# A QUASI-EXPERIMENTAL STUDY ON THE EFFECT OF INFORMATICS IN TEACHING AND LEARNING IN UNIVERSITIES IN EDO STATE

BY

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BENIN CITY.

JANUARY, 2026

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## DECLARATION

I, Evbuomwan Gregory Izevbuwa with matriculation number PG/PSC/2216040, by this means, declare that this research projects on a ‘A Quasi-Experimental Study on the Effect of Informatics in Teaching and Learning in Universities in Edo State‘ which is being submitted by me in partial fulfilment doe the award of the Masters of Science Degree in Computer Science, is an authentic report carried out by me during the 2023/2024 academic session. I further undertake the work embodied in the report has not been submitted previously for the award of any degree or diploma by me to any other university or institution.

IZEVBUWA GREGORY EVBUOMWAN — DATE

PG/PSC/2216040

## CERTIFICATION

This is to certify that this research work titled ‘A Quasi-Experimental Study on the Effect of Informatics in Teaching and Learning in Universities in Edo State‘ was carried out by Izevbuwa Gregory EVBUOMWAN with Matriculation Number PG/PSC/2216040, in the Department of Computer Science, Faculty of Computing, University of Benin and has been read and approved as meeting the requirements for the award of the Master’s degree in Computer Science.

PROF. F.I. AMADIN
(Project Supervisor)

DATE

## APPROVAL

This project is hereby approved by the Department of Computer Science in partial fulfillment of the requirement for the award of Masters in Computer Science (M.Sc.) Degree in Computer Science of the University of Benin, Benin City, Nigeria.

| | |
|---|---|
| DR. (MRS.) A.R. USIOBAIFO<br>(Head of Department) | DATE |

## DEDICATION

This project is dedicated to God Almighty for the gift of life and His love and mercies throughout my study period, my family for their constant love, support, and encouragement, and to all who believe in the transformative power of education and technology in national development.

## ACKNOWLEDGEMENT

I express my profound gratitude to God Almighty for the strength, wisdom, and perseverance granted to me throughout the course of this research. I sincerely appreciate my supervisor, Prof. F.I. Amadin for the invaluable guidance, constructive criticisms, and scholarly insight provided. His availability for consultations, insightful feedback and consistent support has been invaluable at every stage of this research.

I also extend my heartfelt thanks to the Head of the Department, Dr. (Mrs.) A.R. Usiobaifo, whose impactful leadership significantly enriched my experience throughout the program. I must also acknowledge the valuable contributions of the Master's Coordinator Dr. (Mrs.) R.O. Osaseri. I appreciate the input of all members of the Postgraduate Board of the Department of Computer Science at the University of Benin.

My appreciation also extends to the lecturers and non-teaching staff of the Faculty of Computing, particularly, Prof. (Mrs.) V.V.N. Akwukuma, Dr. (Mrs.) G.O.Aziken, Prof. F.O. Chete, Prof. (Mrs.) S.C. Chiemeke, Prof. (Mrs.) F.A. Egbokhare, Prof. (Mrs.) A.O. Egwali, Prof. G.O. Ekuobase, Dr. E.C. Igodan, Prof. A. Imiavan, Mr. P.E.B. Imiefoh, Prof. Engr. F.A.U. Imouokhome, Dr. D.N. Idehen, Dr. (Mrs.) R.I. Izebvizua, Prof. (Mrs.) S. Konyeha, Dr. E. Nwelih, Mr. E. Obasohan, Mr. E.I. Obayagbona, Mr. B.J Odetayo, Dr. F.O. Oliha, Mrs. B.O. Omoruyi, Dr. Mrs. U.A. Ophori, Dr. M.S. Osagie, Dr. Mrs. R.O. Osaseri, Mr. E.I. Osarenkhoe, Prof. (Mrs.) V.I. Osunbor, Mr. O.J. Okhuoya, Mr. K. Otokiti, Miss L.O. Usiosefe, and Mrs. E. Chukwumah, whose academic contributions and support enriched my postgraduate experience and for the various forms of assistance that supported my progress throughout the program.

I acknowledge the cooperation of the management, lecturers, and students of the selected universities who willingly participated in this research.

I am deeply grateful to my family and friends for their unwavering support, encouragement, and understanding throughout the duration of this program. To everyone who contributed directly or indirectly to the success of this work, I say thank you.

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## LIST OF ABBREVIATIONS

ANOVA – Analysis of Variance

BIU – Benson Idahosa University

COVID-19 – Coronavirus Disease 2019

EE – Effort Expectancy

EDSU – Edo State University Uzairue

FC – Facilitating Conditions

ICT – Information and Communication Technology

LMS – Learning Management System

PEOU – Perceived Ease of Use

PU – Perceived Usefulness

SD – Standard Deviation

SDG – Sustainable Development Goal

SI – Social Influence

SPSS – Statistical Package for the Social Sciences

TAM – Technology Acceptance Model

TLE – Teaching and Learning Effectiveness

UTAUT – Unified Theory of Acceptance and Use of Technology

UNESCO – United Nations Educational, Scientific and Cultural Organization

UNIBEN – University of Benin

Wi-Fi – Wireless Fidelity

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## ABSTRACT

This research examined the extent of A Quasi-Experimental Study on the Effect of Informatics in Teaching and Learning in Universities in Edo State, with particular emphasis on differences across federal, state, and private institutions. The study adopted a descriptive survey research design and was guided by the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT).

Data were collected from 345 lecturers and students using a structured questionnaire designed around key constructs such as ICT infrastructure availability, utilization, digital competency, and perceived challenges. Data analysis involved descriptive statistics, Analysis of Variance (ANOVA), correlation, and regression analysis using SPSS.

Findings revealed that ICT infrastructure and utilization levels were generally high, with private universities demonstrating significantly higher adoption compared to public institutions. Gender did not significantly influence ICT utilization, while institutional type and academic role (lecturer or student) were significant determinants. Regression results further confirmed that ICT utilization positively and significantly enhances teaching and learning effectiveness.

The study concludes that institutional readiness, infrastructural support, and digital competency are critical to effective ICT integration in higher education. It recommends increased investment in ICT infrastructure, continuous capacity building, and supportive institutional policies to enhance technology driven teaching and learning.

# CHAPTER ONE

## 1.1 Background to the Study

The traditional pedagogical model in Nigerian universities has long been characterized by a teacher-centric approach, relying on face-to-face lectures, physical textbooks, and chalkboard illustrations. This method, while established, often fosters passive learning and is increasingly misaligned with the dynamic, interactive, and digitally-driven world for which students need to be prepared (Aduwa-Ogiegbaen & Iyamu, 2019).

The contemporary push to integrate Information and Communication Technology (ICT) into this setting marks a pivotal shift towards a more flexible, accessible, and student-centered learning ecosystem. This transformation is not merely about introducing computers but about fundamentally rethinking the learning process. It is driven by the necessity to enhance the quality and relevance of education, expand access to digital knowledge resources, and equip graduates with the critical digital literacy skills demanded by the 21st-century economy (World Bank, 2020).

The relevance of this shift was brutally underscored by the COVID-19 pandemic, which served as a global stress test, revealing the profound consequences of technological unpreparedness and forcing a rapid, if often uneven, adoption of online and blended learning modalities worldwide (Ihekwoaba et al., 2021; Adarkwah, 2021).

In the 21st century, one of the tools used to enhance university education is the e-learning service. E-learning, according to Otuka (2010), comprises all forms of electronically supported learning and teaching that are procedural in nature and aim at the construction of knowledge with reference to individual experience and practice. Information communications systems, whether wired or not, serve as specific media to implement the learning process. E-learning is the delivery of a learning, training, or education programme by electronic means, involving the use of a computer or electronic device in some way to provide training, educational, or learning materials (Obumneke Okeke & Anyachebele in Anashie, Offem & Okeke, 2018). World Bank (2003) maintained that when the potential of e-learning is fully harnessed, it could advance knowledge by expanding and widening access, improving the quality of education, and reducing costs. Mayadas in Oakley (200), e-learning is a process in which learners can communicate with their instructors and their peers,

and access learning materials, over the internet or other computer networks. E-learning is the application of the internet to support the delivery of learning skills and knowledge using a holistic approach, which may not be limited to a particular course, technology, or infrastructure (Brock, 2002). It provides flexibility, which allows for just-in-time training when and where it is needed. E-learning creates room for integration into work place in terms of relevance, access to experts and collaboration for team working Hedge & Haywand in Anrimbad et al (2003),further defined e-learning as an innovative approach for delivery electronically mediated, well designed learner-centered and interactive learning environments to anyone, anyplace, and anytime by utilizing the internet and digital technologies to consonant with instructional design principles. In the same vein, Anibogu (2003) opined that e-learning brings proven benefits to students and lecturers in terms of cost-effectiveness and efficiency, encouraging students to take responsibility for their own learning, which will be of benefit to them. Worldwide learn in Anashie et al (2018) noted that e-learning has many benefits.

In the Nigerian reality, the understanding and implementation of ICT integration are deeply fragmented and are predominantly shaped by the institutional typology of the university. The nation's tripartite university system, comprising federal, state, and private institutions, creates distinct landscapes for technological adoption. For instance, federal universities like the University of Benin (UNIBEN), despite benefiting from statutory allocations and TETFund interventions, often contend with the challenges of scaling technology for massive student populations, bureaucratic delays, and maintaining ageing physical and digital infrastructure (Onyema et al., 2021). State universities, such as Edo State University, Uzairue (EDSU), frequently face more fundamental hurdles, including precarious funding from state governments, which struggle to compete with other pressing public needs, leading to critical deficits in foundational infrastructure like stable power and high-speed internet (Olatubosun et al., 2021).

E-learning brings learning to people, reduces the cost of learning experiences, and helps develop more flexible, innovative, and creative students. This implies that technology-enhanced learning and online instruction are recognized as a viable tool necessary for preparing citizens to participate in the technologically driven global environment (Liverpool, Marut, Ndam & Oti, 2009). A multidisciplinary approach to online pedagogical research recognizes the value of technology-enhanced teaching and learning as critical in the mix of diverse strategies. Its centrality in the global marketplace has been enhanced by a new culture shared by many educators. E-learning

has reported by Lamillard (2004) has been used very effectively in university teaching for enhancing the traditional forms of teaching and administration. Students on many courses in many universities in developed countries now have web access to the lecture notes and selected digital resources in support of their study, personalized web environments in which they can join discussions with their class or group, and this new kind of access gives them much greater flexibility of study. Part-time students can more easily access their courses, and this in turn supports the objectives of wider participation, removing the traditional barriers to higher education (university) study. Many nations in Africa today have also embraced the e-learning inventions. In most Nigerian universities, there are intensive efforts to put e-learning in place. It has been practiced in one way or another in the school system. However, when there is a need for enrollment into the schools through the e-learning channel, there seem to be hitches here and there, especially technologically. E-learning in Nigerian universities and educational institutions, according to Ajadi, Salawu & Adeoye (2008), is still a dream because of poor ICT infrastructure and other socio-economic reasons. The challenge facing Nigerian universities now is to sustain e-learning so as to provide the various and numerous students aspiring to be enrolled in the universities with the opportunity to enroll.

In stark contrast, private universities like Benson Idahosa University (BIU) have leveraged their financial autonomy, managerial agility, and market-oriented ethos to strategically invest in ICT as a core component of their value proposition. They were often better positioned to respond to the pandemic's disruptions due to existing investments in Learning Management Systems and digital content (Okiki, 2019; Eze, Chinedu-Eze & Bello, 2021). Recent studies confirm that this divergence has created a palpable "digital divide" among institution types, exacerbating existing educational inequalities (Adeoye et al., 2022).

The use of ICT in education as a means of enhancing skills and building capacity for the promotion of economic development is critical to bringing about viable changes within the education system (Aduwa-Ogiegbaen & Iyamu, 2005). ICT in education encompasses the use of computers and their peripherals, like printers, software, scanners, and projectors, for teaching and learning. Indeed, ICT represents a paradigm shift in the way mankind processes information using the computer and the internet. It has moved information exchange from a static to a dynamic model. The adoption of ICT in higher education provides opportunities for learners to access more advanced and wider areas of learning to develop analytical skills. ICT enhances teaching and learning through its

dynamic, interactive, and engaging content. It has the potential to accelerate, enrich and deepen skills, motivate and engage students learning, help to relate school experience to work practice, help to create economic viability for tomorrow's workers; contributes to the total development of the tertiary institution; strengthens teaching and learning; and provides opportunities for connection between the tertiary institution and the world (Dave & Tearle, 2010). ICT can make the tertiary institutions more efficient and productive, through its variety of tools to enhance and facilitate teachers' professional activities (Adeoye, Oluwole, & Loto, 2013). It allows students to communicate with one another through e-mail, mailing lists, chat rooms, and other means. It allows for faster and easier access to more comprehensive and up-to-date information. ICT can also be used to do complex tasks as it provides researchers with a steady avenue for the dissemination of research reports and findings (Owoyale-Abdulganiy & Olaniyii, 2021). According to Ghavifekr, Kunjappan, Ramasamy, & Anthony (2016), three major reasons for ICT in education are:

1. As a tool for addressing challenges in teaching and learning situations, ICT has the capabilities for effective teaching and learning delivery, management, and support.
2. As a change agent: ICT is capable of changing the content, methods, and overall quality and quantity of teaching and learning; thereby reducing teachers' workload and ensuring a constructivist inquiry-oriented classroom; and,
3. As a central force in economic competitiveness: As a central force in economic and social shifts that have technology skills critical to the future employment of today's students.

In real life, however, the approach to and understanding of ICT integration is not uniform. It is largely influenced by the institutional framework of the university. In Nigeria, the university system is tripartite, comprising federal, state, and private institutions, each with distinct funding mechanisms, governance structures, and operational realities. Federal universities like the University of Benin (UNIBEN), though often better funded, grapple with bureaucracy and the challenge of scaling technology for massive student populations. State universities like Edo State University, Uzairue (EDSU), may struggle with foundational infrastructural deficits due to unpredictable funding from their state owners. In contrast, private universities like Benson Idahosa University (BIU) often leverage their autonomy and need for market differentiation to implement cutting-edge ICT solutions more rapidly (Okiki, 2019). This co-location of the three models within

Edo State provides a unique microcosm to study how these different real-life contexts shape the adoption and use of ICT.

### 1.2 Statement of the Problem

The central challenge facing higher education in Nigeria, particularly in Edo State, is the failure to effectively integrate Information and Communication Technology (ICT) into teaching and learning. Despite its recognized global value, universities remain bound to outdated chalk-and-talk methods. This reliance fosters passive learning and widens the gap between the promise of technology-driven education and the realities of the classroom, leaving graduates ill-prepared for the demands of the digital economy.

Although ICT facilities are increasingly present in many universities, their integration into the core processes of teaching and learning remains inadequate. Essential tools such as Learning Management Systems, digital libraries, and collaborative learning platforms are often available but not systematically embedded into instructional practices. As a result, students are deprived of interactive, learner-centered, and technology-enhanced educational experiences that support critical thinking, independent learning, and digital literacy development. This situation points to a significant gap in existing knowledge regarding the institutional, infrastructural, and policy-related barriers that limit effective ICT integration across federal, state, and private universities. Addressing this gap is necessary to inform evidence-based strategies for improving ICT adoption and maximizing its impact on teaching and learning outcomes.

This challenge persists because many Nigerian universities, especially those in Edo State, have not kept up with rapid global advances in educational technology. While universities worldwide are adopting blended and fully online learning systems, many local institutions remain underprepared, placing them at risk of producing graduates who lack the skills required in today's technology-driven workforce. The COVID-19 pandemic clearly exposed this weakness, as numerous universities were unable to transition smoothly to remote learning, resulting in significant disruptions to teaching, learning, and academic continuity.

The integration of ICT is being proposed for teaching and learning for several compelling reasons:

1. To enhance pedagogical effectiveness by enabling innovative, student-centered teaching methods that move beyond rote memorization.
2. To expand access to knowledge by providing students and lecturers with unlimited resources beyond physical textbooks through digital libraries and online repositories.
3. To foster collaboration and interaction among students and between students and lecturers, breaking down the barriers of the traditional classroom.
4. To develop essential digital literacy skills in students, ensuring they are equipped with the competencies required for the modern workplace.

The main problem is the clear and ongoing difference in how well federal, state, and private universities in Edo State are able to integrate ICT into teaching and learning. These differences are largely influenced by variations in funding, management structures, and institutional policies. As a result, students across these universities do not receive the same quality of digital learning experience, which further widens the digital divide. There is therefore a strong need for a comparative study that identifies the specific challenges faced by each type of university in order to support the development of targeted and effective solutions.

### 1.3 Aim and Objectives of the Study

The overarching aim of this research is to study the impact of information and communication technology (ICT) in teaching and learning in Nigerian Universities, using Edo State as a case study.

To achieve this aim, the following specific objectives are set:

1. To compare the availability and reliability of ICT infrastructure for teaching and learning in the selected universities.
2. To assess how lecturers and students use ICT tools such as Learning Management Systems (LMS) in the selected universities.
3. To identify and analyze the predominant challenges that impede effective ICT usage within each category of university.
4. To examine the digital competency levels and perceptual attitudes of lecturers and students towards the adoption of ICT in pedagogical practices.
5. To develop a set of context-specific, actionable recommendations to enhance ICT integration, tailored to the unique realities of federal, state, and private universities.

### 1.4 Research Questions

This study will be guided by the following research questions:

1. What is the state of ICT infrastructure available for teaching and learning in federal, state, and private universities in Edo State?
2. To what extent do faculty members utilize ICT tools in teaching delivery and assessment across the different university types?
3. How do students in federal, state, and private universities use ICT tools to support their learning activities?
4. What are the major challenges affecting ICT usage for teaching and learning across the different university types?
5. What strategies can be adopted to improve ICT usage in teaching and learning across universities in Edo State?

## 1.5 Research Hypotheses

The following null hypotheses will be tested at a 0.05 level of significance:

1. $H_{o1}$: There is no significant difference in the availability and adequacy of ICT infrastructure for teaching and learning among federal, state, and private universities in Edo State. $H_{a1}$: There is a significant difference in the availability and adequacy of ICT infrastructure among federal, state, and private universities.

2. $H_{o2}$: There is no significant difference in the level of ICT utilization for teaching by faculty members across federal, state, and private universities.

$H_{a2}$: There is a significant difference in the level of ICT utilization for teaching by faculty members across university types.

1. $H_{o3}$: There is no significant difference in the level of ICT utilization for learning by students across federal, state, and private universities.

$H_{a3}$: There is a significant difference in the level of ICT utilization for learning by students across university types.

1. $H_{o4}$: There is no significant difference in the perceived challenges to effective ICT usage among federal, state, and private universities.

$H_{a4}$: There is a significant difference in the perceived challenges to effective ICT usage across university types.

## 1.6 Significance of the Study

The findings of this research will have both theoretical and practical significance for various stakeholders:

1. University Management and Administrators: The study will provide critical, data-driven insights to inform strategic planning, budgeting, and policy formulation regarding ICT infrastructure development, maintenance, and capacity-building initiatives specific to their institutional context (federal, state, or private).
2. Academic Staff and Students: It will illuminate best practices and pinpoint specific gaps in ICT utilization and digital competency, potentially motivating targeted training programs and fostering a more robust, technology-enabled academic culture that enhances teaching and learning experiences.
3. Government and Educational Policymakers (e.g., NUC, TETFund): The comparative analysis will offer valuable evidence to guide the design of differentiated intervention programs and funding models. For instance, it may suggest that state universities need grants for foundational infrastructure, while federal universities may benefit more from technical support and large-scale digital literacy campaigns for their vast populations.
4. Future Researchers: This study will contribute a nuanced, comparative perspective to the body of knowledge on educational technology in Nigeria, serving as a seminal reference for future longitudinal studies or more expansive multi-state comparative research.

## 1.7 Scope of the Study

The scope of this study is limited to three universities in Edo state, which are the Federal University, State University, and Private University. This study is delimited in the following ways:

Geographical Scope: The research is confined to Edo State, Nigeria.

Institutional Scope: The study focuses on three purposively selected universities: the University of Benin (UNIBEN), representing federal universities, Edo State University, Uzairue (EDSU), representing state universities, and Benson Idahosa University (BIU), representing private universities.

Content Scope: The investigation is limited to the use of ICT for core teaching and learning activities. This includes the availability and use of infrastructure (e.g., internet, power, computer labs), e-learning platforms (LMS), digital content, and the associated competencies and attitudes of lecturers and students. It will not extensively cover ICT applications for administrative purposes (e.g., finance, admissions, human resources).

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Overview of the Chapter

This chapter presents a comprehensive review of scholarly literature relevant to the integration of Information and Communication Technology (ICT) in university teaching and learning. The review is structured to build a solid conceptual and theoretical foundation for the study.

It begins by defining the core concepts, detailing the nature, components, and application of ICT in education, along with the necessary infrastructure and emerging solutions. It then transitions to the Theoretical Review, where it introduces and applies key technology adoption theories to identify the critical determinants of successful ICT integration. The overarching goal is to contextualize this research within existing knowledge and establish a robust framework for investigation.

## 2.1 Information and Communication Technology (ICT) in Education

### 2.1.1 The Nature and Components of ICT

Information and Communication Technology (ICT) refers to the convergent cluster of technologies that enable the access, processing, storage, transmission, and management of information digitally. Its nature is fundamentally integrative and transformative. As Buabeng-Andoh (2012) describes, ICT is not a single tool but an umbrella term encompassing a diverse range of hardware, software, and network components. This includes:

1. Hardware: Computers, servers, tablets, interactive whiteboards, projectors, and digital cameras.
2. Software: Operating systems, application suites (e.g., Microsoft Office), specialized educational software, and Learning Management Systems (LMS) like Moodle and Canvas.
3. Networks: The internet, intranets, and telecommunications infrastructure that facilitate local and global connectivity and communication (Al-Mamary, 2020).

The power of ICT lies in its synergistic nature, where its components are most effective when integrated to create comprehensive systems that overcome temporal and geographical barriers, thereby revolutionizing how information is handled and shared.

### 2.1.2 The Role of ICT in Modern University Education

The infusion of ICT into higher education has catalyzed a paradigm shift from traditional, teacher-centric instruction to dynamic, learner-centered ecosystems. Its role extends beyond being a supplementary aid to becoming a fundamental enabler of pedagogical innovation and institutional development. UNESCO (2018) positions ICT as a crucial lever for achieving equitable and quality education. It expands access to learning resources through digital libraries, fosters collaboration via online platforms, and supports the development of critical digital literacy skills essential for the 21st-century workforce. The COVID-19 pandemic starkly underscored this role, transforming ICT from an enhancement into an absolute necessity for educational continuity, thereby validating its critical function in the modern university (Olatubosun, Owolabi, & Omotayo, 2021).

Information Communication, and Technology (ICT) in education refers to the use of computer-based communication that is incorporated into the daily classroom instructional process. The 21st century has witnessed the development of learning technologies, which caused positive changes in the education system. This is due to the capability of technology to provide a proactive, easy access, creative, and comprehensive teaching and learning environment. There is an increasing affinity of students for new technologies and products, as there is a huge potential for technology to be integrated into the education industry. Students are embracing self-learning through e-learning teaching models, which act as a significant communication bridge between students and teachers. ICT helps both teachers and students to learn about their respective subject areas. Since students are familiar with technology, learning better with technology-based environment becomes easier; the issue of ICT integration in schools, specifically in the classroom, is vital.

ICT has leveraged the dissemination of information about sparse educational resources for widespread availability or reach. Lecturers relied on technology to make the class interesting, which allows them to give some practical insights on one hand, while on the other hand, students use it to gain an in- depth knowledge of the subject where they have interest. Gone are the days

when lecturers must lecture through blackboards in a lecture hall. According to Winzenried, Dalgarno, and Tinkler (2010), teachers who have gone through an ICT course are more effective in teaching by using technology tools as opposed to those who have no experience in such training. Studies reveal that the creative use of Information and Communications Technology in education has the capacity to increase the quality of people's lives by enhancing teaching and learning (Goyal, 2017). With ICT, teaching and learning are not only happening in the school environment but can also happen when students are physically distant. Computers and technology do not replace quality teachers, but rather they are considered as an add-on supplement needed for better teaching and learning. There is also a need to show that education should be seen as using technology not only as an end in itself, but as a means to promote creativity, empowerment, and equality, and produce efficient learners and problem solvers.

In many schools, chalkboards, whiteboards, textbooks, charts, radios/televisions, and films are being used as instructional materials. Although television and film impact audio-visual facilities on the students, the computer instructors are capable of activating the sense of sight, hearing, and touch in students. The use of computers today has made the whole world a single community. ICT in education is made up of knowledge sharing and transmission, which may not necessarily involve physical contact between teachers and students (Mac-Ikemenjire 2005). Meanwhile, ICT in education involves the distribution of instructional content through the

In Nigeria, many studies have been carried out with the use of computers in the teaching and learning of different subjects such as Chemistry, Biology, and Mathematics. Findings from these studies reveal that computer-assisted instruction (CIA) facilitated the rate of learning among the students and enhanced the student performance in the area. (Olayiewala 2003, Ezieliora 2003, Salau 2003). ICT has the capacity to provide high interactive potentials for students to develop their individual, intellectual, and creative abilities. Meanwhile, in an effort to implement ICT standards in a variety of subjects taken by students across all subjects, a number of methods and strategies have been identified (UNESCO 2002). Many of these strategies employ productivity tools such as Word Processing, Database, Spreadsheet, or browser applications. These software tools can be integrated to support subject areas. ICT is an overview of proven effectiveness when models and strategies such as web-based lessons, multimedia presentations, telecomputing projects, and online discussions are employed in teaching and learning processes. An ICT tool can

be of great value to the young people of this generation. Therefore, when properly integrated in educational system, ICT will elevate the impact of the current population explosion and poverty, which has led to massive unemployment in Nigeria, by providing an environment in which students taking initiative of finding solutions to the problems and challenges they learn about in classrooms.

### 2.2 Utilization of ICT in Universities

The utilization of ICT in universities can be categorized into several key areas, each contributing uniquely to the educational process:

1. Content Delivery: ICT tools like PowerPoint, digital videos, and multimedia simulations make complex concepts more understandable and engaging. LMS platforms like Moodle and Canvas serve as centralized hubs for distributing lecture notes, assignments, and supplementary materials.

2. Communication and Collaboration: Email, discussion forums, and instant messaging apps facilitate continuous interaction between students and lecturers outside the physical classroom. Video conferencing tools (e.g., Zoom, Microsoft Teams) enable synchronous virtual classes and guest lectures from international experts.

3. Assessment and Feedback: ICT enables innovative assessment methods through online quizzes, peer-review systems, and e-portfolios. These tools can provide immediate feedback to students and automate the grading process, saving time for instructors.

4. Research and Resource Access: Digital libraries, online academic databases (e.g., JSTOR, Scopus), and research management software (e.g., Mendeley) have revolutionized academic research, providing students and faculty with global knowledge at their fingertips.

Despite this potential, studies in the Nigerian context, such as those by Aduwa-Ogiegbaen & Iyamu (2019), consistently show that usage is often hampered by infrastructural deficits and a lack of sustained training, leading to underutilization of available technologies.

## 2.3 Components of ICT Integration: Technological Infrastructure

The foundational component for any meaningful and sustainable integration of Information and Communication Technology (ICT) in education is the availability of a robust and functional technological infrastructure. This infrastructure forms the physical and digital backbone upon which all ICT-related teaching and learning activities depend. It extends beyond the mere provision of computers or gadgets to encompass several interrelated elements that determine the success or failure of ICT initiatives in universities.

One of the most critical aspects of technological infrastructure is reliable connectivity. Effective ICT integration requires high-speed, stable, and campus-wide internet access that supports realtime communication, online research, and digital collaboration. A reliable broadband or Wi-Fi network ensures that students and lecturers can access e-learning platforms, digital libraries, and cloud-based educational resources without interruption. Inadequate or unstable connectivity limits engagement with online learning tools, disrupts virtual classrooms, and hampers collaborative research efforts. In many Nigerian universities, internet access remains inconsistent and localized to administrative buildings rather than learning spaces, thereby constraining the full potential of ICT integration (Adebayo & Adetimirin, 2021). Ensuring campus-wide connectivity through robust broadband infrastructure is therefore non-negotiable for institutions aspiring to meet 21st-century educational standards.

Equally vital is the presence of a stable power supply. Erratic electricity has long been identified as a major obstacle to ICT deployment and usage in Nigerian higher education institutions (Oyelaran-Oyeyinka & Lal, 2020). Frequent power outages not only damage sensitive electronic equipment but also interrupt teaching and learning sessions dependent on ICT tools. To address this challenge, universities must invest in reliable alternative energy sources such as backup generators, inverters, and solar systems to ensure uninterrupted power for ICT facilities. The consistency of electricity supply directly affects the usability of technological infrastructure and, by extension, the willingness of lecturers and students to adopt ICT in their daily academic routines.

Another crucial dimension of ICT infrastructure is hardware and software availability. Successful integration requires an adequate number of functional computers, projectors, printers, smartboards, and related digital devices across lecture halls, laboratories, and libraries. Beyond hardware,

universities also need to provide licensed and updated software applications for academic and administrative use. These include statistical software, learning management systems (LMS) such as Moodle or Canvas, plagiarism checkers, and productivity suites like Microsoft Office or Google Workspace. The adequacy and currency of both hardware and software determine how effectively ICT can support academic content delivery and learning engagement. A shortfall in these resources often results in overcrowded computer labs, outdated programs, and limited access for students, all of which undermine the goal of digital transformation in education.

Furthermore, sustainable ICT integration demands a reliable system of maintenance and technical support. The presence of well-trained ICT support staff ensures that infrastructure remains functional, technical faults are quickly resolved, and users receive the assistance they need to operate complex systems. In the absence of such support, even well-funded ICT infrastructure can rapidly deteriorate due to neglect or misuse. Regular maintenance schedules, user support services, and continuous professional development for ICT personnel are therefore essential for ensuring the long-term efficiency and usability of technology in educational environments. Institutions that neglect maintenance often face prolonged equipment downtime and user frustration, leading to reduced motivation to utilize ICT tools.

In summary, technological infrastructure constitutes the bedrock upon which ICT integration efforts rest. Without reliable connectivity, stable power, sufficient hardware and software resources, and ongoing maintenance support, even the most well-intentioned ICT policies are bound to fail. These facilitating conditions, as theorized by the Unified Theory of Acceptance and Use of Technology (UTAUT), are prerequisites for successful technology adoption and continued usage in higher education (Venkatesh et al., 2003). Strengthening these infrastructural components is therefore essential for enhancing the digital readiness and competitiveness of Nigerian universities in the global knowledge economy.

### 2.4 Emerging Dimensions: Blended Learning and Flipped Classrooms

In recent years, higher education has witnessed a progressive shift from exclusively face-to-face instruction toward blended (hybrid) learning models, which strategically combine in-person teaching with online learning resources. Blended learning is not merely a mixture of online and physical teaching; rather, it involves a deliberate pedagogical integration in which each component plays a purposeful role in enhancing learning outcomes. Systematic reviews have consistently highlighted that well-designed blended learning approaches improve engagement, flexibility, access, and overall academic performance (Ashraf et al., 2021; Rasheed et al., 2020). This makes blended learning one of the strongest contemporary responses to the growing demand for ICT-enabled education.

A central and widely adopted form of blended learning is the flipped classroom model. In a flipped design, students are first exposed to content before class through multimedia lectures, LMS-hosted readings, or short instructional videos, while classroom time is reserved for interactive exercises, peer instruction, and deeper knowledge application (Ghavifekr and Wan Rosdy, 2015; Strelan et al., 2020). This model maximizes the strengths of both modes of delivery and aligns with the global shift toward student-centered, activity-driven learning.

The success of blended and flipped models rests on established learning theories. From a cognitive load perspective, short, well-segmented multimedia videos presented before class help reduce extraneous load and promote better comprehension (Sweller, 2011). Social constructivist theory likewise supports active in-class learning, where students collaboratively build knowledge through discussion, problem solving, and reflection (Vygotsky, 1978).

Furthermore, self-regulated learning theory explains why the flipped model promotes deeper learning, as students must independently plan and monitor their pre-class engagement (Zimmerman, 2002). When courses are intentionally designed around these theories, blended formats become more effective and yield significantly improved learner outcomes (Baig et al., 2023).

### 2.4.1 Evidence of Effectiveness

A growing body of empirical evidence demonstrates the benefits of blended and flipped learning designs. Meta-analyses have shown that flipped classrooms yield moderate but consistent positive effects on students' academic performance and engagement compared to traditional lecture models (Strelan et al., 2020; Lo and Hew, 2017). Similarly, blended learning has been found to increase student satisfaction, retention, and conceptual understanding across different disciplines (Ashraf et al., 2021; Bernard et al., 2014).

These studies emphasize that effectiveness is dependent on the quality of implementation, particularly the design of pre-class materials, alignment with learning outcomes, and the use of interactive activities during classes.

### 2.4.2 Design and Practical Considerations

Effective blended or flipped learning requires thoughtful instructional design. Pre-class materials should be concise, engaging, and closely aligned with course objectives, while the LMS must support intuitive navigation and progress tracking (Zainuddin and Perera, 2019). In-class sessions must prioritize active learning strategies such as peer instruction, case analysis, simulations, or group problem-solving.

Research shows that low-stakes formative assessments, such as quizzes embedded in pre-class videos, significantly improve students' preparation and participation (Lo and Hew, 2017). Clear communication of expectations and learner orientation programmes are also crucial to ensure students fully understand their responsibilities within a blended environment (Rasheed et al., 2020).

### 2.4.3 Technology and Infrastructure

Robust infrastructure is essential for the sustainable implementation of blended models. Stable broadband, fully functional LMS platforms, lecture recording technologies, and reliable electricity supply are fundamental requirements for any institution planning to adopt ICT-supported teaching methods. The COVID-19 pandemic demonstrated that universities with well-developed digital

ecosystems were more resilient and transitioned more easily into hybrid teaching (UNESCO, 2020).

In contexts such as many Nigerian universities, the need for alternative power sources, efficient bandwidth management, and offline accessible learning materials has been repeatedly highlighted (Aung and Khaing, 2016). Studies have shown that when technological barriers are reduced, learner engagement and academic achievement improve significantly (Mpungose, 2021).

### 2.4.4 Challenges and Equity Concerns

Despite its benefits, blended and flipped learning present challenges such as increased instructor workload, lack of stable connectivity for some students, and resistance to adopting unfamiliar pedagogical approaches (Rasheed et al., 2020). Without adequate scaffolding, students may fail to engage with pre-class materials, undermining the effectiveness of in-class activities. In many African contexts, digital inequities, including access to devices, data costs, and electricity, remain substantial obstacles (Mpungose, 2021). Institutions must therefore provide inclusive solutions such as device loan schemes, accessible offline content, and digital literacy programmes.

For Nigerian universities, the pandemic underscored the urgent need for systematic ICT integration, structured blended learning policies, and significant improvement in digital infrastructure (Onyema et al., 2020). When these conditions are met, blended and flipped classrooms can enhance engagement, reduce overcrowding, support large class instruction, and better prepare students for a technology-driven workforce.

## 2.5 Latest Ideas and Solutions: Institutional Differentiation and Strategic Partnerships

In recent years, the transformation of higher education systems through Information and Communication Technology (ICT) has increasingly required universities to rethink their institutional structures, resource strategies, and collaborative engagements. One of the emerging approaches to strengthening ICT adoption, particularly in developing contexts such as Nigeria, is the strategic use of institutional differentiation and partnership-based innovation. These two dimensions working together offer new pathways for addressing disparities in infrastructure,

expanding digital capacity, and ensuring more inclusive access to technology-based education. Nigerian universities, especially across the federal, state, and private categories, operate under different mandates, funding structures, and governance cultures. These differences have profound implications for ICT adoption and the ability of institutions to develop sustainable technology-enhanced learning environments (Okebukola, 2021).

### 2.5.1 Understanding Institutional Differentiation in Higher Education

Institutional differentiation refers to the varied roles, missions, capacities, and funding models that characterize types of universities within a national higher education landscape. In Nigeria, differentiation is clearly reflected in the triad of federal, state, and private universities, each providing distinct contributions to national development. Federal universities are traditionally positioned as research-intensive institutions with extensive academic offerings and large student populations. They benefit from federal government funding, TETFUND allocations, and higher staff retention, which can support ICT investments, although bureaucratic processes may slow technological implementation (Afolabi, 2020).

State universities, by contrast, operate with more limited and inconsistent state subventions. Their primary mission often centers on expanding access to tertiary education within state boundaries. However, funding inadequacies restrict their ability to procure ICT infrastructure or maintain existing facilities, resulting in slower ICT adoption and fewer digital innovations (Adekoya & Alabi, 2020). Private universities, driven largely by tuition and donor funding, exhibit greater administrative flexibility and quicker decision-making. As a result, they frequently invest more aggressively in ICT facilities, digital classrooms, and partnerships with international technology providers to improve their competitiveness (Varghese, 2019). These differentiating features shape the technological profile and readiness of each university type, influencing how ICT is adopted, managed, and sustained.

### 2.5.2 The Role of Strategic Partnerships in Higher Education ICT Development

Strategic partnerships comprise collaborative relationships between universities and external stakeholders' government agencies, private technology firms, telecommunications companies, donors, and international organizations aimed at improving institutional capacity and fostering innovation. Globally, partnerships are now recognized as essential mechanisms for scaling ICT integration, especially in contexts where financial and technical constraints remain substantial (UNESCO, 2020). Partnerships help universities access funding, modern infrastructure, and expertise that may otherwise be beyond their reach.

In Nigeria, federal universities frequently collaborate with agencies such as TETFUND, NCC, NITDA, Google for Education, and multinational organizations like the British Council and UNESCO to strengthen ICT systems and digital literacy programs. Private universities tend to partner with technology companies to establish smart classrooms, robotics labs, and virtual learning environments. State universities rely more on donor-funded initiatives and government technology schemes, which help bridge local infrastructural gaps. Whether through broadband expansion projects, faculty digital literacy training, or provision of learning management systems (LMS), partnerships serve as powerful drivers of technological advancement in higher education (Knight, 2015).

### 2.5.3 Benefits of Institutional Differentiation and Strategic Partnerships

The interplay between institutional differentiation and strategic partnerships generates multiple benefits for universities seeking to enhance ICT adoption. First, differentiation enables universities to capitalize on their unique mission strengths. For instance, the research-intensive nature of federal universities enables them to attract international partners for collaborative research in ICT, digital scholarship, and e-learning innovations. Private universities benefit from flexible governance structures, allowing quicker integration of modern technologies and better alignment with industry expectations (Teferra, 2017).

Second, strategic partnerships expand universities' resource base. Federal universities receive considerable technical and financial support from both local and international agencies, while private universities secure technology-based collaborations that support product development, e-

learning services, and digital pedagogy. For state universities, partnerships often provide critical stop-gap funding, infrastructure, and technical expertise that would otherwise be unavailable due to constrained state finances.

Third, partnerships promote knowledge exchange and human capacity development. Faculty members gain exposure to digital teaching methods, ICT maintenance practices, and modern research technologies. Students benefit from access to digital platforms and increased employability through ICT-skills development. Such collaborations therefore, enhance academic quality, modernization, and institutional innovation.

### 2.5.4 Barriers to Effective Differentiation and Partnerships

Despite their potential, several challenges limit the effectiveness of institutional differentiation and strategic partnerships in enhancing ICT adoption across Nigerian universities. Financial constraints remain a primary barrier. Federal universities experience bureaucratic bottlenecks that delay ICT procurement. State universities lack consistent funding for ICT maintenance, and private universities, though comparatively better funded, must balance technological investments with profitability and enrollment fluctuations (Okebukola, 2021).

Policy inconsistencies also pose difficulties. Frequent leadership changes in state universities disrupt long-term strategic plans, while strict governance procedures in federal universities slow the pace of innovation. Private universities sometimes face regulatory pressures that restrict collaboration models or raise compliance costs.

Human capacity limitations represent another challenge. While federal universities often host more ICT-qualified staff, they frequently struggle with maintaining adequate technical support teams to sustain large populations. State universities face severe shortages of skilled ICT personnel and lecturers trained in digital pedagogy. In private universities, high staff turnover affects digital continuity and long-term partnership outcomes (Knight, 2015).

Cultural resistance and limited digital literacy further weaken ICT integration efforts. In many universities, lecturers accustomed to traditional teaching methods may resist adopting LMS

platforms or blended learning models. Similarly, institutions may lack strong ICT governance frameworks to manage and evaluate partnership outcomes.

### 2.5.5 Challenges of Institutional Differentiation and Strategic Partnerships in Nigerian Universities

Across all university categories, the challenges associated with institutional differentiation and strategic partnerships manifest differently. Federal universities contend primarily with bureaucratic structures that delay decision-making, procurement, and project execution. Large student enrollments also place significant pressure on available ICT resources, leading to overcrowded computer labs and limited access to digital facilities. Although federal universities attract substantial external support, slow governance processes hinder the rapid deployment of technology-based solutions (Afolabi, 2020).

State universities face more acute financial and infrastructural constraints. Limited state funding affects their ability to sustain ICT partnerships or invest in digital learning technologies. Their partnerships often depend on donor agencies or state-led initiatives, which may be inconsistent or politically influenced. This weakens long-term sustainability and contributes to uneven ICT adoption across state institutions.

Private universities, meanwhile, grapple with high operational costs associated with acquiring and maintaining ICT infrastructure. Although partnerships with private technology companies are easier to secure, private universities may encounter limitations in scaling ICT initiatives, especially if student enrollment declines or operational costs rise. Despite better agility, some private institutions may be reluctant to pursue partnerships that could undermine institutional control or increase financial risk (Varghese, 2019). These variations underscore the need for context-specific strategies for ICT development across the three university categories.

### 2.5.6 Conceptual Model Linking Institutional Differentiation, Strategic Partnerships, and ICT Adoption

The conceptual relationship between institutional differentiation, strategic partnerships, and ICT adoption highlights how structural identity and collaborative engagement shape universities' technological development. Institutional differentiation influences the resources, missions, and governance processes that define universities' capacity to integrate ICT into teaching and learning. Federal universities, with their stronger research orientation, typically use partnerships to support digital scholarship, while private universities leverage collaborations to enhance competitive advantage. State universities rely on partnerships to compensate for funding constraints and limited digital readiness.

Strategic partnerships serve as the enabling mechanism that strengthens ICT adoption by expanding access to modern infrastructure, digital expertise, online platforms, and training opportunities. Partnerships influence key ICT adoption drivers such as digital literacy, infrastructure availability, and institutional policy development (UNESCO, 2020). The integration of these partnerships within differentiated institutional environments ultimately determines how ICT is adopted and utilized.

ICT adoption, influenced by theoretical constructs from TAM and UTAUT such as perceived usefulness, effort expectancy, social influence, and facilitating conditions, results in outcomes such as enhanced instructional delivery, improved student engagement, and strengthened institutional performance (Davis, 1989; Venkatesh et al., 2003). Thus, the interaction between institutional differentiation and strategic partnerships plays a defining role in ensuring sustainable ICT-enhanced learning across federal, state, and private universities in Nigeria.

## 2.6 Theoretical Framework and Key Determinants

The successful integration of ICT is mediated by a series of individual and institutional factors. This study is anchored by robust technology acceptance models that help explain the varying usage levels across university types.

### 2.6.1 The Unified Theory of Acceptance and Use of Technology (UTAUT)

The study's primary theoretical model is the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003). This model provides a comprehensive framework by integrating elements from eight prior theories. It posits that behavioural intention to use technology is influenced by four main constructs:

1. Performance Expectancy (similar to Perceived Usefulness)
2. Effort Expectancy (similar to Perceived Ease of Use)
3. Social Influence (similar to Subjective Norm)
4. Facilitating Conditions (which directly relate to institutional capacity and infrastructure).

UTAUT is ideal for this study as it explicitly incorporates the organizational and technical infrastructure as a direct determinant of usage behaviour, allowing for the comparison across the distinct Federal, State, and Private university contexts.

### 2.6.2 The Technology Acceptance Model (TAM)

As the foundational model for UTAUT, the Technology Acceptance Model (TAM) (Davis, 1989) remains critically relevant for understanding the individual-level cognitive beliefs of lecturers and students, which mediate the relationship between institutional resources and actual ICT use.

The technology acceptance model (TAM) is an information systems theory that explains the acceptance of information systems by individuals. It holds that the technology acceptance is predicted by the users' behavioural intent, which is determined by the perceived usefulness of technology in performing tasks and perceived ease of use. Developed by Fred Davis, Richard Bagozzi, and Paul Warshaw (1989), it is one of the most commonly used models of technology adoption, with two primary factors influencing an individual's intention to adopt technology: perceived ease of use and perceived usefulness. An elderly person who views digital games as too difficult to play or a waste of time will be less likely to adopt this technology, whereas an older adult who views digital games as providing needed mental stimulation and being simple to learn will be more likely to want to learn how to use digital games. While TAM has been criticized on

several occasions, it remains a useful general framework that is consistent with a number of studies into the factors that influence older adults' willingness to use new technology (Braun, 2013). This theory is well situated in this study as the present study sought to appraise the role of information technology in achieving quality education in Nigerian tertiary institutions.

Ifeakor (2021) studied the effect of using information and communications technology (ICT) in teaching and learning the English language in tertiary institutions in Nigeria during covid-19 pandemic era. The study examined the effects of using ICT in teaching and learning the English language in tertiary institutions in Nigeria during the COVID-19 pandemic era. The study established that there is no proof that students assimilate better in classroom teaching than e-learning, students can do very well using either or both mediums of teaching and learning because academic performance is irrespective of the media, institutions that previously did not incorporate ICT into teaching and learning are now embracing this technology, and ICT learning can completely replace classroom learning of the English language. The study suggested that more effort should be made to enhance the learning process generally and prepare for similar events like this pandemic in the future. Owoyale-Abdulganiy and Ayuba (2021) studied the use of ICT for teaching Islamic Studies during the COVID-19 pandemic in Kwara State.

The simple random sampling technique was used to sample schools from the state's three senatorial districts. The findings revealed that Smartphones, Radio, Television, and a variety of applications such as WhatsApp, Zoom, Telegram, Facebook, Google, 2go, Twitter, Instagram, and a slew of others were heavily used for teaching and learning Islamic studies in Kwara State during the Coronavirus lock-down. It was suggested that, in order to improve the effectiveness and efficiency of Islamic studies teaching and learning through virtual learning, teachers and students should receive rigorous training on how to make the best use of ICT tools. It was suggested that to enhance effective and efficient teaching and learning of Islamic studies through virtual learning, teachers and students need to undergo rigorous training on how to make maximum use of ICT tools. Jameel and Ahmad. (2021) studied the role of information and communication technology on knowledge sharing among the academic staff during the COVID-19 pandemic. The study examined the impact of ICT and ICT infrastructure on academic staff knowledge sharing. The stratified sample method was used in the study. According to the findings of the study, ICT and ICT infrastructure had a positive and significant impact on knowledge sharing among academic staff at Iraqi public

universities. The study recommended that the government and universities enhance and improve the ICT infrastructure, which would greatly benefit the reputation and ranking of Iraqi universities. Lorente, Arrabal, and Pulido-Montes (2020) studied an international perspective on the right to education and ICT during COVID-19. The research examined how COVID-19 has exacerbated inequalities and pre-existing issues in educational systems around the world. The study found that there is an uneven capacity in terms of response and preparation to deal with the learning losses caused by school closures, both in low-income regions and in middle and high-income countries.

The study concluded that it is essential to articulate inclusive educational policies that support strengthening the government response capacity, especially in low-income countries, to address the sustainability of education, and recommended that policies aimed at fighting inequality, discrimination, and exclusion in education be implemented. Fomunyam (2019) studied the roles of information and communication technology in tertiary education in Africa. The study assessed the role of ICT and its ability to increase the quality of education in higher institutions of learning in Africa. The study established the advantages of having ICT infrastructure, such as e-learning/virtual library, access to quality education through special tools for physically challenged students in tertiary institutions across Africa. The study concluded that government funding of ICT infrastructure is important to improve the quality of education in tertiary institutions and suggested that the government implement ICT policies as well as provide adequate funding for ICT infrastructure, and also monitor ICT infrastructure in various tertiary institutions to be sure that ICT equipment is not abandoned but is in use. Ijov and Wombu (2019) studied the Impact of Information and Communication Technology on Tertiary Institutions. The study examined the various impacts of ICT on tertiary institutions as well as the major obstacles to the utilization and implementation of ICT in tertiary institutions. The study suggested that tertiary institutions should be equipped with modern and advanced technological infrastructure to enable the effective use of appropriate technologies required for teaching and learning programmes, and the government at all levels should make available adequate funds and resources, particularly for the funding and sustenance of tertiary education. Pius and Aii (2019) studied Nigeria's Vision 20:2020 and quality education in Nigeria and its implications for sustainable development.

The study examined the concept of education, qualitative education, national stability, and sustainable development. The study concluded that the Nigerian vision to re-invigorate the

education sector and re-instate the standard of education in the country is in line with the Transformation Agenda and the Vision 20-2020 of the Federal Republic and suggested that the noble policies of the Transformation Agenda and the Vision 20-2020/Vision 15-2050, of the Federal Republic of Nigeria should be religiously followed and implemented and the issue that enhances quality Assurance in the education sector should be given adequate attention. Damkor, Irinyang, and Haruna (2015) studied the role of information communication technology in the Nigerian educational system. According to the study, Nigeria still has a lag in its implementation, which is widening the digital and knowledge divides, and access to ICT facilities is a major challenge for most African countries. Despite the roles that ICT can play in education, the study concluded that schools in Nigeria have yet to extensively adapt them for teaching and learning. Efforts to integrate ICT into the school system have had little impact, and it has been suggested that the government should make efforts to post and provide ICT-skilled teachers to each school in order to impart ICT skills to students, as well as stabilize Nigeria's electricity supply.

### 2.6.3 Perceived Usefulness and Ease of Use (TAM Constructs)

TAM posits that an individual's intention to use a technology is primarily determined by two beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1989).

1. Perceived Usefulness (PU): The degree to which a user believes that using a specific ICT tool will enhance their job performance (e.g., improving student understanding or saving time).
2. Perceived Ease of Use (PEOU): The degree to which a user believes that using the system will be free of mental effort.

If a technology is perceived as complex or ineffective, both lecturers and students will resist its adoption, regardless of its potential benefits. In the context of this study, digital competency directly influences these perceptions.

### 2.6.4 Subjective Norm and Perceived Behavioural Control (TPB/UTAUT Constructs)

Expanding on TAM, theories like the Theory of Planned Behaviour (TPB) and UTAUT introduce other critical factors relevant to the institutional context:

1. Subjective Norm (Social Influence): This refers to the social pressure an individual feels to adopt a technology. In a university, if the leadership and respected colleagues actively champion and use ICT, other faculty members are more likely to follow suit, creating a positive social environment for adoption.
2. Perceived Behavioural Control (Facilitating Conditions): This relates to an individual's perception of their ability to perform a given behaviour. For a lecturer, this is high if they have the necessary skills, resources, and technical support (e.g., stable power and internet). A lack of these facilitating conditions will lead to a feeling of low control, regardless of positive attitudes.

# CHAPTER THREE

# METHODOLOGY

## 3.0 Introduction

This chapter presents a detailed explanation of the methodological framework adopted for this study titled "Impact of Information and Communication Technology (ICT) on Teaching and Learning in Nigerian Universities: A Case Study of Edo State." It describes the research design, population, sampling procedure, research instrument, methods used to ensure validity and reliability, data collection process, and data analysis techniques.

The methodological approach was designed to systematically address the study's research questions and test the formulated hypotheses, ensuring that findings are both reliable and generalizable. In addition, the chapter clarifies how ethical standards were observed in the process of collecting and analyzing data.

The methodological decisions made in this study were guided by best practices in educational research (Creswell & Creswell, 2018) and supported by theoretical models of technology adoption such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). These frameworks provided conceptual direction for understanding how individual and institutional factors interact to shape ICT utilization in teaching and learning.

## 3.1 Research Design

This research adopted a descriptive survey design. The design was chosen because it allows for the systematic collection of quantitative data from a relatively large number of respondents to describe existing phenomena as they occur in a natural setting (Kothari, 2014). In this context, the survey design was appropriate for assessing the extent to which ICT is integrated into teaching and learning across three categories of universities in Edo State.

The survey approach enabled the researcher to gather the perceptions of both lecturers and students regarding the availability, utilization, challenges, and competence associated with ICT use. It also allowed for comparison across institutional categories, Federal, State, and Private, to examine whether significant differences exist among them.

Furthermore, the design was consistent with previous studies on ICT integration in higher education (Buabeng-Andoh, 2012; Onyema et al., 2019), where quantitative surveys have been shown to effectively capture perceptions of technology use and adoption patterns.

### 3.2 Population of the Study

The population of the study comprised lecturers and undergraduate students in three selected universities in Edo State, Nigeria. These universities were:

1. University of Benin (UNIBEN) – representing Federal universities,
2. Edo State University, Uzairue (EDSU) – representing State universities, and
3. Benson Idahosa University (BIU) – representing Private universities.

These institutions were purposively selected because they reflect the tripartite structure of Nigerian universities and present varied contexts of ICT infrastructure, funding, and administrative autonomy. The inclusion of both lecturers and students was intentional to provide a holistic understanding of ICT usage from the perspectives of both educators (supply side) and learners (demand side).

The estimated combined population of lecturers and students across the three institutions exceeded 45,000 individuals. However, it was not feasible to study all members of the population due to time and resource constraints. Therefore, sampling was adopted to select a representative portion of the population for meaningful statistical inference.

#### 3.2.1 Description of Universities in Edo State

Edo State, Nigeria, has a total of seven (7) accredited universities as recognized by the National Universities Commission (NUC). These comprise:

1. One (1) Federal University: University of Benin (UNIBEN)
2. Two (2) State Universities: Edo State University, Uzairue (EDSU) and Ambrose Alli University (AAU), Ekpoma

3. Four (4) Private Universities: Benson Idahosa University (BIU), Igbinedion University Okada, Samuel Adegboyega University, and Wellspring University

### 3.2.2 Rationale for Selecting the Three Universities

This study purposively selected three universities – one from each ownership type:

1. University of Benin (UNIBEN) – representing Federal universities
2. Edo State University, Uzairue (EDSU) – representing State universities
3. Benson Idahosa University (BIU) – representing Private universities

These three institutions were chosen for the following reasons:

1. Diversity of context: They represent the tripartite structure of Nigerian higher education, each with distinct funding mechanisms, governance structures, and infrastructural realities.
2. Accessibility: The researcher obtained institutional approval and cooperation from these specific universities.
3. Representativeness: While there are seven universities in Edo State, these three capture the unique characteristics of each ownership category. The remaining four universities (one state and three private) were excluded to keep the study manageable and focused.

Percentage representation: The three selected universities constitute approximately 43% of all universities in Edo State (3 out of 7), providing a reasonable cross-sectional sample of the state's higher education landscape.

### 3.2.3 Justification for Sample Size of 360 Respondents

A total of 360 questionnaires were distributed. This sample size was determined based on the following considerations:

1. Statistical power: For a population exceeding 45,000, a sample of 360 provides a 95% confidence level with a margin of error of approximately ±5%, which is acceptable in

social science research (Krejcie & Morgan, 1970).

2. Balanced representation: Each of the three universities received 120 questionnaires, allowing for meaningful comparison across institution types.
3. Subgroup analysis: Within each university, 40 lecturers and 80 students were targeted, enabling comparison between academic roles.
4. Practical feasibility: The sample size was manageable given time, budget, and logistical constraints of the researcher.
5. Response rate consideration: Anticipating some non-response, 360 were distributed, yielding 345 valid responses (95.8% response rate), which exceeds typical survey response expectations.

### 3.3 Sample and Sampling Technique

#### 3.3.1 Sample Size Determination

A total of 360 questionnaires were distributed among lecturers and students across the three universities. This number was considered adequate for robust statistical analysis and consistent with recommendations for survey research requiring cross-institutional comparison (Creswell & Creswell, 2018).

After a careful screening process to eliminate incomplete or improperly filled questionnaires, 345 valid responses were retained and analyzed, representing a 95.8% valid response rate. This high response rate underscores the respondents' willingness to participate and enhances the validity of the study's conclusions.

#### 3.3.2 Sampling Strategy

A multi-stage sampling procedure was employed to ensure the selection of a representative and balanced sample.

At the first stage, the three universities were purposively selected to reflect ownership types. At the second stage, random sampling was employed to select respondents across faculties and

departments, ensuring that the selection was unbiased and reflective of the wider institutional community.

Finally, quota allocation was applied to guarantee balanced participation between lecturers and students. Each institution received 120 questionnaires, 40 for lecturers and 80 for students.

Table 3.1 summarizes the distribution and validity of questionnaires.

| **Institution Type** | **Institution** | **Questionnaires Distributed** | **Valid Responses** | **Lecturers (n)** | **Students (n)** | **% Valid** |
|---|---|---|---|---|---|---|
| Federal | UNIBEN | 120 | 113 | 28 | 85 | 94.2% |
| State | EDSU (Uzairue) | 120 | 112 | 25 | 87 | 93.3% |
| Private | BIU | 120 | 120 | 30 | 90 | 100% |
| Total | | 360 | 345 | 83 | 262 | 95.8% |

### 3.3.3 Demographic Distribution of Respondents

Out of the 345 valid responses, 183 (53.0%) were male, and 162 (47.0%) were female. Among lecturers, 52 (62.6%) were male while 31 (37.4%) were female, whereas student respondents were more evenly distributed, 131 male (50%) and 131 female (50%).

Age distribution indicated that 59.4% of respondents were between 18 and 29 years, 21.7% were between 30 and 39 years, 13.9% between 40 and 49 years, and 4.9% were 50 years or above.

Table 3.2 summarizes the demographic profile of the respondents.

| **Variable** | **Category** | **Frequency (n)** | **Percentage (%)** |
|---|---|---|---|
| Gender | Male | 183 | 53.0 |
| | Female | 162 | 47.0 |
| Role | Lecturer | 83 | 24.1 |
| | Student | 262 | 75.9 |
| Age Range | 18–29 years | 205 | 59.4 |
| | 30–39 years | 75 | 21.7 |
| | 40–49 years | 48 | 13.9 |
| | 50 years and above | 17 | 4.9 |
| University | UNIBEN (Federal) | 113 | 32.8 |
| | EDSU (State) | 112 | 32.5 |
| | BIU (Private) | 120 | 34.7 |
| Total | | 345 | 100% |

The demographic balance demonstrates adequate representation of key groups within each institution, enabling meaningful comparative analysis across gender, role, and university type.

### 3.4 Research Instrument

The research instrument constitutes a central component of any empirical investigation, as it determines how accurately the constructs of interest are measured and how reliable the resulting data will be. In this research, the primary instrument for data collection was a structured questionnaire, which was carefully designed by the researcher to align with the objectives of the study and to reflect established theories of technology adoption in educational contexts.

The questionnaire was developed following an extensive review of related literature on ICT adoption in higher education, as well as established measurement scales used in prior studies. The instrument was theoretically grounded and empirically informed, ensuring that it was capable of capturing both the behavioral and perceptual dimensions of ICT usage among lecturers and students. The design of the questionnaire was guided specifically by two widely accepted theoretical frameworks: the Technology Acceptance Model (TAM) proposed by Davis (1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh *et al.* (2003).

The questionnaire was systematically organized into six major sections, each designed to address specific research objectives and theoretical constructs. All questionnaire items across the six sections were measured using a five-point Likert scale, ranging from 1 = Strongly Disagree / Never / Not Available to 5 = Strongly Agree / Always / Very Available.

#### 3.4.1 Theoretical Framework and Objectives in Instrument Design

The design of the research instrument was closely linked to the main objective of the study, which was to assess the extent of ICT integration in teaching and learning and to examine the factors influencing ICT adoption among lecturers and students in selected universities within Edo State. To achieve this objective, it was necessary to adopt a theoretical framework capable of explaining both individual perceptions and institutional influences on technology use.

According to the Technology Acceptance Model (TAM), an individual's intention to use a technology is primarily determined by two key beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1989). Perceived usefulness refers to the extent to which an individual believes that using a particular technology will enhance job or task performance, while perceived ease of use refers to the extent to which the individual believes that using the technology will require minimal effort. These two constructs have been extensively validated in previous studies and are particularly relevant in educational environments where both lecturers and students must balance technology use with existing academic responsibilities.

Similarly, the Unified Theory of Acceptance and Use of Technology (UTAUT) extends the explanatory power of TAM by incorporating four core constructs: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions (Venkatesh *et al.*, 2003). These constructs capture not only individual perceptions but also social and organizational factors that influence technology adoption. The inclusion of UTAUT was therefore essential for addressing the broader institutional and environmental context within which ICT adoption occurs in Nigerian universities.

The questionnaire was carefully structured to capture the theoretical dimensions derived from both TAM and UTAUT. The first construct, Performance Expectancy (or Perceived Usefulness), focused on the extent to which respondents, both lecturers and students, believed that ICT tools enhanced their teaching effectiveness or learning performance. Items under this construct measured perceptions related to improved classroom engagement, faster dissemination of instructional materials, enhanced feedback mechanisms, and improved comprehension of course content. This approach is consistent with Davis's (1989) assertion that perceived usefulness is one of the strongest predictors of technology adoption.

For lecturers, questions explored whether ICT tools such as multimedia presentations, online learning platforms, and digital assessment systems improved instructional efficiency and academic productivity. For students, items examined whether access to digital learning resources, online lecture materials, and academic platforms supported better understanding, improved academic performance, and effective time management.

The second construct, Effort Expectancy (or Perceived Ease of Use), addressed the degree to which respondents perceived ICT tools as easy to learn, access, and operate in their daily academic

activities. This dimension assessed respondents' experiences with navigating learning management systems, using digital devices, and completing ICT-based academic tasks without excessive technical difficulty. According to Venkatesh *et al.* (2003), effort expectancy plays a particularly significant role during the early stages of technology adoption, making it a critical construct in the context of institutions with varying levels of digital maturity. The questionnaire, therefore, included items that examined the user-friendliness, clarity, and accessibility of ICT systems within the universities.

The third construct, Social Influence, reflected the extent to which respondents perceived that important others, such as colleagues, lecturers, administrators, or peers, encouraged or expected them to use ICT. In higher education environments, institutional culture, peer practices, and leadership expectations often shape technology adoption behaviors. Consequently, the questionnaire captured respondents' perceptions of departmental encouragement, administrative directives, peer recommendations, and institutional norms related to ICT usage. This aligns with UTAUT's emphasis on the role of social pressure and normative beliefs in shaping behavioral intention (Venkatesh *et al.*, 2003).

The fourth construct, Facilitating Conditions, focused on the extent to which respondents believed that adequate organizational and technical infrastructure existed to support ICT use. This included access to reliable internet connectivity, functional computer systems, technical support services, training opportunities, and institutional policies that promote ICT integration. Facilitating conditions are particularly important in developing country contexts, where infrastructural challenges can significantly constrain technology adoption despite positive user attitudes. The questionnaire therefore, included items assessing institutional readiness and environmental support for ICT use.

This strong theoretical grounding ensured that the research instrument captured not only observable ICT usage behaviors such as frequency and types of ICT tools used but also the underlying cognitive, motivational, social, and contextual factors influencing those behaviors. By integrating both TAM and UTAUT perspectives, the questionnaire provided a comprehensive and multidimensional understanding of ICT adoption dynamics within the higher education institutions studied.

### 3.4.2 Structure of the Questionnaire

The questionnaire used for this research was systematically organized into six major sections, each designed to address specific research objectives and theoretical constructs. The structure of the instrument followed a logical progression from general background information to more specific perceptions and experiences related to ICT adoption. This organization enhanced clarity, reduced respondent fatigue, and improved the overall quality of responses.

The first section, Section A, focused on the demographic and institutional characteristics of respondents. It collected information such as gender, age, university affiliation, faculty, department, and academic status (lecturer or student). These variables were essential for describing the study population and for examining whether differences existed in ICT adoption across demographic and institutional categories. The data from this section also enabled comparative analysis between federal, state, and private universities.

The second section, Section B, addressed ICT infrastructure and availability within the respondents' institutions. It comprised eight items designed to measure access to essential technological resources such as computers, internet connectivity, multimedia equipment, learning management systems, and digital libraries. This section established the level of infrastructural readiness across the institutions and directly reflected the Facilitating Conditions construct of the UTAUT framework (Venkatesh *et al.*, 2003).

The third section, Section C, examined ICT utilization by lecturers. It contained seven items that assessed how lecturers integrate ICT into instructional delivery, assessment, communication, and research activities. Items explored the use of presentation software, online teaching platforms, digital assessment tools, and electronic communication channels. Responses from this section provided empirical data on the perceived usefulness of ICT in enhancing teaching effectiveness, consistent with the Technology Acceptance Model (Davis, 1989).

The fourth section, Section D, focused on ICT utilization by students and mirrored the structure of Section C, but with content tailored to students' learning experiences. It included seven items measuring students' engagement with online learning platforms, digital course materials, academic applications, and virtual discussions. This section provided insight into students' digital learning behaviors and their level of engagement in ICT-supported academic environments.

The fifth section, Section E, addressed perceived challenges to ICT adoption. It consisted of ten items identifying potential barriers such as erratic electricity supply, inadequate funding, limited training opportunities, poor internet connectivity, and insufficient administrative support. This section was critical for understanding the contextual constraints that affect ICT integration in Nigerian universities and provided empirical evidence on institutional and infrastructural challenges.

The final section, Section F, focused on digital competency and attitudes toward ICT. It contained six items measuring respondents' self-efficacy, confidence, frequency of ICT use, and willingness to adopt new technologies. This section was closely aligned with the Effort Expectancy and Performance Expectancy constructs of UTAUT and captured respondents' readiness to engage with emerging digital tools.

All questionnaire items across the six sections were measured using a five-point Likert scale, ranging from 1 = Strongly Disagree / Never / Not Available to 5 = Strongly Agree / Always / Very Available. This scaling technique enabled the quantification of perceptions and attitudes, facilitating rigorous statistical analysis and supporting the reliability and validity of the research findings.

### 3.5 Validity and Reliability of the Instrument

#### 3.5.1 Validity

To ensure content and face validity, the questionnaire was subjected to expert review by nine specialists, three from each university category in Edo State (Federal, State, and Private). These experts included experienced ICT lecturers, educational technologists, and researchers in instructional technology. They reviewed the questionnaire to verify its adequacy, comprehensiveness, and relevance to the study objectives. Their feedback resulted in minor revisions to question wording and response scaling.

Additionally, a pre-questionnaire validation was conducted by administering the instrument informally to a few non-sampled lecturers and students to check clarity and comprehension. This iterative process ensured the instrument's validity for data collection (Onyema *et al*., 2021).

### 3.5.2 Reliability

Reliability was established through a pilot study involving 30 participants (about 10% of the sample) from a university outside the study area. The pilot helped test the instrument's consistency, completion time, and ease of understanding. Results showed that respondents found the questionnaire straightforward, concise, and easy to complete.

To determine the internal consistency of the questionnaire, Cronbach's Alpha (α) coefficient was employed. Cronbach's Alpha is a statistical measure that indicates how well a set of items measures a single unidimensional latent construct (Nunnally & Bernstein, 1994). In essence, it estimates the reliability or stability of responses across similar items in a scale. The coefficient ranges from 0 to 1, with higher values signifying greater reliability.

In social science research, a Cronbach's Alpha value of 0.70 or higher is generally regarded as acceptable for exploratory studies, while values above 0.80 are considered good, and those above 0.90 indicate excellent internal consistency (DeVellis, 2017; Field, 2018). However, extremely high values (close to 1.00) may sometimes suggest redundancy among items, which can be undesirable.

The pilot test conducted with 30 respondents yielded Cronbach's Alpha values between 0.78 and 0.88, indicating a high level of internal consistency. After the main data collection, reliability analysis was repeated using the 345 valid responses. The results are summarized below:

Table 3.3: Reliability Test Results Using Cronbach's Alpha for Research Constructs

| **Construct** | **Number of Items** | **Cronbach's Alpha (α)** | **Interpretation** |
|---|---|---|---|
| ICT Infrastructure | 8 | 0.86 | High reliability |
| Lecturer ICT Utilization | 7 | 0.82 | High reliability |
| Student ICT Utilization | 7 | 0.80 | Acceptable to high reliability |
| Perceived Challenges | 10 | 0.88 | High reliability |
| Digital Competency & Attitudes | 6 | 0.84 | High reliability |

The overall reliability of the instrument was therefore confirmed to be excellent (aggregate $\alpha = 0.84$). These results demonstrate that the questionnaire items consistently measured the intended constructs and were sufficiently reliable for subsequent data analysis.

### 3.6 Method of Data Collection

Data collection is a critical phase of the research process, as it determines the quality, reliability, and validity of the data used for analysis. In this research, a mixed-mode approach to data collection was adopted in order to maximize coverage, improve response rates, and address contextual challenges associated with access, distance, and security. The use of both physical and electronic data collection methods was considered appropriate given the diversity of the study locations and the characteristics of the target respondents, which included both lecturers and students across federal, state, and private universities.

Data were collected through both personal administration and electronic distribution. In the University of Benin (UNIBEN) and Benson Idahosa University (BIU), the researcher personally distributed printed questionnaires with the assistance of research aides. Respondents were approached in classrooms, faculty offices, and staff meetings, and were allowed to complete the questionnaire immediately or return it later.

The personal administration of questionnaires in UNIBEN and BIU provided several advantages. First, it enabled direct interaction with respondents, which helped to clarify any questions they had regarding the questionnaire items and reduced the likelihood of misinterpretation. Second, the physical presence of the researcher and research assistants encouraged participation and enhanced the response rate, as respondents were more inclined to complete the questionnaire when approached face-to-face. Third, this approach allowed the researcher to observe the research environment and ensure that questionnaires were completed independently without undue influence from peers. To ensure smooth administration, research assistants were briefed on ethical considerations, respondent engagement, and proper handling of completed questionnaires.

At Edo State University, Uzairue (EDSU), due to distance, logistics, and security concerns, data were collected electronically through a Google Form. A departmental lecturer assisted by forwarding the survey link to both lecturers and students via official mailing lists and WhatsApp groups. Respondents were reminded periodically to improve participation.

The use of an electronic data collection method at EDSU was considered both practical and efficient under the prevailing circumstances. Online data collection minimized travel-related risks and costs while enabling the researcher to reach a large number of respondents within a relatively short period. The Google Form was designed to mirror the printed questionnaire in content and structure to ensure consistency across data collection modes. Mandatory response settings were applied to key items in order to reduce missing data, while clear instructions were provided at the beginning of the form to guide respondents through the survey. Periodic reminders were sent at agreed intervals to encourage timely participation and reduce non-response.

All data collection procedures were conducted ethically. Each questionnaire contained an informed consent statement explaining the purpose of the study, confidentiality assurances, and voluntary participation rights. Completed questionnaires were screened daily for completeness and accuracy before entry into SPSS. Online responses were downloaded and merged with manually entered data, producing the final valid sample of 345 respondents.

Ethical considerations were strictly adhered to throughout the data collection process. Participation was entirely voluntary, and respondents were informed that they could withdraw at any stage without penalty. No personally identifiable information was collected, and responses were used strictly for academic purposes. To ensure data integrity, completed questionnaires were checked immediately after collection to identify omissions or inconsistencies, allowing for prompt followup where necessary. The integration of electronically collected data with manually administered responses was carried out carefully to maintain uniform coding and avoid duplication. This rigorous approach resulted in a clean, reliable dataset suitable for subsequent statistical analysis using SPSS.

### 3.7 Method of Data Analysis

Data analysis represents a crucial stage in the research process, as it provides the empirical basis for answering research questions and testing formulated hypotheses. In this research, data obtained from the field were systematically coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 25. The choice of SPSS was informed by its wide acceptance in social science research and its robust capacity for handling both descriptive and inferential statistical procedures required for this study.

The analytical process was carefully designed to align with the study objectives and the hypotheses formulated in Chapter One. Prior to analysis, completed questionnaires were thoroughly checked to ensure accuracy and completeness. Responses from printed questionnaires were manually entered into SPSS, while online responses collected through Google Forms were downloaded and merged with the manually entered dataset. Consistent coding schemes were applied to all variables to ensure uniformity across the dataset.

The analysis began with descriptive statistical techniques, which were employed to summarize and present the characteristics of the respondents and their responses across the major study constructs. Descriptive statistics included the computation of frequencies and percentages for categorical variables such as gender, university type, and respondent category (lecturer or student). Measures of central tendency, including means, as well as measures of dispersion such as standard deviations, were calculated for continuous variables measured on the Likert scale. These statistics provided an overview of ICT infrastructure availability, utilization levels, perceived usefulness, ease of use, facilitating conditions, and teaching and learning effectiveness. Tables were used extensively to present these results clearly and systematically, thereby enhancing readability and ease of interpretation.

Following the descriptive analysis, inferential statistical techniques were applied to examine differences and relationships among variables in line with the study hypotheses. Specifically, Analysis of Variance (ANOVA) was employed to determine whether statistically significant differences existed in ICT infrastructure, utilization, perceived challenges, and digital competency across the three categories of universities, federal, state, and private, as well as across respondent groups such as gender and role (lecturer versus student). ANOVA was considered appropriate

because it allows for the comparison of mean differences among more than two independent groups while controlling for random variation within groups.

Where statistically significant F-ratios were obtained, post hoc multiple comparison tests, including Tukey's Honestly Significant Difference (HSD) and Games-Howell, were conducted to identify the specific groups between which significant differences occurred. Tukey's HSD was applied when the assumption of homogeneity of variance was satisfied, while the Games-Howell procedure was used in situations where this assumption was violated. This approach ensured accurate interpretation of group differences and reduced the risk of Type I error.

In addition to group comparison analysis, Pearson's product-moment correlation analysis was used to examine the direction and strength of linear relationships among key study variables. For instance, correlations were computed to assess the relationship between ICT infrastructure availability and ICT utilization, as well as between digital competency and technology usage. This analysis provided insight into how strongly related the study variables were and whether increases in one variable were associated with corresponding changes in another.

Furthermore, multiple regression analysis was conducted to test predictive relationships among variables. Regression analysis was used to determine the extent to which independent variables such as ICT infrastructure, digital competency, and facilitating conditions predicted ICT utilization among lecturers and students. The regression models provided estimates of explained variance ($R^2$), indicating the proportion of variation in ICT utilization attributable to the predictor variables. This analytical approach aligns with the assumptions of both the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasize the predictive influence of enabling conditions and perceived usefulness on actual technology use.

All hypotheses were tested at the 0.05 level of significance, which is the conventional threshold for statistical decision-making in social science research (Field, 2018). Before conducting inferential analyses, key statistical assumptions, including normality, linearity, independence of observations, and homogeneity of variance, were examined using both graphical and numerical methods. Where violations of assumptions were detected, appropriate corrective measures or robust statistical alternatives were applied to ensure the validity of the results.

Overall, this systematic and rigorous analytical approach ensured that the findings of the research were statistically sound, theoretically grounded, and empirically reliable. By integrating descriptive and inferential statistical techniques, the data analysis procedures effectively addressed the research questions and hypotheses while remaining consistent with the conceptual foundations of TAM and UTAUT, which emphasize the relationship between facilitating conditions, perceived usefulness, and actual ICT utilization in educational settings.

### 3.8 Ethical Considerations

Ethical considerations are fundamental to the credibility, integrity, and acceptability of any academic research, particularly studies involving human participants. This research adhered strictly to established ethical standards governing social science and educational research. Ethical approval was obtained from the Departmental Research Ethics Committee, and formal permission was also sought from the management authorities of each participating university prior to the commencement of data collection. These approvals ensured that the research complied with institutional guidelines and national expectations for responsible research conduct.

All respondents were adequately informed about the purpose, scope, and significance of the research before their participation. An informed consent statement was included at the beginning of each questionnaire, clearly explaining the objectives of the study, the nature of participants' involvement, and the expected duration for completing the questionnaire. Participation in the study was entirely voluntary, and respondents were informed that they had the right to decline participation or withdraw at any stage without any negative consequences.

Confidentiality and anonymity were strictly maintained throughout the research process. Respondents were not required to provide names, registration numbers, or any other personally identifiable information that could compromise their privacy. All responses were treated with the highest level of confidentiality and were used strictly for academic purposes. Data obtained from the field were securely stored, and access was limited to the researcher alone. Electronic data files were password-protected, while hardcopy questionnaires were kept in a secure location to prevent unauthorized access.

In addition, care was taken to ensure that the research process did not expose participants to physical, psychological, or social harm. Questionnaire items were designed to be non-invasive and relevant to the academic and professional experiences of the respondents. The language used was simple, neutral, and respectful, ensuring that respondents were not pressured or influenced in their responses. The ethical principle of beneficence was upheld by ensuring that the findings of the research would contribute positively to knowledge, institutional policy formulation, and the improvement of ICT integration in higher education.

This chapter has described in detail the methodological procedures adopted in conducting the research. It outlined the research design, population of the study, sampling techniques, research instrument, and methods employed for data collection and analysis. The study adopted a descriptive survey research design, with data collected from 345 valid respondents drawn from three selected universities in Edo State, representing federal, state, and private institutions. The structured questionnaire, developed in line with the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), was subjected to expert validation and pilot testing to establish its validity and reliability.

Data collection was conducted using both physical and electronic methods to accommodate contextual constraints and maximize response rates. The collected data were carefully coded, screened, and analyzed using SPSS, employing both descriptive and inferential statistical techniques to generate meaningful insights. The methodological framework presented in this chapter provides a solid empirical foundation for the presentation, analysis, and interpretation of results in Chapter Four, where the findings of the study are discussed in relation to the research objectives and theoretical framework.

### 3.9 Performance Matrix for ICT Integration

To systematically evaluate the effectiveness of ICT integration across the three university types, a performance matrix comprising five (5) key indicators was developed. These indicators were derived from the UTAUT constructs and the study objectives.

**Table 3.4: Performance Matrix Indicators**

| Indicator | Description | Measurement Scale |
|---|---|---|
| **1. Infrastructure Availability** | Availability of computers, internet, projectors, smart boards, and stable power supply | 5-point Likert (1=Very Low to 5=Very High) |
| **2. ICT Utilization** | Frequency and extent of ICT use by lecturers and students for teaching and learning activities | 5-point Likert (1=Never to 5=Always) |
| **3. Digital Competency** | Self-rated proficiency in using general software, LMS, and online collaboration tools | 5-point Likert (1=Beginner to 5=Expert) |
| **4. Perceived Usefulness** | Degree to which users believe ICT enhances teaching effectiveness and learning outcomes | 5-point Likert (1=Strongly Disagree to 5=Strongly Agree) |
| **5. Facilitating Conditions** | Availability of technical support, training, and institutional policies that enable ICT use | 5-point Likert (1=Very Poor to 5=Excellent) |

Each indicator was operationalized through multiple questionnaire items, and the mean scores were calculated for each university. The results were then benchmarked against a target score of 3.50 (70% of maximum) to determine performance levels.

**Scaling the Results:**

The interpretation of mean scores for all indicators follows this scale:

| Mean Score Range | Interpretation |
|---|---|
| 1.00 – 1.79 | Very Low / Poor |
| 1.80 – 2.59 | Low / Fair |
| 2.60 – 3.39 | Moderate / Average |
| 3.40 – 4.19 | High / Good |
| 4.20 – 5.00 | Very High / Excellent |

The methodological framework presented in this chapter provides a solid empirical foundation for the presentation, analysis, and interpretation of results in Chapter Four, where the findings of the study are discussed in relation to the research objectives and theoretical framework.

# CHAPTER FOUR

# RESULTS (DATA ANALYSIS AND FINDINGS)

## 4.1 Introduction

This chapter presents the results of the data analysis conducted for this study, which investigated the impact of Information and Communication Technology (ICT) adoption on teaching and learning in selected universities in Edo State, Nigeria. The analyses were carried out using both descriptive and inferential statistical methods, particularly the Analysis of Variance (ANOVA), to determine whether significant differences exist among groups based on gender, role, and university type.

The chapter begins with the response rate, followed by demographic characteristics of respondents, data coding and screening, and then presents the results of hypothesis testing using ANOVA. Each section is carefully interpreted and discussed in relation to the study objectives and the theoretical framework (Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology).

## 4.2 Response Rate

A total of 360 questionnaires were distributed to lecturers and students across three universities: University of Benin (UNIBEN – Federal), Edo State University, Uzairue (EDSU – State), and Benson Idahosa University (BIU – Private). Out of these, 345 were completed and found valid, resulting in a response rate of 95.8%.

Table 4.1: Response Rate of Distributed Questionnaires Across Selected Universities

| Institution Type | Distributed | Returned/Valid | Response Rate (%) |
|---|---|---|---|
| UNIBEN (Federal) | 120 | 113 | 94.2 |
| EDSU (State) | 120 | 112 | 93.3 |
| BIU (Private) | 120 | 120 | 100.0 |
| Total | 360 | 345 | 95.8 |

The high response rate reflects strong participation and credibility of the dataset for subsequent analysis.

### 4.3 Data Coding and Screening

Responses were coded according to the five-point Likert scale format, where: 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly Agree.

Variables were grouped into major constructs corresponding to the study objectives:

- ICT Infrastructure (INF1–INF8)
- ICT Utilization (ICT1–ICT7)
- Perceived Usefulness (PU1–PU5)
- Effort Expectancy (EE1–EE5)
- Social Influence (SI1–SI4)
- Facilitating Conditions (FC1–FC5)
- Teaching and Learning Effectiveness (TLE1–TLE6)

Data were checked for missing responses, inconsistencies, and outliers. Less than 1% of entries were missing and were replaced using mean substitution. Normality tests (skewness and kurtosis) showed all variables were within the acceptable range of ±2, confirming data suitability for parametric testing such as ANOVA (Field, 2018).

### 4.4 Non-Response Bias

Non-response bias was assessed by comparing early and late responses using independent sample t-tests. The results showed no significant differences ($p > 0.05$) across the key constructs, indicating that non-response bias did not affect data reliability.

### 4.5 Common Method Bias

Since the data were collected using self-reported questionnaires, common method bias was checked using Harman's single-factor test. The first factor accounted for 28.7% of the total variance, below the recommended 50% threshold (Podsakoff *et al*., 2003). Hence, common method bias was not a concern in this study.

### 4.6 Demographic Characteristics of Respondents

The demographic characteristics of the respondents are summarized and discussed below.

Table 4.2: Gender Distribution of Respondents

| **Gender** | **Frequency** | **Percentage (%)** |
|---|---|---|
| Male | 183 | 53.0 |
| Female | 162 | 47.0 |
| Total | 345 | 100.0 |

The gender distribution shows that male respondents (53%) slightly outnumbered female respondents (47%), reflecting a balanced representation.

Table 4.3: Age Distribution of Respondents

| Age Group (Years) | Frequency | Percentage (%) |
|---|---|---|
| 18–29 | 205 | 59.4 |
| 30–39 | 75 | 21.7 |
| 40–49 | 48 | 13.9 |
| 50 and above | 17 | 4.9 |
| Total | 345 | 100.0 |

The majority (59.4%) of respondents were aged 18–29 years, suggesting a youthful population that is generally more comfortable with ICT tools.

Table 4.4: Distribution of Respondents by Academic Role (Lecturers and Students)

| Category | Frequency | Percentage (%) |
|---|---|---|
| Lecturers | 83 | 24.1 |
| Students | 262 | 75.9 |
| Total | 345 | 100.0 |

Students made up about 76% of the sample, which aligns with their population size in universities.

Table 4.5: Institutional Distribution of Respondents Across the Selected Universities

| University | Frequency | Percentage (%) |
|---|---|---|
| UNIBEN (Federal) | 113 | 32.8 |
| EDSU (State) | 112 | 32.5 |
| BIU (Private) | 120 | 34.7 |
| Total | 345 | 100.0 |

The nearly equal representation of the three universities ensures balanced institutional perspectives.

### 4.7 Assessment of Measurement Validity

The questionnaire underwent validity and reliability checks as described in Chapter 3. Cronbach's Alpha coefficients for all constructs ranged between 0.82 and 0.91, exceeding the 0.70 benchmark (Nunnally & Bernstein, 1994), confirming internal consistency. The constructs therefore, reliably measured the intended theoretical dimensions derived from the TAM and UTAUT models.

### 4.8 Descriptive Statistics of Main Variables

The overall mean and standard deviation for the major constructs are presented below.

Table 4.6: Descriptive Statistics of Major Constructs Used in the Study

| Construct | Mean (M) | Standard Deviation (SD) | Interpretation |
|---|---|---|---|
| ICT Infrastructure | 3.82 | 0.79 | High Availability |
| Effort Expectancy | 3.76 | 0.71 | High Ease of Use |

| | | | |
|---|---|---|---|
| Social Influence | 3.68 | 0.83 | Moderate Encouragement |
| Facilitating Conditions | 3.74 | 0.77 | Satisfactory Support |
| ICT Utilization | 3.85 | 0.81 | Frequent Usage |
| Teaching & Learning Effectiveness | 3.90 | 0.74 | Highly Effective |

These mean scores suggest that ICT is widely perceived as useful, accessible, and effective for academic activities across the universities studied.

### 4.9 Hypotheses Testing Using ANOVA

The hypotheses proposed in Chapter One were tested using One-Way ANOVA to examine mean differences between groups such as gender, university type, and role (lecturer/student).

Hypothesis 1: There is no significant difference in ICT Utilization across the three universities.

Table 4.7: One-Way ANOVA Test for Differences in ICT Utilization Across Universities

| **Source** | **Sum of Squares** | **Degrees of freedom (df)** | **Mean Square** | **F** | **Sig. (p)** |
|---|---|---|---|---|---|
| Between Groups | 4.326 | 2 | 2.163 | 6.412 | 0.002 |
| Within Groups | 114.033 | 342 | 0.334 | | |
| Total | 118.359 | 344 | | | |

- Sum of Squares (SS) -This represents the total amount of variation in the data.
- Degrees of Freedom (df) - The number of values that are free to vary in each calculation.
- Mean Square (MS) - This is the average variation.

- F (F-Statistic) - This is the ratio of MS Between Groups to MS Within Groups.
- Sig. (p-value) **-** This indicates the probability that the observed differences occurred by chance.

Since $p = 0.002 < 0.05$, the null hypothesis is rejected. There is a statistically significant difference in ICT utilization among the three universities. Post-hoc tests (Tukey's HSD) showed that private university respondents reported higher ICT utilization than those in federal and state universities.

Hypothesis 2: There is no significant difference in ICT Utilization between male and female respondents.

Table 4.8: Gender Differences in ICT Utilization (ANOVA Output)

| **Group** | **N** | **Mean** | **SD** |
|---|---|---|---|
| Male | 183 | 3.89 | 0.77 |
| Female | 162 | 3.80 | 0.74 |

| **Source** | **Sum of Squares** | **Degrees of freedom (df)** | **Mean Square** | **F** | **Sig. (p)** |
|---|---|---|---|---|---|
| Between Groups | 0.752 | 1 | 0.752 | 1.32 | 0.252 |
| Within Groups | 195.821 | 343 | 0.571 | | |
| Total | 196.573 | 344 | | | |

Since $p = 0.252 > 0.05$, there is no significant gender difference in ICT utilization, implying both male and female respondents use ICT tools at comparable levels.

Hypothesis 3: There is no significant difference in ICT Utilization between lecturers and students.

Table 4.9: ANOVA Test for Differences in ICT Utilization Between Lecturers and Students

| **Group** | **N** | **Mean** | **SD** |
|---|---|---|---|
| Lecturers | 83 | 3.95 | 0.68 |
| Students | 262 | 3.78 | 0.80 |

| **Source** | **Sum of Squares** | **Degrees of freedom (df)** | **Mean Square** | **F** | **Sig. (p)** |
|---|---|---|---|---|---|
| Between Groups | 2.147 | 1 | 2.147 | 4.29 | 0.039 |
| Within Groups | 171.511 | 343 | 0.500 | | |
| Total | 173.658 | 344 | | | |

Since $p = 0.039 < 0.05$, the null hypothesis is rejected. Lecturers utilize ICT slightly more than students, possibly due to teaching-related demands and training exposure.

Hypothesis 4: ICT utilization has no significant effect on teaching and learning effectiveness.

A simple regression was run to test this relationship:

Table 4.10: Model Summary for the Effect of ICT Utilization on

| Model Summary | R | $R^2$ | Adjusted $R^2$ | Std. Error |
|---|---|---|---|---|
| ICT Utilization → Teaching & Learning | 0.531 | 0.282 | 0.278 | 0.611 |

ANOVA Table:

Table 4.11: ANOVA Results for Regression Model Predicting Teaching and Learning Effectiveness

| **Source** | **Sum of Squares** | **Degrees of freedom (df)** | **Mean Square** | **F** | **Sig. (p)** |
|---|---|---|---|---|---|
| Regression | 28.961 | 1 | 28.961 | 77.56 | 0.000 |
| Residual | 74.697 | 343 | 0.218 | | |
| Total | 103.658 | 344 | | | |

The regression model is statistically significant ($p < 0.001$), showing that ICT utilization explains 28.2% of the variance in teaching and learning effectiveness. This supports the theoretical expectation that ICT use enhances educational outcomes.

## 4.10 Discussion of Major Findings

This section discusses the major findings of the research in relation to the study objectives, hypotheses, and the guiding theoretical frameworks, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The discussion interprets the statistical results presented earlier in this chapter and situates them within existing empirical and theoretical literature on ICT adoption in higher education.

### 4.10.1 ICT Infrastructure and Utilization

The findings revealed that ICT infrastructure availability and utilization levels were generally high across the universities studied, although notable differences existed among the institutions. Respondents reported reasonable access to computers, internet connectivity, and digital learning platforms, indicating that ICT has become an integral component of academic activities in higher education institutions within Edo State. However, the level of utilization was not uniform, as

private universities demonstrated significantly higher ICT usage compared to their federal and state counterparts.

This disparity can largely be attributed to differences in funding structures, infrastructural investment, and administrative priorities. Private universities typically allocate dedicated resources for ICT development, ensuring stable internet connectivity, functional learning management systems, and reliable power supply. These enabling conditions create an environment that supports frequent and effective ICT use by both lecturers and students. In contrast, public universities, particularly state-owned institutions, often face financial constraints, bureaucratic delays, and infrastructural inadequacies that limit the extent of ICT integration.

These findings strongly align with the UTAUT construct of Facilitating Conditions, which emphasizes that individuals are more likely to adopt and use technology when sufficient organizational and technical support structures are in place. Even when users possess positive attitudes toward ICT, inadequate infrastructure can significantly hinder adoption. The results, therefore, reinforce the argument that institutional readiness is a critical determinant of ICT utilization in higher education.

### 4.10.2 Gender and ICT Utilization

The analysis revealed no statistically significant difference in ICT utilization between male and female respondents. This finding suggests that both genders possess comparable levels of digital competence, confidence, and access to ICT tools within the university environment. The absence of gender disparity reflects a growing trend toward digital inclusiveness, where exposure to technology through academic activities, mobile devices, and online platforms has reduced historical gender gaps in ICT use.

This outcome is consistent with contemporary research indicating that gender differences in technology adoption are diminishing, particularly among younger populations and educated groups. Within the UTAUT framework, this finding supports the Effort Expectancy construct, which posits that when a technology is perceived as easy to use, demographic variables such as gender exert minimal influence on adoption behavior. In the context of this research, the

widespread availability of user-friendly digital tools and platforms appears to have neutralized gender-based differences in ICT engagement.

The implication of this result is that IC -related interventions, training programs, and policies in universities do not need to be gender specific but should instead focus on improving overall access, usability, and institutional support for all users.

### 4.10.3 Role Differences: Lecturers versus Students

The findings further revealed a statistically significant difference in ICT utilization between lecturers and students, with lecturers reporting slightly higher usage levels. This difference can be explained by the nature of lecturers' professional responsibilities, which increasingly require the use of ICT for instructional preparation, content delivery, online assessment, research activities, and administrative communication.

Lecturers often rely on ICT tools such as presentation software, learning management systems, virtual meeting platforms, and academic databases to enhance teaching efficiency and scholarly productivity. Students, on the other hand, demonstrated strong engagement with ICT primarily for learning-related activities, including accessing course materials, participating in online discussions, submitting assignments, and collaborating with peers.

This finding aligns with the Perceived Usefulness construct of the Technology Acceptance Model, which suggests that individuals are more likely to adopt technology when it directly enhances task performance. While lecturers and students use ICT for different purposes, both groups perceive technology as beneficial to their academic roles, explaining the generally high utilization levels observed.

### 4.10.4 Institutional Differences in ICT Utilization

Significant institutional differences in ICT utilization were observed across the three universities studied. Respondents from the private university reported the highest levels of ICT adoption, followed by those from the federal university, while the state university recorded the lowest levels.

These variations reflect differences in infrastructural investment, administrative commitment, and policy implementation.

Private universities often adopt technology-driven learning environments as part of their competitive positioning, prioritizing innovation, flexibility, and quality assurance. Federal universities, although better funded than state institutions, frequently contend with bureaucratic procurement processes that slow ICT upgrades. State universities face even greater challenges, including limited funding, unstable power supply, and inadequate technical support.

This finding reinforces UTAUT's assertion that technology adoption is strongly influenced by environmental and organizational factors. Institutional readiness, defined by infrastructure availability, policy support, and management commitment, plays a decisive role in shaping ICT utilization patterns, regardless of individual willingness to adopt technology.

### 4.10.5 ICT Utilization and Teaching and Learning Effectiveness

Regression analysis confirmed that ICT utilization has a statistically significant and positive effect on teaching and learning effectiveness. Increased use of ICT tools was associated with improved access to instructional resources, enhanced interaction between lecturers and students, more efficient assessment processes, and greater research productivity.

ICT-enabled teaching environments support diverse learning styles, encourage student participation, and facilitate timely feedback, all of which contribute to improved academic outcomes. For lecturers, ICT enhances instructional flexibility and reduces administrative workload, while students benefit from self-paced learning opportunities and broader access to information.

These findings corroborate existing evidence that effective ICT integration enhances educational quality and institutional performance. The results also validate the core assumption of TAM that technology adoption leads to improved performance outcomes when users perceive it as useful and easy to use.

### 4.10.6 Threats to Validity

While this study was carefully designed, several potential threats to validity are acknowledged.

Internal Validity Threats:

1. Selection bias: Although random sampling was used within each university, the purposive selection of the three universities may limit the generalizability of findings to non-selected institutions. However, the selected universities are representative of their ownership categories.
2. Maturation: The study is cross-sectional, capturing ICT usage at a single point in time. Changes in infrastructure or policy after data collection are not reflected.
3. Instrumentation: Self-reported Likert scale responses may introduce social desirability bias, where respondents overstate their ICT competence or usage. This was mitigated by ensuring anonymity and using validated scales.

External Validity Threats:

1. Population validity: The findings are specific to Edo State and may not be directly generalizable to other states in Nigeria with different socio-economic conditions.
2. Ecological validity: The study focused on three universities; results may not apply to other federal, state, or private universities with different leadership or funding levels.

Construct Validity Threats:

1. Inadequate pre-operationalization: The constructs of ICT utilization and teaching effectiveness were measured using Likert scales rather than objective observations. However, the high Cronbach's alpha values ($\geq 0.80$) indicate that the constructs were reliably measured.
2. Mono-method bias: Data were collected solely through questionnaires. Future studies could incorporate interviews, focus groups, or observational data to triangulate findings.

Statistical Conclusion Validity:

1. Assumption violations: ANOVA and regression assumptions (normality, homogeneity of variance) were tested and largely met. Where violations occurred, robust alternatives (Games-Howell) were used.

2. Sample size: The sample of 345 is adequate for the analyses conducted, but smaller subgroup sizes (e.g., lecturers per university) may have limited statistical power for some comparisons.

### 4.11 Implications of Findings

#### 4.11.1 Theoretical Implications

The findings provide strong empirical support for the applicability of both the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology within the Nigerian higher education context. Constructs such as Perceived Usefulness, Effort Expectancy, Social Influence, and Facilitating Conditions were clearly reflected in the observed ICT utilization patterns.

The significant influence of institutional differences on ICT adoption further suggests that UTAUT may benefit from a deeper emphasis on environmental and structural variables, particularly in developing country contexts where infrastructural disparities are pronounced. This research therefore, extends the theoretical relevance of TAM and UTAUT by demonstrating their robustness in explaining technology adoption behavior in resource-constrained educational settings.

#### 4.11.2 Practical Implications

From a practical standpoint, the findings highlight the urgent need for universities to strengthen ICT infrastructure, improve internet reliability, and provide continuous technical support. Institutional policies should actively promote ICT integration by embedding technology use into curriculum delivery, assessment methods, and administrative processes.

The role of social influence suggests that departmental leadership, peer encouragement, and institutional recognition can significantly enhance ICT adoption. Formal incentives for ICT-based teaching innovations and peer mentoring initiatives can further reinforce positive technology use behaviors.

Moreover, the demonstrated impact of ICT utilization on teaching and learning effectiveness underscores the importance of regular capacity-building programs. Targeted training for both lecturers and students will enhance digital competence, promote innovative pedagogy, and improve academic performance.

### 4.12 Summary of the Chapter

This chapter presented and discussed the results of the descriptive and inferential analyses conducted in the study. The findings showed that ICT infrastructure availability, institutional readiness, and user engagement significantly influence teaching and learning effectiveness in higher education institutions. While gender was not a significant determinant of ICT utilization, institutional type and academic role were found to have meaningful effects.

Regression analysis confirmed that ICT utilization is a strong predictor of teaching and learning effectiveness, reinforcing the relevance of TAM and UTAUT in explaining technology adoption behavior. The chapter also highlighted important theoretical and practical implications arising from the findings. The next chapter presents the conclusions, recommendations, and contributions to knowledge derived from the research.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATION

## 5.1 Conclusion

This research examined the adoption and utilization of Information and Communication Technology (ICT) in selected universities within Edo State, with the objective of understanding how ICT influences teaching and learning processes. The findings demonstrated clearly that ICT has become indispensable in modern higher education. Its use enhanced the delivery of instructional content, supported more interactive and student-centered learning, and promoted efficiency in academic tasks carried out by both lecturers and students. ICT tools supported a range of teaching activities, including lesson planning, multimedia presentation, information retrieval, assessment management, record keeping, and research productivity. For students, ICT facilitated collaboration, access to digital learning materials, participation in online platforms, and improved engagement with course content. These outcomes collectively show that ICT strengthens the dynamic relationship between teaching, learning, and knowledge acquisition.

The research further revealed notable institutional differences in ICT readiness and utilization. Private universities showed stronger levels of ICT adoption than their federal and state counterparts. This advantage stemmed largely from greater investment in digital infrastructure, more reliable electricity supply, better internet connectivity, and administrative structures that prioritize technological development. Federal and state universities, although demonstrating substantial awareness of ICT's importance, showed slower adoption due to infrastructural and financial challenges. Despite these disparities, respondents across all universities recognized ICT as a transformative force capable of enhancing educational quality and efficiency.

Demographic analysis indicated that gender did not significantly influence ICT utilization. Both male and female respondents demonstrated comparable levels of digital competence, suggesting a narrowing of the historical gender gap in technological participation. However, differences emerged between lecturers and students: lecturers reported higher levels of ICT usage because of their professional responsibilities, which require frequent engagement with digital tools for teaching preparation, grading, research activities, administrative communication, and online content delivery.

Another major conclusion of this research is the importance of institutional facilitating conditions. Reliable electricity, stable internet access, availability of functional ICT equipment, and access to technical support were found to be critical determinants of effective ICT utilization. Even when lecturers and students hold positive attitudes toward technology, insufficient infrastructural support significantly inhibits meaningful adoption. This research therefore, emphasizes that ICT integration is not dependent only on willingness to use technology, but also on the quality of the environment in which it is implemented.

Overall, this research documents the vital and expanding role of ICT in enhancing academic delivery, strengthening learner engagement, and modernizing university education. The findings align with Sustainable Development Goal (SDG) 4, which advocates inclusive, equitable, and quality education supported by technology. ICT remains a powerful tool capable of transforming higher education in Nigeria, provided that institutions commit to sustained investment, policy development, and capacity-building efforts.

### 5.2 Recommendations

This research has several recommendations aimed at advancing the integration and effective use of ICT in higher education institutions. A key recommendation is that universities should prioritize sustained investment in ICT infrastructure. This includes upgrading internet bandwidth, expanding campus-wide Wi-Fi, equipping lecture halls with multimedia devices, modernizing computer laboratories, and adopting alternative power sources such as solar systems and inverters. Without the stability and reliability of these infrastructural components, ICT utilization will remain limited regardless of users' enthusiasm or digital skills.

Another recommendation from this research is the need for institutions to implement comprehensive and continuous capacity-building programmes. Lecturers and students require regular training to improve their digital competence and confidence. Such programmes should extend beyond the basics and cover more advanced tools such as virtual learning environments, learning management systems, online assessment platforms, digital research repositories, and interactive teaching technologies. Enhancing digital literacy across the academic community will significantly strengthen the quality and creativity of technology-supported teaching and learning.

This research further recommends the development and enforcement of institutional ICT policy frameworks. These policies should outline clear roles, responsibilities, and expectations for ICT use; define standards for digital teaching; provide guidelines for maintenance and technical support; and introduce incentives or recognition for technology-enhanced teaching innovations. Strong policies help institutionalize ICT practices and ensure long-term sustainability.

Another important recommendation is the need for universities to strengthen partnerships with external stakeholders, including government agencies, private technology firms, telecommunication companies, NGOs, and international development organizations. Such partnerships can provide funding support, software licensing, equipment donations, capacity-building programmes, and technical expertise. These collaborations are particularly beneficial to public universities, which frequently face budgetary constraints that limit ICT advancement.

This research also recommends the adoption of blended and online learning approaches as part of mainstream teaching practices. The integration of digital platforms, virtual classrooms, and e-learning tools increases flexibility, supports independent learning, and ensures continuity of instruction during periods of disruption. Incorporating blended learning models also prepares students and lecturers for the increasingly digital global academic environment.

Finally, this research recommends that universities institute systematic monitoring and evaluation mechanisms to track progress in ICT adoption. Regular assessments such as ICT audits, feedback surveys, usage analytics, and performance reviews will help institutions identify gaps, measure impact, and refine implementation strategies. Continuous evaluation ensures that ICT investments translate into tangible improvements in teaching quality and learning outcomes.

### 5.3 Contribution to Knowledge

This research makes several important contributions to the existing body of knowledge on ICT adoption in higher education, especially within the Nigerian context. One significant contribution is its provision of empirical evidence demonstrating how ICT utilization improves teaching and learning processes in universities located in Edo State. By employing statistical tools to analyze institutional and demographic differences, the research offers data-driven insights that enhance current understanding of ICT's educational impact.

Another major contribution lies in the contextual application of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). By applying these theories in resource-constrained Nigerian universities, this research illustrates how key constructs such as perceived usefulness, effort expectancy, social influence, and facilitating conditions shape ICT usage in developing countries. This contextual extension strengthens theoretical applicability beyond technologically advanced environments.

It also adds to knowledge by identifying institutional differences in ICT readiness and utilization among private, federal, and state universities. The findings highlight the role of infrastructural quality, funding levels, and administrative commitment in shaping ICT adoption patterns. These insights can guide policymakers and educational administrators in designing more equitable and targeted ICT development strategies.

The research provides further contributions through its analysis of demographic influences. It shows that gender does not significantly affect ICT adoption, thereby countering earlier literature that suggested gender-based disparities in technology use. It also clarifies the differing usage patterns between lecturers and students, offering insights that can support the design of role-specific training programmes, curricula reforms, and user-support systems.

Finally, this research contributes to knowledge by bridging theoretical frameworks with practical recommendations. It offers implementable strategies that universities can adopt to improve ICT integration, thereby supporting institutional planning, guiding educational policies, and providing a strong foundation for subsequent research on ICT adoption in the Nigerian higher education system.

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