICT in teaching and learning within Nigeria's higher education system. Irregular power supply in class; irregular power supply in hostel; limited access to useful, relevant, and appropriate

hardware and software; inadequate maintenance of ICT equipment. In today's globalized context, students in higher education institutions in Edo State, Nigeria, may face challenges in competing internationally if they lack sufficient ICT skills. It is imperative that Nigerian universities incorporate information and communication technology effectively into teaching and learning processes.

Recommendations

Below are the recommendations based on the reviewed literature and findings of the study that will contribute to bringing solutions to the challenges faced by students:

1. Implementing training programs for both students and instructors is essential to keep pace with rapidly evolving technology and enhance technical proficiency to meet industry standards. Additionally, introducing computer literacy courses for students from disadvantaged secondary schools would enable them to effectively utilize e-learning platforms and enhance their academic performance. Palvia et al. (2018), in their investigation on the status, challenges, trends, and implications of online education, affirmed that providing educators and students with adequate resources would significantly improve their technological competence, engagement, and the dissemination of education.

2. Enhancements in technical assistance and internet accessibility will significantly promote the sustained utilization of ICT. According to the study's findings, students perceive the internet as sluggish. Moreover, reinforcing technical proficiency and support is vital as it establishes a feedback mechanism to inform technical teams about the technical requirements, errors, and challenges encountered by faculty, support staff, and particularly students (Jamil, Sethi, and Ali, 2016). Consequently, it is suggested that the Department of Information Technology augment bandwidth to enhance internet speeds and bolster the stability of ICT platforms.
3. Implementing solar energy sources would assist institutions in achieving complete integration of ICT by offering a backup power supply for teaching and learning purposes.
4. Administrators of higher education institutions should integrate ICT into their strategic planning to ensure connectivity of the institution with Local Area Network (LAN).
5. In order to facilitate the comprehensive integration of ICT in teaching and learning, affluent individuals, non-governmental organizations, community-

based organizations, and other agencies should collaborate with the state government to provide staff training.

Contributions to Knowledge

This study contributed the following insights:

1. It highlighted the factors affecting the use of ICT in teaching taxonomy at the University of Benin.
2. It demonstrated that ICT tools enhance the effectiveness of students' taxonomy lessons.
3. It assessed the extent to which students utilize more dynamic and engaging ICT skills in learning taxonomy.
4. At the University of Benin in Edo State, Nigeria, it explored how undergraduate students perceive their ability to adapt to and apply information communication technologies.

Suggestions for Further Studies

This study has investigated the perceptions of undergraduate students regarding the utilization of ICT in teaching taxonomy in biological sciences. However, further research is needed in the following areas:

1. Investigation of how ICT usage impacts students' conceptual understanding of Taxonomy and biological classification.

2. Investigation of how ICT usage influences students' interest and motivation in pursuing biological sciences careers.
3. Analysis of the impact of ICT on students' critical thinking and problem-solving skills in Taxonomy-related case studies.
4. Exploration on the use of artificial intelligence and machine learning in teaching Taxonomy concepts.
5. Exploration of the role of ICT in promoting collaborative learning and peer-to-peer teaching in Taxonomy classes.

REFERENCES

Kiboss, J. K., (1997). Relative Effects of a Computer-Based Instruction in Physics on Students' Attitudes, Motivation and Understanding about Measurement and Perceptions of Classroom Environment. Unpublished PhD Thesis, University of the Western Cape.

Too, J. K., (1996). A Survey of the Availability and Use of Media Resources in Mathematics Instruction: The Case of Secondary Schools in Nandi District, Kenya. Unpublished Masters Thesis, Moi University.

Aina, J.K. (2013). Effective teaching and learning in science education through Information and Communication Technology. IOSR journal of Research and Method in Education, College of Education, Nigeria.

Bekyibei, E. B (2012). Availability of Information and Communication Technology Resources in Teaching and Learning of Biology by Secondary Schools in Uasin Gishu County, Kenya. 80. Osodo.

Douglas, R. (2011). ICT for teaching and ICT for learning: They are not the same. Computers in New Zealand Schools: Learning, teaching, technology, retrieved from http://www.otago.ac.nz/cdelt/otago064427.

Ezechi, N.G.& Egbo J J (2014). Assessment of ICT utilization competencies science and technology teachers in secondary schools in teacher education in Nigeria.

Gambari, A. I. & Chike-Okoli, A. (2007). Availability and utilization of information and communication technology (ICT) facilities in higher institutions in Niger state, Nigeria. The Information Technologists. An International journal of Information and communication technology (ICT).

Mdlongwa, Thabani (2012). Information and Communication Technology (ICT) as a Means of Enhancing Education in Schools in South Africa: Challenges, Benefits and Recommendations.

Nwafor, C. E. (2006). Technological devices for integrated science teaching. The Journal of Information Communications and Computing Technologies.

Twinomujuni, J. (2011). Problems in ICT Implementation in Selected Institutions of Higher Learning in Kabale District. Unplibshed master dessertation, Education in Information and Communication Technology, Makerere University, Kampala, Uganda.

Van Rooy and Wilhelmina, S. (2012). Using ICT to maximum: Learning and teaching Biology with limited digital technologies. Research in Science and Technological Education, Volume 30.

Aibara, H.D., 2017. To Study the Impact of Information and Communication Technology ICT as A Subject in Std X Students of Maharashtra State Board SSC Schools in Mumbai.

Youssef, A. & Dahmani, M. (2008). The Impact of ICT on Student Performance in Higher Education: Direct Effects, Indirect Effects and Organisational Change. Revista de Universidad Y Sociedad Del Conocimiento, http://doi.org/10.7238/rusc.

APPENDIX

UNDERGRADUATE STUDENTS' PERCEPTION OF THE USE OF ICT IN THE TEACHING OF TAXONOMY IN BIOLOGICAL SCIENCES

SURVEY QUESTIONNAIRE

Please give us your views as your answers to these questions will be of great benefit in helping to shape the use of ICT in the teaching of Taxonomy and will be kept confidential and solely used for the purpose of this research. Thank you for giving me your valuable time to complete this questionnaire.

Please mark boxes where applicable

SECTION A

What is your gender? Male [ ] Female [ ]

Course area: AEB [ ] CIT [ ] PBB [ ]

SECTION B

Q1. What purpose and how frequently do you use ICT in the study of Taxonomy?

Purpose	**Very Often**	**Often**	**Sometimes (a few times a month)**	**Rarely (once in several months)**	**Not at all**
To find and acquire information on Taxonomy.					
To use and manipulate existing information on Taxonomy using existing information.					
To compose, compile, produce new information on Taxonomy.					
To exchange and to transmit information on Taxonomy with other students using E-mail and internet.					

Q2. Please indicate your level of skills in the use of computer applications for the study of taxonomy.

COMPUTER APPLICATION SKILLS	**Excellent**	**Good**	**Poor**	**No capability**
I am able to use word processor to create, edit and format documents on taxonomy.				
I am able to use presentation tools (PowerPoint) in learning taxonomy.				
I am able to use applications (word processing, spreadsheet, PowerPoint) for learning taxonomy.				
I can use various applications to do assignments, research and projects on taxonomy.				
I am able to use email to collaborate on group assignments and projects with other students and exchange information on taxonomy.				

Q3. Rank the items below choosing either SA (Strongly agree), A (Agree), SD (Strongly disagree) or D (Disagree) to indicate your level of agreement or disagreement with the following Information Communication Technologies (ICT).

ITEM	**SA**	**A**	**SD**	**D**
Learning taxonomy with ICT requires highly developed study skills and strategies.				
I would like to study taxonomy with a computer even if it is complicated.				
Audio-visual materials do not improve my learning of taxonomy.				
Video materials can improve my learning of Taxonomy.				

I prefer learning taxonomy with traditional education method rather than with ICT.				
Using the internet alone to study taxonomy is acceptable to me.				
ICT does not improve my learning of taxonomy.				
Learning taxonomy with ICT brings reality in the classroom.				
Availability and access to ICT provide more opportunities to enhance my learning of taxonomy.				
ICT allows for effective sharing of information on taxonomy.				

Q4. Rank the items below choosing either SA, A, SD or D to indicate your level of agreement or disagreement with the following barriers to Technology usage in learning taxonomy.

Barriers to Technology Usage	**SA**	**A**	**SD**	**D**
Limited access to useful, relevant, and appropriate hardware and software.				
Unavailability of electrical power supply in classrooms and hostels.				
Poor internet connectivity in classrooms and hostels.				
Lack of interest of students in technology usage.				
Inadequate maintenance of ICT equipment.				