

**INFLUENCE OF BIOLOGY TEACHERS' WILLINGNESS ON THE INTEGRATION
OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN TEACHING**

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APRIL, 2025

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**A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF CURRICULUM AND
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CERTIFICATION

We, the undersigned, certify that this work was carried out by Benedicta Hannah AKANDE (EDU2005232) in the department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, Nigeria.

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DEDICATION

This project is dedicated to the resilient educators of Nigeria, whose passion for teaching transcends resource constraints, may this work contribute to the tools and recognition you deserve.

To every student, who will walk into a biology classroom tomorrow, may your learning experience be transformed by the possibilities of technology.

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ABSTRACT

This study examines biology teachers' willingness to integrate Information and Communication Technology (ICT) into their instructional practices, identifying key barriers and enablers to adoption in secondary schools. A descriptive survey design was employed, with data collected from thirty (30) biology teachers across schools, using a Likert-scale questionnaire.

Findings revealed strong teacher willingness, with high enthusiasm for ICT tools and peer advocacy. However, systemic challenges particularly unstable electricity, inadequate school infrastructure, and insufficient training significantly hindered implementation. Teachers proposed actionable solutions, including regular subject-specific training, dedicated technical support teams, and biology-focused ICT tools.

The study concludes that while biology teachers are predisposed to adopt ICT, transformative integration requires targeted interventions addressing infrastructure deficits, professional development, and curricular flexibility. These findings contribute to the Technology Acceptance Model (TAM) by contextualizing its constructs within resource-constrained educational settings. Recommendations are provided for policymakers, school administrators, and teacher training programs to bridge the gap between willingness and effective ICT adoption.

CHAPTER ONE

INTRODUCTION

Background of the Study

Information and Communication Technology (ICT) refers to the diverse set of tools, resources, and technologies used to communicate, create, disseminate, store, and manage information. These technologies include computers, the Internet, broadcasting technologies like radios and televisions, telephones, etc. Globalization and innovations in technology have led to an increased use of ICTs in all sectors and education is no exception. Uses of ICTs in education are widespread and are continually growing worldwide. ICT in education encompasses a wide range of digital tools including computers, tablets, projectors, interactive whiteboards, the internet, educational software, and multimedia resources such as videos, animations, and simulations. These technologies have revolutionized the way knowledge is delivered, accessed, and shared, making learning more interactive, engaging, and accessible (UNESCO, 2011).

Globally, the integration of ICT in education has been recognized as a critical driver of educational reform and innovation. It has transformed traditional teaching methods, enabling educators to move beyond the confines of textbooks and chalkboards. ICT allows teachers to use multimedia presentations to explain complex concepts, conduct virtual experiments, and provide students with access to a wealth of online resources including digital textbooks, e-books, online

journals, and educational websites. This access eliminates the constraints of physical resources like printed textbooks and physical libraries for research and study materials, ensuring students have up-to-date and diverse learning materials at their fingertips. Additionally, digital libraries and online repositories allow educators and students to share and access educational content, fostering a culture of knowledge exchange and collaboration. This shift from teacher-centered to student-centered learning has been shown to improve student engagement, critical thinking, and academic performance.

The importance of ICT in education is underscored by its role in preparing students for the 21st-century workforce. In an increasingly digital world, proficiency in ICT is no longer optional but essential for success in virtually every field. From healthcare to engineering, business to agriculture, digital literacy is a prerequisite for career advancement and innovation. By integrating ICT into education, schools can equip students with the skills and knowledge needed to thrive in a technology-driven society. This transformative potential of ICT in the educational system has long been recognized globally by the governments, and has led to the widespread and well-established adoption of ICT in education in developed countries. For example, countries like Finland, South Korea, and Singapore have successfully integrated ICT into their national curricula, providing students and teachers with access to cutting-edge technologies and resources

(OECD, 2015). These countries have also invested heavily in teacher training programs to ensure that educators are equipped with the skills and confidence to use ICT effectively in the classroom. The Nigeria government has also long recognized the transformative potential of Information and Communication Technology (ICT) in its educational system. This recognition is evident in the National Policy on Computer Education (FME, 2014), which underscored the importance of integrating ICT into the Nigerian education system. The policy outlined specific objectives for different levels of education. At the primary school level, it emphasized introducing pupils to basic computer skills, such as using computers for learning, text writing, computation, and data entry. For secondary schools, the goals were more advanced, aiming to build on the foundational skills acquired at the primary level. At the tertiary level, institutions were mandated to teach computer science as a discipline and integrate ICT into school administration and instruction. The National Policy on Education (FRN), revised in 1988 and 2004, further reinforced the importance of ICT integration in Nigeria's educational system. This revision reflected a broader vision, moving beyond basic computer education to embrace the full spectrum of ICT. It also highlighted the need for adequate infrastructure to support this integration. Additionally, the Nigerian National Policy for Information Technology (FRN, 2001) outlined three key objectives: empowering youths with ICT skills to enhance their global competitiveness, integrating ICT into the core of education and training, and establishing specialized ICT institutions as centers of

excellence. These policies collectively demonstrate Nigeria's commitment to leveraging ICT for educational advancement.

Although the potential benefits of ICT in education are widely acknowledged in Nigeria, its adoption in Nigerian schools has been slow and uneven. One of the most significant barriers to ICT adoption in Nigerian schools is the lack of adequate infrastructure. Many schools, particularly those in rural areas, lack basic ICT tools such as computers, projectors, and internet connectivity. According to the National Bureau of Statistics (2019), only 34% of Nigerian schools have access to computers, and a mere 11% have internet connectivity. This disparity is even more pronounced in rural areas, where schools often lack electricity and other basic amenities. The absence of reliable electricity is a major impediment to ICT integration. The World Bank (2020) reports that only 55% of Nigerians have access to electricity, and this figure drops significantly in rural areas. Without a stable power supply, schools cannot effectively use ICT tools, rendering even the most advanced technologies useless. Additionally, the lack of internet connectivity limits students' and teachers' access to online resources, which are critical for modern education.

Another major challenge is the limited funding allocated to education in Nigeria. Despite the government's recognition of the importance of ICT in education, budgetary allocations to the sector have consistently fallen short of the UNESCO-recommended 15-20% of the national

budget. In 2023, for example, only about 7% of Nigeria's budget was allocated to education, leaving little room for investment in ICT infrastructure and resources. The inadequate funding has far-reaching implications. Schools cannot afford to purchase computers, software, or other ICT tools. Even when ICT equipment is provided, there is often no budget for maintenance, leading to the rapid deterioration of these resources. Furthermore, the misappropriation of funds and corruption in the education sector worsens the problem, as resources meant for ICT projects are often diverted for other purposes, leaving the education sector unattended to.

Despite these challenges, the need to embrace ICT in education, particularly in science subjects like biology, where digital tools can enhance understanding and engagement, cannot be overemphasized. The integration of ICT in biology education offers unique opportunities to address some of the challenges associated with teaching the subject. One of these is limited access to visual and interactive resources. Biology involves complex concepts and processes (e.g., cell division, photosynthesis, and human anatomy) that are often abstract and difficult to visualize and without ICT tools like animations, simulations, and videos, students may struggle to grasp these concepts, leading to poor comprehension and retention(Akpan & Umoh, 2017).

Another challenge associated with teaching the subject without the use of ICT is the lack of access to up-to-date information. Biology is a dynamic field with constant advancements in areas like genetics, biotechnology, and ecology. Without access to the internet or digital resources,

teachers and students rely on outdated textbooks, missing out on current scientific discoveries and trends. ICT can provide biology teachers with access to up-to-date information and resources, enabling them to stay current with advancements in the field. For example, online platforms and databases offer a wealth of research articles, case studies, and educational materials that can enrich the teaching and learning experience. By leveraging these resources, biology teachers can create more dynamic and interactive lessons that cater to the diverse learning needs of their students.

Limited exposure to global perspectives is another challenge that cannot be overlooked when biology is being taught in schools without the use of ICT. Without ICT, students' knowledge is confined to local or outdated information, limiting their ability to think globally and critically about biological challenges. ICT provides access to global research, case studies, and perspectives on biological issues through multimedia resources like videos, animations, and documentaries from around the world; educational websites like Khan Academy, BBC Bitesize, and National Geographic; online research databases on platforms like PubMed, JSTOR, and Google Scholar; and virtual collaborations which enable students to participate in international projects, webinars, and competitions.

Therefore, the willingness of biology teachers to integrate Information and Communication Technology (ICT) into their teaching practices plays a critical role in the successful adoption and

implementation of ICT in Nigerian schools. Teachers' attitudes, motivations, and readiness to embrace ICT significantly influence how effectively these technologies are used to enhance teaching and learning. When biology teachers are willing to adopt ICT, they can drive its successful integration in enhancing teaching and learning, improving understanding, and developing their profession, as willing teachers are more motivated to attend ICT training programs, improving their digital literacy and teaching skills and also to experiment with new teaching methods and tools, fostering a culture of innovation in the classroom.

However, several factors can act as barriers to biology teachers' willingness in the integration of ICT in teaching. One of these factors is lack of training. Many Nigerian teachers lack the necessary skills and training to incorporate ICT into their teaching practices. A study by Adedoja and Abidoje (2013) found that less than 20% of Nigerian teachers have received formal training in ICT integration. This lack of training has several consequences. First, teachers who are unfamiliar with ICT tools stick to traditional teaching methods which are not as effective as using ICT. Second, even when ICT resources are available, teachers may not know how to use them effectively, limiting their impact on student learning. Finally, the absence of continuous professional development opportunities means that teachers are unable to keep up with advancements in educational technology.

Resistance to change is another factor acting as a barrier to biology teachers' willingness in the integration of ICT in teaching. Many biology teachers are accustomed to and comfortable with traditional teaching methods, such as lectures, chalkboard explanations, and textbook-based instructions. They view these methods as sufficient and see no need to adopt ICT, especially if they have been teaching successfully without it for years. Also, older teachers, in particular, may find it challenging to adapt to new technologies due to a lack of exposure or experience. They may perceive ICT as something for younger, tech-savvy teachers rather than for themselves. Finally, some teachers are skeptical about the benefits of ICT and question its impact on student learning. They believe that ICT is a distraction and that it undermines the traditional teacher-student relationship.

Lastly, the workload and time constraints of biology teachers act as barriers to the integration of ICT in teaching. Integrating ICT into lessons requires additional time and effort for planning and preparation. Teachers with heavy workloads may struggle to find the time to prepare ICT-based lessons, especially if they are teaching multiple classes or subjects, and therefore may be unwilling to take on the extra responsibility. Also, teachers may need to create their own ICT resources, such as presentations, videos, or quizzes, in the absence of readily available, high-quality digital resources. These can be time-consuming and increase the workload for teachers. They may also face technical challenges in the process of creating these digital resources and

spend extra time troubleshooting technical issues, such as software glitches, internet connectivity problems, or hardware malfunctions. These challenges can be time-consuming and frustrating, discouraging teachers from using ICT.

Statement of the Problem

The integration of Information and Communication Technology (ICT) in education has been widely recognized as a transformative tool for enhancing teaching and learning outcomes. Globally, ICT has revolutionized education by providing interactive and engaging learning experiences, improving access to educational resources, and preparing students for a technology-driven world. In Nigeria, the adoption of ICT in education is seen as a critical step toward addressing the challenges of the education system, including inadequate infrastructure, outdated teaching methods, and low student performance in science subjects like biology. However, despite the potential benefits of ICT, its integration in Nigerian schools has been slow and uneven, particularly in the teaching of biology.

One of the key factors influencing the successful integration of ICT in education is the willingness of teachers to adopt and use these technologies in their teaching practices. However, many biology teachers in Nigeria are reluctant to integrate ICT into their teaching due to various barriers, such as inadequate training, lack of infrastructure, and resistance to change. This reluctance has significant implications for the quality of biology education, as students are

deprived of access to interactive and engaging learning resources that could enhance their understanding of biological concepts.

The lack of ICT integration in biology teaching limits students' exposure to modern teaching methods and global perspectives, hindering their ability to compete in a technology-driven world. Furthermore, it exacerbates the disparities between urban and rural schools, as students in rural areas are often more disadvantaged due to limited access to ICT resources. Without addressing these challenges, the quality of biology education in Nigeria will continue to decline, ultimately affecting the country's development in science and technology.

Therefore, this study seeks to explore the influence of biology teachers' willingness on the integration of ICT in teaching. By identifying the factors that influence teachers' willingness and the challenges they face, the study aims to provide insights into how to promote ICT adoption in Nigerian schools, ultimately enhancing the quality of biology education.

Research Questions

1. What is the level of willingness among biology teachers to integrate ICT into their teaching practices?
1. What factors influence biology teachers' willingness to adopt ICT in teaching?
2. How can the factors that influence teachers' willingness to integrate ICT be controlled?

Purpose of the Study

This study aims to investigate

- The level of willingness among biology teachers to integrate ICT into their teaching practices.
- The factors influencing biology teachers' willingness to adopt ICT in teaching.
- How the factors that influence teachers' willingness to integrate ICT can be controlled.

Significance of the Study

The findings of this study are expected to be beneficial to teachers, students, school administrators, policy makers and researchers.

With the numerous benefits of ICT in the educational sectors, policy makers and school administrators will find this study valuable, as it will provide actionable insights for designing effective interventions to promote ICT integration in Nigerian schools.

Students stand to benefit significantly from this study, as improved ICT integration in teaching biology will transform their learning experiences.

The findings of this study can be used in benchmarking biology teachers' willingness in integrating ICT in teaching.

Researchers could develop on findings from this study, research more into the field of ICT integration in the teaching and learning process of biology.

Scope and Delimitations of the Study

This study will investigate the influence of biology teachers' willingness on the integration of information and communication technology (ICT) in teaching.

The study is delimited to biology teachers in senior secondary schools in Ovia North-East Local Government Area of Edo State.

Definition of Terms

The following terms will be encountered in the course of the study, and are defined as used in the study.

Biology: The branch of science that deals with the study of living organisms.

ICT (Information and Communication Technology): These are the diverse set of tools, resources, and technologies used to communicate, create, disseminate, store, and manage information.

Integration: The act of incorporating ICT into biology teaching practices.

Teachers' willingness: The attitude or readiness of biology teachers to adopt and integrate ICT into their teaching methods.

CHAPTER TWO

LITERATURE REVIEW

In this chapter, related literature to the topic will be discussed under the following sub-headings:

- Theoretical Framework
- Concept of Biology
- Concept of Technology
- Concept of ICT
- Teachers' Willingness to Integrate ICT
- Summary of Literature Review

Theoretical Framework

The theoretical framework for this study is grounded in three key theories: the Technology Acceptance Model (TAM), Diffusion of Innovations Theory, and Self-Efficacy Theory. These theories collectively provide a comprehensive lens through which the influence of biology teachers' willingness on ICT integration can be understood. Each theory contributes unique insights into the psychological, social, and contextual factors that shape teachers' attitudes and behaviors toward ICT adoption in teaching. By examining these theories, this study aims to uncover the underlying mechanisms that drive or hinder ICT integration in biology education.

The Technology Acceptance Model (TAM), developed by Davis (1989), is one of the most widely used theories for explaining how individuals adopt and use technology. At its core, TAM posits that two key factors determine an individual's willingness to adopt a new technology. These are perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which a teacher believes that using ICT will enhance their teaching effectiveness and improve student learning outcomes. For example, if a biology teacher believes that using animations or simulations will help students better understand complex concepts like cell division or photosynthesis, they are more likely to adopt ICT. Perceived ease of use on the other hand, refers to the degree to which a teacher believes that using ICT will be stress-free and easy to implement. If a teacher finds ICT tools intuitive and easy to use, they are more likely to integrate them into their teaching, and teachers who find them difficult to use or time-consuming may resist adoption, even if they recognize its potential benefits. The Technology Acceptance Model provides a valuable lens for understanding how biology teachers' perceptions of ICT's usefulness and ease of use influence their willingness to adopt it, thus highlighting the importance of addressing teachers' perceptions to promote ICT integration in biology education. While the Technology Acceptance Model focuses on individual perceptions of technology, the Diffusion of Innovations Theory developed by Rogers in 2003 provides a broader perspective on how new technologies or ideas spread within a social system. According to this theory, the

adoption of an innovation is influenced by five key factors: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage refers to the degree to which ICT is perceived as better than traditional teaching methods. For example, if teachers believe that ICT offers significant advantages, such as increased student engagement or access to up-to-date resources, they are more likely to adopt it. Compatibility refers to the degree to which ICT aligns with teachers' existing practices, values, and needs. If ICT tools are compatible with the curriculum and teaching methods, teachers are more likely to integrate them. Complexity refers to the degree to which ICT is perceived as difficult to understand or use. If teachers perceive ICT as complex or time-consuming, they are less likely to adopt it. Trialability refers to the degree to which teachers can experiment with ICT on a limited basis before fully adopting it. If teachers have the opportunity to try ICT tools in a low-stakes environment, they are more likely to overcome initial resistance. And finally, observability refers to the degree to which the benefits of ICT are visible to others. If teachers can see the positive impact of ICT on their colleagues' teaching or students' learning, they are more likely to adopt it. However, those who find ICT of no relative advantage, not compatible with their teaching style or curriculum and too complex, or those who have not tried using it before, nor have observed any positive changes from their colleagues and students due to ICT integration, will resist integrating it into their teaching.

The Self-Efficacy Theory, proposed by Albert Bandura in 1977 as part of his broader Social Cognitive Theory, explains how individuals' beliefs in their capabilities influence their behavior. In the context of teaching, self-efficacy refers to a teacher's confidence in their ability to perform specific tasks, such as integrating ICT into their lessons. According to Bandura, self-efficacy is shaped by four primary sources: mastery experiences (successful past experiences), vicarious experiences (observing others), verbal persuasion (encouragement from others), and emotional states (feelings of anxiety or confidence).

In the context of this study, Self-Efficacy Theory provides a psychological framework for understanding how biology teachers' confidence in using ICT influences their willingness to adopt it. Teachers with high self-efficacy are more likely to embrace ICT, as they believe in their ability to overcome challenges and effectively integrate these tools into their teaching. Conversely, teachers with low self-efficacy may avoid ICT due to fear of failure or lack of confidence. This theory highlights the importance of professional development and training in building teachers' self-efficacy and promoting ICT integration. By addressing teachers' confidence and competence, this study can identify strategies to enhance their willingness to adopt ICT in biology teaching.

Concept of Biology

Biology, derived from the Greek words "bios" meaning life and "logos" meaning study, represents the scientific discipline dedicated to the systematic investigation of living organisms and their vital processes (Campbell et al., 2018). As a fundamental natural science, biology encompasses the study of life at all levels of organization, from molecular interactions within cells to the complex dynamics of entire ecosystems (Urry et al., 2021). This comprehensive field examines the structure, function, growth, origin, evolution, and distribution of living organisms, providing crucial insights into the natural world.

The scope of biological science has expanded significantly through its various specialized branches. Molecular biology focuses on understanding cellular processes at the molecular level, including DNA replication and protein synthesis (Alberts et al., 2022); Genetics explores heredity and genetic variation while ecology investigates the relationships between organisms and their environments (Smith & Smith, 2021); Evolutionary biology examines the origins and changes in species over time, and physiology studies the functional mechanisms of living systems (Sherwood, 2016). These interconnected disciplines collectively contribute to our understanding of life in all its forms.

In educational contexts, biology serves as a cornerstone subject with profound implications for scientific literacy and critical thinking development (Bybee, 2018). The study of biology equips

learners with essential knowledge about life processes, from cellular metabolism to ecosystem dynamics, while fostering skills in scientific inquiry and evidence-based reasoning (NGSS Lead States, 2013). Furthermore, biological education provides foundational knowledge for numerous career pathways in medicine, biotechnology, environmental science, and related fields (National Research Council, 2012).

However, the teaching of biology presents unique challenges due to the abstract nature of many biological concepts and the rapid advancement of biological knowledge (Johnstone, 2006). Educators must continually adapt to incorporate new discoveries while effectively communicating complex ideas about cellular processes, genetic mechanisms, and ecological systems (Duschl & Bybee, 2014). These challenges highlight the importance of developing innovative pedagogical approaches to facilitate student understanding of biological principles.

Concept of Technology

Technology represents the systematic application of scientific knowledge to solve practical problems and improve human capabilities (Brey, 2018). Derived from the Greek words "techne" meaning art/craft, and "logos" meaning study, technology encompasses the tools, machines, systems, and methods developed through human ingenuity to extend our physical and mental capacities (Volti, 2017). In contemporary society, technology has become an indispensable force

shaping nearly all aspects of human life, from communication and transportation to healthcare and education.

The evolution of technology can be traced through several key revolutions in human history (Mokyr, 2016). The agricultural revolution marked the development of tools for cultivation, while the industrial revolution introduced mechanized production systems. The digital revolution of the late 20th century brought about computers and information systems, and we now find ourselves in the midst of the artificial intelligence revolution (Schwab, 2017). Each technological revolution has fundamentally transformed how humans interact with their environment and with each other.

Modern technology can be categorized into several domains (Roco & Bainbridge, 2013). Information technology deals with data processing and communication systems, while biotechnology applies biological principles to medical and agricultural applications. Green technology focuses on sustainable environmental solutions, and educational technology enhances teaching and learning processes. These diverse technological fields share the common purpose of improving human efficiency, solving problems, and creating new possibilities for societal development.

In educational contexts, technology serves multiple critical functions (Selwyn, 2016). It provides tools for content delivery, facilitates interactive learning experiences, enables access to vast

information resources, and supports collaborative learning environments. The effective integration of technology in education requires careful consideration of pedagogical goals, teacher competencies, and institutional infrastructure (Mishra & Koehler, 2006). When properly implemented, educational technology can enhance student engagement, personalize learning experiences, and prepare students for a technologically advanced workforce.

The relationship between technology and society is complex and reciprocal (Bijker et al., 2012). While technology drives social change, it is simultaneously shaped by cultural values, economic factors, and political decisions. This dynamic interaction highlights the importance of developing technological literacy among all citizens to enable informed participation in contemporary society (Feenberg, 2017). As technology continues to advance at an unprecedented pace, understanding its nature and implications becomes increasingly crucial for individuals and communities worldwide.

Concept of ICT

Information and Communication Technology (ICT) represents the technological infrastructure that facilitates the creation, storage, management, and exchange of digital information (Buabeng-Andoh, 2018). As a comprehensive term, ICT encompasses all technologies that enable users to access, retrieve, store, transmit, and manipulate information in digital form (UNESCO, 2018).

This includes hardware components such as computers, smartphones, and networking equipment, along with software applications and digital services that process and communicate information.

The evolution of ICT has progressed through several distinct phases (Castells, 2010). Early developments focused on basic computing machines, followed by the emergence of personal computing in the 1980s. The internet revolution of the 1990s marked a significant turning point, enabling global connectivity and information sharing. Currently, we are experiencing the era of mobile computing, cloud technologies, and artificial intelligence-driven systems (Schwab, 2016). Each phase has brought increasingly sophisticated capabilities for information processing and communication.

Modern ICT systems typically comprise several core components (Laudon & Laudon, 2020). Hardware elements include input/output devices, processing units, and storage media. Software components range from operating systems to specialized applications. Network infrastructure enables data transmission, while data management systems organize and secure digital information. These technical elements combine to create integrated systems that support various organizational and personal functions.

In educational settings, ICT serves multiple critical functions (Selwyn, 2016). It provides platforms for content delivery, facilitates interactive learning experiences, enables access to global information resources, and supports collaborative learning environments. Specific

educational applications include learning management systems, digital assessment tools, educational software, and online collaboration platforms (Hwang et al., 2015). The effective implementation of ICT in education requires careful consideration of pedagogical objectives, teacher competencies, and institutional infrastructure (Mishra & Koehler, 2006).

The adoption of ICT in education offers several potential benefits (Fu, 2013). It can enhance student engagement through interactive multimedia content, provide personalized learning pathways, facilitate anytime-anywhere learning opportunities, and develop digital literacy skills essential for the modern workforce. However, successful integration depends on addressing challenges such as infrastructure limitations, teacher training needs, and curriculum alignment (Ertmer & Ottenbreit-Leftwich, 2013). When properly implemented, ICT can transform traditional educational paradigms and create more dynamic, student-centered learning environments.

Teachers' Willingness to Integrate ICT

Teachers' willingness to integrate Information and Communication Technology (ICT) in instructional practices represents a critical factor in successful technology adoption in educational settings (Scherer et al., 2019). This construct encompasses educators' readiness, motivation, and behavioral intention to incorporate digital tools and resources into their teaching methodologies (Teo, 2011). Research indicates that teacher willingness serves as a significant

predictor of actual ICT implementation in classrooms, often outweighing the mere availability of technological resources (Inan & Lowther, 2010).

The theoretical foundation for understanding teachers' willingness to adopt ICT draws upon several psychological and behavioral models (Venkatesh et al., 2003). The Technology Acceptance Model (TAM) suggests that perceived usefulness and perceived ease of use significantly influence adoption intentions (Davis, 1989). Social Cognitive Theory emphasizes the role of self-efficacy in technology integration, where teachers' confidence in their technical abilities affects their willingness to use ICT (Bandura, 1997). Additionally, the Unified Theory of Acceptance and Use of Technology (UTAUT) identifies performance expectancy, effort expectancy, social influence, and facilitating conditions as key determinants of technology adoption behavior (Venkatesh et al., 2003).

Several factors influence teachers' willingness to integrate ICT in their pedagogical practices (Ertmer & Ottenbreit-Leftwich, 2010). Personal factors include technological self-efficacy, attitudes toward innovation, and perceived benefits of ICT for student learning. Organizational factors encompass institutional support, availability of technical infrastructure, and professional development opportunities. Contextual factors involve curriculum requirements, student characteristics, and societal expectations regarding technology use in education (Tondeur et al.,

2017). The interplay of these elements creates complex dynamics that either facilitate or hinder teachers' technology adoption decisions.

Research has identified multiple barriers that affect teachers' willingness to implement ICT (Hew & Brush, 2007). Resource-related barriers include inadequate hardware, software, and technical support. Institutional barriers involve restrictive policies, lack of time for technology integration, and insufficient professional development. Personal barriers stem from low self-confidence with technology, negative attitudes, or resistance to change (Somekh, 2008). Subject-specific challenges also emerge, particularly in disciplines like biology where teachers may struggle to identify appropriate digital resources that align with curriculum objectives (Jimoyiannis, 2010).

Professional development programs play a crucial role in enhancing teachers' willingness to adopt ICT (Mishra & Koehler, 2006). Effective training should address both technical skills and pedagogical strategies for technology integration, following the Technological Pedagogical Content Knowledge (TPACK) framework. Ongoing support, collaborative learning communities, and hands-on practice opportunities significantly increase teachers' confidence and motivation to use ICT in their teaching (Voogt et al., 2013). School leadership and institutional culture also serve as powerful influences, where supportive administrators and technology-positive environments foster greater teacher willingness (Zhao & Frank, 2003).

The impact of teachers' willingness to integrate ICT manifests in various aspects of educational practice (Hattie, 2009). Willing teachers demonstrate more frequent and varied use of technology, employ more student-centered pedagogical approaches, and show greater persistence in overcoming technical challenges (Tondeur et al., 2017). Their classrooms often feature higher levels of student engagement, collaborative learning opportunities, and development of digital literacy skills (Tamim et al., 2011). Conversely, reluctant teachers may use technology minimally or in ways that fail to capitalize on its transformative potential (Cuban, 2001).

Summary of Literature Review

This comprehensive literature review has systematically examined the key factors influencing biology teachers' willingness to integrate Information and Communication Technology (ICT) in their instructional practices. The review was structured around five core themes that collectively provide a robust theoretical and practical foundation for understanding this educational phenomenon.

The theoretical framework established the conceptual underpinnings of the study, drawing upon three complementary models: the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and ease of use; Diffusion of Innovations Theory (DIT), which explains the social and contextual factors in technology adoption; and Self-Efficacy Theory, which highlights teachers' confidence in their technological capabilities. These theoretical perspectives

collectively suggest that ICT integration is influenced by complex interactions between technological, individual, and environmental factors.

The examination of biology as a discipline revealed its unique characteristics that both necessitate and challenge ICT integration. As a visually-intensive, conceptually complex, and rapidly evolving science, biology education stands to benefit significantly from digital visualization tools, virtual laboratories, and interactive simulations. However, the abstract nature of many biological concepts and the practical demands of laboratory work present particular challenges for technology integration that may influence teachers' willingness to adopt ICT solutions.

The analysis of technology and ICT concepts traced their evolution and educational applications, demonstrating how modern digital tools have transformed teaching and learning paradigms. The literature highlighted that effective ICT integration requires more than just technical access - it demands appropriate pedagogical strategies, institutional support, and teacher readiness. These findings contextualize the challenges and opportunities biology teachers face when considering technology adoption.

The exploration of teachers' willingness to integrate ICT identified multiple influencing factors operating at personal, institutional, and societal levels. Key determinants include teachers' technological self-efficacy, perceived benefits for student learning, availability of professional

development, institutional support structures, and alignment with curriculum requirements. The literature consistently emphasizes that willingness is not merely an individual attribute but emerges from complex interactions between teacher beliefs, school contexts, and technological systems.

The literature review underscores several important implications for practice and policy. Successful ICT integration requires comprehensive approaches that address teachers' technological pedagogical content knowledge, institutional support systems, alignment with curriculum goals, and ongoing professional learning opportunities. Particularly for biology education, subject-specific training is needed to help teachers identify and implement appropriate digital resources that enhance rather than distract from core biological concepts.

This review establishes a strong foundation for the current study by clarifying the multidimensional nature of teachers' willingness to integrate ICT. It positions the research within existing theoretical frameworks while identifying specific gaps that the study aims to address, particularly regarding the unique context of biology education. The findings highlight the need for holistic approaches to technology integration that consider both individual teacher factors and broader institutional ecosystems. Future research directions suggested by this review include investigating subject-specific technology integration challenges, exploring the longitudinal

development of teacher willingness, and examining effective models for sustaining ICT use in biology classrooms.

CHAPTER THREE

METHODOLOGY

In this chapter, the following will be discussed in respect to the research work to be carried out, under these subheadings:

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

Research Design

A descriptive survey design will be used for this research. The design would be ideal for this study, as it seeks to analyze the influence of biology teachers' willingness on the integration of information and communication technology (ICT) in teaching.

Population of the Study

The population for this study will include all biology teachers in the 174 secondary schools in Ovia North-East Local Government Area of Edo State.

Sample and Sampling Techniques

From the study's population which comprises 174 secondary schools in Ovia North-East Local Government Area, a stratified sampling technique was employed to select 30 biology teachers across urban and rural areas and public and private schools in the aforementioned locality.

Research Instruments

Data will be collected using a well structured questionnaire titled "A Questionnaire on the Influence of Biology Teachers' Willingness on the Integration of ICT in Teaching"

The questionnaire has been distinctively divided into two sections: Section A and Section B. Section A is designed to gather information regarding the demographic profile of the respondents, offering insights into the diverse backgrounds that contribute to the research context. Section B

on the other hand, comprises of twenty(20) carefully crafted items aimed at extracting information concerning the subject matter being researched on.

The questionnaire will include questions with a four-point Likert-scale responses which are Strongly Agree(SA), Agree(A), Disagree(D) and Strongly Disagree(SD). When the items are positively phrased, SA = 4 points, A = 3 points, D = 2 points, and SD = 1 point. However, negatively phrased items will be scored using reversed scoring.

This scaling system facilitates a detailed understanding of participants' perspectives, allowing for a more comprehensive analysis of the data collected.

Validity of the Instrument

The questionnaire will be validated by the researcher's supervisor in the department of Curriculum and Instructional Technology (CIT) and two other experts from the Faculty of Education, University of Benin. Their corrections and suggestions will be used to produce the final draft of the research instrument.

Reliability of the Instrument

To determine the reliability of the instrument, a test-retest reliability test was carried out using ten (10) biology teachers who would not be part of the main study, by administering the instrument twice to them within a two-week interval. The data got was subjected to Cronbach's Alpha test, and a reliability coefficient of 0.703 was got.

Method of Data Collection

The questionnaire would be administered by the researcher, and orientation on the research would be given to respondents so as to aid proper answering of questions. The questionnaire would be collected by the researcher as soon as they are completed by the respondents.

Method of Data Analysis

The collected data will be systematically organized and tabulated. Descriptive statistics will be used to analyze the collected data, using mean and standard deviation for a comprehensive examination.

CHAPTER FOUR

PRESENTATION OF DATA AND ANALYSIS

This chapter entails the presentation, analysis and interpretation of data collected using the questionnaire.

Research Question 1 What is the level of willingness among Biology teachers to integrate ICT into their teaching practices?

Table 1: Descriptive Statistics on the Level of Willingness Among Biology Teachers to Integrate ICT into their Teaching Practices.

S/N	ITEMS	N	SA	A	D	SD	MEAN	STANDARD DEVIATION	DECISION
1	I am enthusiastic about using ICT tools in teaching biology.	30	17 56.7%	13 43.3%	0 0%	0 0%	3.57	.50	Agree
2	I believe ICT makes biology lessons more engaging for students.	30	18 60%	10 33.3%	2 6.7%	0 0%	3.53	.62	Agree
3	I frequently use ICT to explain complex biology concepts (e.g., photosynthesis, DNA).	30	8 26.7%	12 40%	10 33.3%	0 0%	2.93	.77	Agree
4	I prefer ICT-enhanced lessons to traditional teaching methods.	30	20 66.7%	7 23.3%	3 10%	0 0%	3.57	.67	Agree
5	I feel ICT is unnecessary for effective biology teaching.	30	1 3.3%	4 13.3%	15 50%	10 33.3%	3.13	.76	Disagree
6	I actively recommend ICT tools to fellow biology teachers.	30	19 63.3%	10 33.3%	1 3.3%	0 0%	3.60	.56	Agree
GRAND MEAN							3.38	.65	Agree

The data, as shown in table 1, indicates strong enthusiasm among Biology teachers for using ICT tools, with a mean score of 3.57. This suggests that the majority of teachers are highly motivated to incorporate ICT into their teaching practices, reflecting a positive attitude toward technological integration.

Teachers overwhelmingly believe that ICT enhances student engagement, as evidenced by a mean score of 3.53. This implies that ICT is perceived as a valuable tool for making Biology lessons more interactive and captivating for students.

The mean score of 2.93 (SD = 0.77) suggests that while a majority of Biology teachers use ICT to explain complex concepts (e.g., photosynthesis, DNA), the adoption is moderate and not yet universal. This indicates that there is room for improvement.

With a mean score of 3.57 (SD = 0.67), teachers clearly prefer ICT-enhanced lessons over traditional teaching methods. This strong preference highlights a shift toward modern pedagogical approaches in Biology education.

For the reverse-coded statement, “ICT is unnecessary for effective Biology teaching”, the mean score of 3.13 (SD = 0.76) which is above the midpoint indicates disagreement. This reinforces the consensus that ICT is considered essential for contemporary teaching.

The highest mean score of 3.60 (SD = 0.56) reveals that teachers actively recommend ICT tools to colleagues, demonstrating widespread advocacy and confidence in its benefits.

Research Question 2: What factors influence Biology teachers' willingness to adopt ICT in teaching?

Table 2: Descriptive Statistics on the Factors that Influence Biology Teachers' Willingness to Adopt ICT in Teaching.

S/N	ITEMS	N	SA	A	D	SD	MEAN	STANDARD DEVIATION	DECISION
1	I struggle with technical setup (e.g., projectors, software).	30	8 26.7 %	11 36.7%	10 33.3%	1 3.3%	2.13	.85	Disagree
2	I can create my own digital resources(e.g., quizzes, videos) for biology.	30	6 20%	15 50%	9 30%	0 0%	2.90	.70	Agree
3	I feel anxious when trying new ICT tools.	30	3 10%	10 33.3%	13 43.3%	4 13.3%	2.60	.84	Agree
4	My school provides reliable ICT infrastructure(computers, internet).	30	3 10%	8 26.7%	11 36.7%	8 26.7%	2.20	.94	Disagree
5	I receive adequate training on ICT tools for Biology teaching.	30	3 10%	11 36.7%	12 40%	4 13.3%	2.43	.85	Disagree
6	Technical support is available when I encounter ICT problems.	30	4 13.3 %	11 36.7%	11 36.7%	4 13.3%	2.50	.88	Agree

7	Unstable electricity/internet disrupts my ICT use.	30	16	9	4	1	1.67	.83	Disagree
			53.3%	30%	13.3%	3.3%			
8	The Biology curriculum leaves no time for ICT integration.	30	8	7	10	5	2.40	1.05	Disagree
			26.7%	23.3%	33.3%	16.7%			
GRAND MEAN							2.35	.87	Disagree

The data indicates that technical setup challenges significantly hinder ICT integration, with a mean score of 2.13. This suggests that teachers frequently struggle with basic technical aspects like projectors and software, highlighting a need for more user-friendly systems and better technical support.

Teachers demonstrate strong capability in creating digital resources, as shown by the mean score of 2.90. This implies that most educators are comfortable developing digital quizzes and videos, which could serve as a foundation for peer-learning initiatives.

While the mean score of 2.60 suggests most teachers don't feel anxious about new ICT tools, the standard deviation of 0.84 indicates some variability in responses. This means that while many are confident, a significant minority still experience apprehension when adopting new technologies.

The mean score of 2.20 for provision of reliable school infrastructure reveals inadequate provision of ICT resources. This suggests that many schools lack reliable computers and internet access, creating a fundamental barrier to effective technology integration in Biology classrooms.

With a mean score of 2.43, the data shows that current ICT training opportunities are insufficient. This indicates that teachers require more comprehensive and subject-specific professional development to fully leverage educational technologies.

Technical support availability shows marginal adequacy with a mean score of 2.50. While some

support systems exist, the near-neutral score suggests they are inconsistent and need to be strengthened across schools.

Electricity and internet disruptions present the most severe challenge, with a mean score of 1.67. This underscores the critical need for infrastructure improvements to create stable environments for ICT-enabled teaching.

The mean score of 2.40 regarding curriculum time constraints indicates that many teachers struggle to find opportunities for ICT integration. This suggests the Biology curriculum may need restructuring to better accommodate technology-enhanced learning methods.

Research Question 3: How can the factors that influence teachers' willingness to integrate ICT be controlled?

Table 3: Descriptive Statistics on How the Factors that Influence Biology Teachers' Willingness to Integrate ICT can be Controlled.

S/N	ITEMS	N	SA	A	D	SD	MEAN	STANDARD DEVIATION	DECISION
1	Regular ICT training would significantly increase my usage.	30	22 73.3%	8 26.7%	0 0%	0 0%	3.73	.45	Agree
2	A dedicated technical support team would boost my ICT adoption.	30	22 73.3%	7 23.3%	1 3.3%	0 0%	3.7	.53	Agree
3	Reduced curriculum load would encourage me to use ICT more.	30	11 36.7%	13 43.3%	6 20%	0 0%	3.17	.73	Agree
4	Provision of biology-focused ICT tools would enhance my teaching.	30	21 70%	9 30%	0 0%	0 0%	3.7	.46	Agree
5	Peer collaboration on ICT integration would motivate me.	30	14 46.7%	13 43.3%	2 6.7%	1 3.3%	3.33	.75	Agree
6	School policies should strongly incentivize ICT use in teaching.	30	19 63.3%	9 30%	2 6.7%	0 0%	3.57	.62	Agree
GRAND MEAN							3.53	.59	Agree

The data shows overwhelming support for regular ICT training, with a mean score of 3.73 (SD = 0.45). This suggests that teachers believe continuous professional development would significantly increase their ICT usage, highlighting the need for structured, ongoing training programs.

Teachers strongly agree that a dedicated technical support team would boost ICT adoption, as indicated by the mean score of 3.70 (SD = 0.53). This implies that reliable, on-demand assistance is critical for overcoming technical barriers in the classroom.

With a mean score of 3.17 (SD = 0.73), teachers agree that a reduced curriculum load would encourage greater ICT use. This indicates that time constraints are a significant hurdle, and curriculum adjustments may be necessary to facilitate technology integration.

The provision of subject-specific ICT tools is highly supported, with a mean score of 3.70 (SD = 0.46). This suggests that teachers are more likely to adopt ICT when tools are tailored to Biology content, such as virtual labs or interactive simulations.

Teachers agree that peer collaboration would motivate ICT integration, as reflected in the mean score of 3.33 (SD = 0.75). This underscores the value of professional learning communities where educators can share strategies and resources.

The data reveals strong agreement that school policies should incentivize ICT use, with a mean score of 3.57 (SD = 0.62). This indicates that institutional support, such as recognition or rewards, could drive broader adoption of technology in teaching.

Discussion of Findings

The grand mean of 3.25 demonstrates strong overall willingness among Biology teachers to integrate ICT into their teaching practices. This positive disposition is particularly evident in their enthusiasm for ICT tools, belief in ICT's ability to enhance student engagement, and active peer recommendations. Such results suggest that teachers fundamentally recognize the value of technology in Biology education, aligning with Davis's (1989) Technology Acceptance Model which posits that perceived usefulness drives adoption intentions.

The grand mean of 2.35 from Table 2 reveals a critical tension in ICT integration: while Biology teachers demonstrate willingness to adopt technology (as evidenced by Table 1's grand mean of 3.28), systemic barriers significantly hinder implementation. This below-midpoint score underscores how infrastructure deficiencies and institutional constraints outweigh individual readiness. The data paints a nuanced picture where teachers' capability to create digital resources is undermined by crippling electricity disruptions and unreliable school infrastructure. According to these findings, first-order external barriers – particularly resource limitations – dominate implementation challenges in resource-constrained educational contexts(Howard et al., 2021).

The grand mean of 3.53 reveals overwhelming consensus among Biology teachers about strategies to boost ICT integration, reflecting stronger agreement than both Table 1 and Table 2. This high score, anchored by near-perfect agreement on regular training, technical support and subject-specific tools, signals that teachers have clear, actionable solutions to overcome adoption challenges. Notably, the lowest-scoring item (reduced curriculum load -3.17) still exceeds the scale's midpoint, suggesting that while time constraints matter, they are less critical than other factors. This nuanced findings suggest that teachers prioritize practical interventions (e.g., training, tools) over structural reforms when adopting innovations (Farjon et al., 2019).

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The study examines the influence of Biology teachers' willingness on the integration of information and communication technology (ICT) in teaching.

1. The overall assessment reveals strong teacher willingness, with notable enthusiasm for ICT tools and peer advocacy, indicating a solid foundation for technology adoption.
2. Despite this readiness, critical barriers hinder implementation, including infrastructure deficits (electricity, school tools) and insufficient training. These challenges underscore systemic gaps that require urgent attention.
3. Positive feedback on actionable solutions such as regular training, technical support teams and Biology-focused ICT tools, highlights clear pathways to enhance integration.
4. There is room for improvement in addressing curriculum constraints and reducing anxiety among late-adopting teachers, which could further optimize ICT adoption.

The study employs three(3) research questions to delve into various aspects of the programme, including its theoretical framework, concept of Biology, concept of technology, concept of ICT,

teachers' willingness to integrate ICT and its impact on students, teachers, administrators and the government.

The research encompasses Biology teachers in the 174 secondary schools in Ovia North-East Local Government Area, Edo State. Thirty (30) teachers were chosen using a stratified sampling technique. Data collection relied on structured questionnaires, revealing that there is a strong level of willingness among Biology teachers to integrate ICT in their teaching practices, various barriers hinder teachers from adopting ICT in their teaching, and there are efficient ways to control the various factors acting as barriers to Biology teachers' adoption of ICT in teaching.

Findings

Based on the analysis, below are the findings of the study.

1. Biology teachers have a very high level of willingness and are enthusiastic to integrate ICT into their teaching practices.
2. Various factors, particularly resource limitations like poor infrastructure and institutional constraints, influence teachers' willingness to integrate ICT in their teaching.
3. The various factors that influence Biology teachers' willingness to integrate ICT in their teaching can be controlled by providing subject-specific tools, technical support and regular training.

Conclusion

The study concludes that while Biology teachers are predisposed to adopt ICT, systemic barriers particularly infrastructure and training gaps, limit full implementation.

The alignment between teachers' proposed solutions and their reported challenges provides an actionable blueprint for stakeholders.

These findings resonate with Venkatesh's Technology Acceptance Model (2003), emphasizing that perceived usefulness alone cannot drive change without enabling conditions.

Recommendations

1. The government should prioritize infrastructure investments (stable electricity, internet, and hardware).
2. The government should mandate subject-specific ICT training for Biology teachers, focusing on complex concepts (e.g., virtual labs for DNA modeling).
3. School administrators should establish dedicated ICT support teams and peer-mentoring programs.
4. School administrators should also incentivize ICT innovation through recognition and career advancement opportunities.
5. Teachers are encouraged to collaborate through Professional Learning Communities (PLCs) to share digital resources and strategies.

6. Teachers are to advocate for institutional support by documenting and reporting implementation barriers.

Suggestions for Further Studies

1. Investigate the impact of post-intervention support (e.g., after infrastructure upgrades).
2. Explore long-term student outcomes linked to ICT-integrated Biology instruction.

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APPENDIX

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY (CIT)

FACULTY OF EDUCATION

UNIVERSITY OF BENIN, BENIN CITY, NIGERIA

Dear Respondent,

APPEAL FOR THE COMPLETION OF QUESTIONNAIRE

I am an undergraduate student in the above-named department and as part of the requirement for the programme, I am conducting a research on the **influence of teachers' willingness on the integration of information and communication technology (ICT) in teaching.**

In this regard, you are kindly invited to participate in the research by completing a short questionnaire. I assure that your responses will be strictly confidential and solely used for research purposes.

Thank You.

Sincerely,

Benedicta Hannah Akande.

(Researcher)

**QUESTIONNAIRE ON THE INFLUENCE OF BIOLOGY TEACHERS' WILLINGNESS
ON THE INTEGRATION OF ICT IN TEACHING**

SECTION A (DEMOGRAPHIC VARIABLES)

Instruction: Please tick [✓] against your chosen response.

Gender: Male[] Female[]

School Type: Rural[] Urban[]

Years of Experience: 0-3 years[] 4-7 years[] 8-11 years[] 12 years and above []

SECTION B

Instruction: Please indicate the extent to which you agree with the following.

Key: SA=Strongly Agree, A=Agree, D=Disagree, SD=Strongly Disagree.

S/N	QUESTIONS	SA	A	D	SD
	WHAT IS THE LEVEL OF WILLINGNESS AMONG BIOLOGY TEACHERS TO INTEGRATE ICT INTO THEIR TEACHING PRACTICES?				
1	I am enthusiastic about using ICT tools in biology teaching.				
2	I believe ICT makes biology lessons more engaging for students.				
3	I frequently use ICT to explain complex biology concepts (e.g., photosynthesis, DNA).				

4	I prefer ICT-enhanced lessons over traditional teaching methods.				
5	I feel ICT is unnecessary for effective biology teaching.				
6	I actively recommend ICT tools to fellow biology teachers.				
	WHAT FACTORS INFLUENCE BIOLOGY TEACHERS' WILLINGNESS TO ADOPT ICT IN TEACHING?				
7	I struggle with technical setup (e.g., projectors, software).				
8	I can create my own digital resources (e.g., quizzes, videos) for biology.				
9	I feel anxious when trying new ICT tools.				
10	My school provides reliable ICT infrastructure (computers, internet).				
11	I receive adequate training on ICT tools for biology teaching.				
12	Technical support is available when I encounter ICT problems.				
13	Unstable electricity/internet disrupts my ICT use.				
14	The biology curriculum leaves no time for ICT integration.				
	HOW CAN THE FACTORS THAT INFLUENCE TEACHERS' WILLINGNESS TO INTEGRATE ICT BE CONTROLLED?				
15	Regular ICT training would significantly increase my usage.				
16	A dedicated technical support team would boost my ICT				

	adoption.				
17	Reduced curriculum load would encourage me to use ICT more.				
18	Provision of biology-focused ICT tools would enhance my teaching.				
19	Peer collaboration on ICT integration would motivate me.				
20	School policies should strongly incentivize ICT use in teaching.				