UTILIZATION OF OPEN-SOURCE SOFTWARE FOR ACADEMIC ACTIVITIES

BY

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SUBMITTED TO THE DEPARTMENT OF COMPUTER SCIENCE, FACULTY OF PHYSICAL SCIENCES, UNIVERSITY OF BENIN, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF A BACHELOR OF SCIENCE (B.SC.) HONS DEGREE IN COMPUTER SCIENCE

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CERTIFICATION

This is to certify that this project work was carried out by **OKOHA FORTUNE ONYINYECHI** with matriculation number **PSC2105380**, Faculty of Physical Sciences, Department of Computer Science, University of Benin, Benin City under my supervision.

_____ _____

Dr. Mrs. Grace Aziken **Date**

(Project Supervisor)

APPROVAL

This project report written by **OKOHA FORTUNE ONYINYECHI** with matriculation number **PSC2105380** in partial fulfillment of the requirement for the award of the University of Benin Bachelor of Science (B. Sc.) degree in Computer Science, is adequate both in scope and content and it is hereby approved for presentation.

DR. ROSEMARY USIOBAIFO	**Date**
Head of Department	

DEDICATION

This project is dedicated to God Almighty for giving me the strength and wisdom to see it through to completion, and even throughout my stay in the University of Benin (UNIBEN). It is also dedicated to my parents; Mr and Mrs Okoha. I thank you all for the love, support and guidance throughout my academic journey.

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Also to the Head of Department, Dr. Mrs. Rosemary Usiobaifo, and other lecturers in the Department of Computer Science who I have been opportune to cross paths with, and have impacted me immensely these past few years.

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ABSTRACT

This project explored how open-source software (OSS) is being used for academic activities in Nigerian universities, focusing on the University of Benin as a case study. The aim was to find out how aware students and ICT personnel are of OSS, how they use it for learning, teaching, and research, the benefits they gain from it, and the challenges that limit its proper use.

A descriptive survey design was used for the study, and data were gathered through a structured questionnaire created with Google Forms. Seventy (70) valid responses were collected from students and ICT staff across different faculties. The data were analyzed using simple descriptive statistics such as frequencies, percentages, and mean scores, and the results were presented in tables for clarity.

Findings showed that most respondents were aware of and made use of open-source tools like Moodle, Google Workspace, DSpace, and Koha. These tools were mainly used for online learning, collaboration, and research work. The study also revealed that OSS is appreciated for being affordable, flexible, and easy to access, though some challenges—such as poor internet connection, limited training, and lack of institutional support—still make it difficult to use effectively.

In conclusion, the study shows that OSS plays an important role in supporting academic work at the University of Benin. However, to get the best out of it, universities should invest more in ICT facilities, organize regular training for users, and develop policies that encourage the wider use of open-source tools.

CHAPTER ONE
INTRODUCTION

1.1 Background Study

Software is essential to the operation of educational institutions in the current digital era. It helps in teaching, research, administration, and student involvement, among other things. Nigerian colleges have been using proprietary software solutions for these activities for a long time. However, the high cost of licensing, vendor lock-in, restricted customization, and ongoing subscription costs present serious difficulties, especially for public colleges with limited funding (Oyelaran-Oyeyinka & Adeya, 2004).
Software whose source code is publicly accessible for anyone to use, alter, and distribute is referred to as Open-Source Software (OSS) (Stallman, 2002). OSS offers freedom, affordability, and a platform for cooperative development in contrast to proprietary software. OSS has become more and more popular worldwide in a variety of fields, including education, where organizations use it to improve instruction, learning, and administrative duties while encouraging technical independence and teamwork (Wheeler, 2007; UNESCO, 2019).

OSS is becoming a more alluring option in Nigerian colleges due to the growing expense of proprietary software and a lack of financing (Adebayo & Adesanya, 2020). Open-source software like Moodle for learning management, LibreOffice for document processing, Linux for server management, and R or Python for data analysis and research are starting to be investigated by many institutions. The use of OSS in academic activities includes a number of aspects, including how these tools are used in research projects, teaching and learning procedures, administrative tasks, and group projects. To maximize the benefits of these technologies in the academic sector, it is crucial to comprehend how OSS is now used, how much it is integrated into everyday academic operations, and what variables help or impede its effective usage.

OSS is still not widely used in Nigerian colleges, despite its accessibility and potential advantages. Many organizations still rely significantly on commercial software, possibly as a result of things like ignorance, a lack of technical expertise, a lack of institutional

support, or insufficient training (Yusuf & Onasanya, 2021). Prior research has identified obstacles such low technical capability, worries about software security and quality, and a lack of institutional frameworks to facilitate OSS integration (Olugbara et al., 2010; Adebayo & Abdulhamid, 2014).

This study investigates the utilization of Open-Source Software for academic activities in the University of Benin, focusing on the current state of usage, the benefits realized, challenges encountered, and strategies for improving its effective deployment across various academic functions.

1.2 Statement of the Problem

The cost of acquiring and maintaining proprietary software has placed a significant financial burden on many Nigerian universities. This challenge often limits access to essential tools and services needed for effective teaching, learning, and research (Adebayo & Adesanya, 2020; Yusuf & Onasanya, 2021). As a result, institutions may struggle to provide quality education in a technology-driven academic environment.

Although OSS offers a free and flexible alternative, its utilization across Nigerian universities has been inconsistent and often suboptimal. The problem lies not only in the availability of OSS but also in how effectively these tools are being used for academic activities. Many institutions may have access to open-source tools, but lack the awareness, technical capacity, infrastructure, and institutional support needed for their effective deployment and utilization.

Specific challenges include: insufficient training for staff and students on how to use OSS tools effectively; lack of technical support for troubleshooting and maintenance; absence of clear institutional policies and frameworks guiding OSS implementation; limited integration of OSS into existing academic workflows; and resistance from stakeholders accustomed to proprietary systems (Nwakanma, 2018).

Furthermore, there is limited documentation on how OSS is currently being utilized in Nigerian universities, which academic activities benefit most from these tools, and what

factors contribute to successful implementation. Without understanding the current utilization patterns and addressing the barriers to effective use, Nigerian universities may continue to underutilize the potential of OSS to enhance educational delivery, research productivity, and administrative efficiency.

This study seeks to examine how Open-Source Software is being utilized for academic activities in the University of Benin, identify the factors that facilitate or hinder effective utilization, and provide recommendations to enhance its strategic deployment across various academic functions.

1.3 Aim and Objectives

The aim of this research project is to examine the utilization of Open-Source Software for academic activities in the University of Benin and recommend strategies to improve its effectiveness. The specific objectives are:

i. To determine the level of awareness and current usage patterns of Open-Source Software among university students
ii. To identify the types and categories of Open-Source Software currently being utilized for learning, research, and administrative purposes.
iii. To propose practical strategies to enhance the utilization and effectiveness of Open-Source Software for academic activities in Nigerian universities.
iv. To examine the perceived benefits and challenges associated with the utilization of Open-Source Software in academic activities.

1.4 Research Questions

The following research questions will guide the study:

1. What is the level of awareness of Open-Source Software (OSS) among students at the University of Benin?
2. What types of Open-Source Software are currently being utilized for academic activities within the University of Benin?

3. How extensively are students utilizing Open-Source Software for teaching, learning, research, and administrative purposes?
4. What are the perceived benefits of utilizing Open-Source Software for academic activities in the University of Benin?
5. What challenges affect the effective utilization of Open-Source Software for academic activities in the University of Benin?
6. What factors influence the effective utilization of Open-Source Software in the University of Benin?
7. What strategies can be recommended to improve the utilization of Open-Source Software for academic activities in the University of Benin?

1.5 Significance of Study

The adoption of open-source software (OSS) holds great potential for transforming the Nigerian university system, especially in the areas of teaching, research, and administration. This study is significant for several reasons:

1. **For University Management and Administrators:**
   It provides insights into how Open-Source Software (OSS) can reduce operational costs and improve software accessibility across departments. By understanding the benefits and challenges of OSS, university leaders can make informed decisions on ICT investments and policy direction.
2. **For ICT and Technical Staff:**
   The study will highlight the technical feasibility of Open-Source Software (OSS) deployment and the skills needed to manage open-source systems. It will serve as a guide to identify capacity gaps and training needs required to implement OSS successfully.
3. **For Students and Academic Staff:**
   OSS can improve access to educational tools and resources that are often limited by the high cost of proprietary software. The study emphasizes how Open-Source Software (OSS) can support learning, research, and innovation by providing customizable and affordable alternatives.

4. **For Policy Makers and Government Agencies:**
   The research offers evidence-based recommendations that can inform national ICT policies and funding strategies. It underscores the importance of promoting open-source solutions as a path toward digital inclusion and educational advancement.
5. **For Future Researchers:**
   The study will contribute to the academic literature on ICT in education and serve as a reference point for future studies focused on software utilization, technology integration, and open-source adoption in Nigerian universities and similar contexts.

Ultimately, this research aims to promote the wider use of Open-Source Software (OSS) in higher education as a sustainable and cost-effective solution, especially for institutions operating in resource-constrained environments like Nigeria.

1.6 Scope of Study

This study focuses on examining the utilization of Open-Source Software for academic activities at the University of Benin. Specifically, it investigates:

- How OSS is being used in teaching, learning, research, and administrative activities
- The level of awareness and current usage patterns among staff and students
- The types and categories of OSS tools being utilized
- The benefits realized and challenges encountered in using OSS
- Factors that influence effective utilization of OSS in the academic environment

The study covers various categories of academic activities including: course delivery and learning management, research and data analysis, document processing and productivity tools, communication and collaboration platforms, library and information management, and administrative operations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter provides a comprehensive literature review of existing research on Open-Source Software (OSS) and its utilization in academic settings, with particular focus on Nigerian universities. It aims to synthesize existing knowledge, document previous findings, and identify gaps relevant to the study. In recent years, the increased need for cost-effective, flexible, and collaborative technological solutions has prompted many institutions of higher learning across the world, including Nigerian institutions, to consider OSS alternatives to proprietary software (Iheanyi, Orubebe, & Oladokun, 2024).

This literature review is organized into thematic subsections for clear understanding of the subject. It begins with an overview and definition of Open-Source Software, then elaborates on how OSS has been utilized in the educational sector globally and in Nigeria. It proceeds to discuss the distinction between adoption and utilization, theoretical frameworks for understanding technology utilization, empirical studies on OSS implementation in Nigerian universities, the benefits and challenges of OSS utilization, and strategies for enhancing effective use. This chapter not only provides a foundation for the study but also identifies areas that require further research.

2.2 Overview of Open-Source Software

2.2.1 Definition and Characteristics

Open-Source Software (OSS) refers to any software whose source code is publicly disclosed for users to study, modify, and distribute according to their preference. This approach to software development encourages openness, innovation, and cooperative problem-solving (Coelho & Valente, 2017). Compared to proprietary software, in which access to source code is restricted and users are bound by licensing terms, OSS empowers users to control their tools and systems.

Key characteristics of OSS include:

- **Accessibility and Transparency:** The source code is freely available to anyone who wishes to view, study, or modify it. This transparency allows users to understand exactly how the software functions and to verify its security and reliability.
- **Modifiability and Customization:** Users have the freedom to modify the software to suit their specific needs without legal restrictions. This flexibility is particularly valuable in academic environments where customization may be necessary to meet unique institutional or pedagogical requirements.
- **Collaborative Development:** OSS is typically developed through collaborative efforts involving communities of developers, users, and contributors worldwide. This collaborative model often results in rapid innovation, continuous improvement, and robust software solutions.
- **Cost-Effectiveness:** Most OSS is available at no licensing cost, though there may be costs associated with implementation, training, customization, and technical support. The absence of licensing fees makes OSS particularly attractive for resource-constrained institutions.
- **Community Support:** OSS projects are typically supported by active communities that provide documentation, forums, tutorials, and peer assistance. This community-driven support model differs from the vendor-dependent support common with proprietary software.

2.2.2 Common Open-Source Software in Academic Settings

Well-known OSS tools used in academic environments include:

- **Operating Systems:** Linux distributions (Ubuntu, Fedora, CentOS) for servers and desktop computing
- **Learning Management Systems:** Moodle for course management and online learning delivery

- **Library Management Systems:** Koha and Evergreen for library automation and cataloging
- **Institutional Repositories:** DSpace and EPrints for managing digital collections and research outputs
- **Office Productivity:** LibreOffice and Apache OpenOffice for document processing
- **Research and Analysis Tools:** R, Python, GNU Octave, and PSPP for statistical analysis and data processing
- **Content Management:** WordPress, Drupal, and Joomla for websites and portals
- **Collaboration Tools:** Nextcloud for file sharing, BigBlueButton for video conferencing
- **Reference Management:** Zotero for organizing research citations

OSS develops through community contributions, where developers worldwide collaborate to develop and maintain the software. In academic terms, this communal nature aligns well with the academic culture of openness and shared knowledge (Ahmed et al., 2015).

In Nigeria, awareness and utilization of OSS have been rising gradually, especially in universities and research institutions. Many public universities have ventured into open-source systems as a more affordable alternative to expensive commercial software. Koha, for instance, has replaced many proprietary library systems, while DSpace is being used for institutional repositories (Njoku, Eze, & Nwachukwu, 2021). Despite this growth, effective utilization remains inconsistent across institutions due to various socio-technical factors, which will be discussed in later sections.

2.3 Distinction between Adoption and Utilization of Technology

It is important to distinguish between technology "adoption" and "utilization" as these concepts represent different phases in the technology implementation process.

Adoption refers to the initial decision and act of acquiring or implementing a technology within an organization. It involves making OSS available to users, installing the software on institutional systems, and providing basic access to the tools (Rogers, 2003). An institution that has installed Moodle on its servers and created accounts for staff and students has "adopted" the LMS.

Utilization, on the other hand, encompasses how the technology is actually used in practice, the extent of its integration into workflows, the frequency and depth of use, and the effectiveness of its application in achieving intended purposes (Venkatesh et al., 2003; Burton-Jones & Grange, 2013). Utilization examines whether staff and students actually employ these tools in their daily academic activities, how extensively they use the available features, and what value they derive from such use.

In the context of OSS in universities, an institution may adopt OSS (make it available) without achieving effective utilization (meaningful, productive use). For example, a university may install Moodle but find that only 20% of lecturers actively use it for course delivery, or that users only access basic features while ignoring advanced capabilities. Understanding utilization patterns provides insights into whether adopted technologies are meeting their intended purposes and delivering expected benefits (Fichman, 2000).

This study focuses specifically on utilization—examining how OSS tools are being used for various academic activities, the patterns and intensity of use, the factors that influence effective utilization, and the outcomes derived from OSS deployment in university settings.

2.4 Theoretical Framework

Several theoretical models help explain technology utilization behavior in organizational contexts. This section reviews key frameworks relevant to understanding OSS utilization in academic settings.

2.4.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model, developed by Davis (1989), is one of the most widely applied theories for understanding technology acceptance and use. TAM posits that technology utilization is primarily influenced by two key factors:

- **Perceived Usefulness (PU):** The degree to which a person believes that using a particular technology would enhance their job performance or productivity. In an academic context, this relates to whether staff and students believe OSS will improve their teaching, learning, research, or administrative tasks.
- **Perceived Ease of Use (PEOU):** The degree to which a person believes that using a technology would be free of effort. This factor is particularly relevant for OSS, where user interfaces and learning curves may differ from familiar proprietary software.

TAM suggests that these perceptions influence attitudes toward technology use, which in turn affect behavioral intentions and actual usage behavior (Davis, 1989; Venkatesh & Davis, 2000). Research has applied TAM to understand OSS adoption and utilization in various contexts, finding that perceived usefulness and ease of use significantly influence OSS acceptance and continued use among users (Ven & Verelst, 2006; Dedrick & West, 2004).

For this study, TAM provides a framework for understanding how user perceptions of OSS usefulness and ease of use influence their actual utilization of these tools for academic activities.

2.4.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model, developed by Venkatesh et al. (2003), integrates elements from eight prominent technology acceptance theories to provide a comprehensive framework

for understanding technology adoption and use. UTAUT identifies four key determinants of technology acceptance and usage behavior:

- **Performance Expectancy:** The degree to which using the technology will provide benefits in performing activities. This is similar to TAM's perceived usefulness and relates to the expected benefits of using OSS for academic work.
- **Effort Expectancy:** The degree of ease associated with using the technology, corresponding to TAM's perceived ease of use. For OSS, this includes the learning curve and technical complexity involved.
- **Social Influence:** The degree to which an individual perceives that important others (colleagues, supervisors, peers) believe they should use the technology. In academic settings, recommendations from colleagues or institutional policies can significantly influence OSS utilization.
- **Facilitating Conditions:** The degree to which an individual believes that organizational and technical infrastructure exists to support use of the technology. This includes availability of technical support, training, adequate ICT infrastructure, and institutional resources.
- UTAUT also recognizes that these relationships are moderated by individual factors such as age, gender, experience, and voluntariness of use (Venkatesh et al., 2003). The model has been successfully applied to understand technology utilization in educational contexts (Tarhini et al., 2017) and provides a comprehensive lens for examining OSS utilization in Nigerian universities.

2.4.3 Diffusion of Innovations Theory (DOI)

Rogers' (2003) Diffusion of Innovations theory explains how, why, and at what rate new ideas and technologies spread through social systems. The theory identifies five key attributes that influence technology adoption and utilization:

- **Relative Advantage:** The degree to which an innovation is perceived as better than the idea it supersedes. For OSS, this includes cost savings, flexibility, and freedom from vendor lock-in compared to proprietary alternatives.

- **Compatibility:** The degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential adopters. OSS compatibility with existing systems and workflows affects utilization.
- **Complexity:** The degree to which an innovation is perceived as difficult to understand and use. Lower complexity encourages higher utilization rates.
- **Trialability:** The degree to which an innovation may be experimented with on a limited basis. OSS's free availability allows for easy trial and experimentation before full-scale deployment.
- **Observability:** The degree to which the results of an innovation are visible to others. When OSS benefits are clearly visible, other departments or institutions are more likely to adopt and utilize similar tools.
- These theoretical frameworks collectively provide lenses through which to examine OSS utilization in Nigerian universities, considering individual perceptions, social influences, organizational factors, and innovation characteristics.

2.5 Utilization of Open-Source Software in Higher Education

2.5.1 Global Perspectives

The utilization of OSS in educational systems has transformed teaching, learning, and research processes in many parts of the world. In tertiary education, institutions have been drawn toward utilizing OSS due to its affordability, flexibility, and the ability for users to explore the inner workings of the software. OSS allows universities to customize applications for their unique educational needs without being restricted by limiting licenses or high subscription charges (Kamau & Namuye, 2022).

Universities worldwide, particularly in countries such as India, Brazil, South Africa, and various European nations, have utilized OSS extensively for expanded access and improved educational delivery. Moodle, for example, is widely used to manage online classes, deliver course materials, facilitate discussions, and administer assessments. Koha is the preferred choice for managing digital libraries in many institutions. These tools

enable institutions, particularly less-resourced ones, to deliver digital services cost-effectively (Uche, Orubebe, & Oladokun, 2024).

Research on OSS utilization in higher education globally shows varied patterns. Some institutions achieve deep integration of OSS into their core operations, with high utilization rates and extensive customization to meet specific needs. Others experience superficial adoption with low utilization rates, where OSS tools are available but underused due to lack of training, resistance to change, or inadequate technical support (Fitzgerald, 2006; Lakhan & Jhunjhunwala, 2008).

The open licensing of these software tools also aligns with the tenets of academic freedom and knowledge sharing, making them ideal for learning environments. Studies have shown that effective OSS utilization in education requires not just software availability, but also supportive institutional policies, adequate training, ongoing technical support, and a culture that embraces open technologies (Wheeler, 2007; UNESCO, 2019).

2.5.2 OSS Utilization in African Universities

In the African context, several universities have made significant strides in OSS utilization. South African universities such as the University of Cape Town and University of the Western Cape have integrated OSS extensively into their operations, using Moodle for learning management, Linux for server infrastructure, and open-source tools for research computing.

In East Africa, universities in Kenya and Tanzania have utilized OSS for library automation, institutional repositories, and e-learning platforms. Studies from these regions indicate that successful utilization often correlates with dedicated ICT support units, comprehensive staff training programs, and institutional commitment to open technologies.

However, challenges similar to those in Nigeria persist across Africa, including infrastructure limitations, skills gaps, and insufficient institutional support for sustained OSS utilization.

2.5.3 OSS Utilization in Nigerian Universities

In Nigeria, OSS utilization in education has been growing but remains inconsistent. Nigerian universities have started embracing OSS tools like Moodle and Koha, particularly for e-learning and library services, as documented by Falade, Omolola, and Michael (2021). These tools provide more flexible learning environments, facilitate remote access to learning resources, and support digital record-keeping systems free of recurring license renewal fees.

Despite this growing interest, there remains a discernible lag in consistent and effective OSS utilization across the majority of Nigerian tertiary institutions. While some universities have integrated OSS into their routine operations, others continue to use expensive proprietary packages or have adopted OSS without achieving meaningful utilization. This variation is often attributed to differences in technical capability, management support, availability of ICT infrastructure, and level of user training (Iheanyi, Orubebe, & Oladokun, 2024).

The shift toward open-source systems has been accelerated by external factors, most notably the COVID-19 pandemic. The sudden closure of physical campuses created urgent need for remote learning tools. Institutions that had already explored and effectively utilized OSS platforms found it easier to transition to online learning, while others struggled to adapt quickly (Wadata, Sule, & Abdul-Rasheed, 2022). This episode underscored the importance of having flexible, scalable, and accessible digital tools like OSS already integrated into institutional operations.

Research indicates that successful OSS utilization in Nigerian universities depends not merely on software availability, but also on supportive institutional policies, adequate

funding for infrastructure and training, regular capacity-building programs for staff, and cultivation of a technology-friendly organizational culture. Without these enabling conditions, the full potential of OSS for enhancing education may remain untapped (Kamau & Namuye, 2022).

2.6 Applications of Open-Source Software in Nigerian Universities

In Nigerian universities, OSS has gradually become integrated into various administrative and academic functions. Several institutions have incorporated OSS into their everyday operations, ranging from teaching and learning to record-keeping, digital libraries, and research data management, though utilization rates and patterns vary significantly by institution and function.

2.6.1 Learning Management Systems (LMS)

Moodle, a modular open-source LMS, enables instructors to upload course materials, administer online tests, facilitate discussions, and monitor student progress. Moodle's adaptability, support for multiple languages, and free licensing make it an ideal tool for institutions with limited resources (Falade, Omolola, & Michael, 2021).

Several Nigerian universities, including Obafemi Awolowo University, University of Nigeria Nsukka, and the National Open University of Nigeria (NOUN), have adopted Moodle to facilitate digital instruction and blended learning, particularly following the disruptions caused by the COVID-19 pandemic. However, utilization patterns vary considerably. At NOUN, where distance learning is core to the institutional mission, Moodle is extensively utilized with high engagement rates. In contrast, at some traditional universities, Moodle adoption has not translated to high utilization rates, with many lecturers using only basic features or reverting to traditional teaching methods (Okebukola & Omotayo, 2021; Olowe & Fasola, 2022).

2.6.2 Library Management Systems

Koha, an integrated open-source library management system, supports cataloging, acquisitions, circulation, and Online Public Access Catalogs (OPAC). Many Nigerian university libraries have transitioned from manual systems or expensive commercial software to Koha, which provides freedom to customize the software according to local needs while saving licensing costs.

Studies show that Koha adoption has improved service delivery, automation, and access to digital collections in Nigerian university libraries (Njoku, Eze, & Nwachukwu, 2021). However, effective utilization varies across institutions. Some libraries, such as those at Umaru Musa Yar'adua University (UMYU) and University of Ilorin, actively use Koha for core operations but report underutilization of advanced modules due to insufficient technical expertise and training (Maharazu & Malumfashi, 2021; Omopupa, Adedeji, & Sulyman-Haroon, 2019).

At the University of Jos, migration to Koha from proprietary systems enabled online registration and improved access, though challenges in achieving full implementation of all features were noted (Okpokodje & Edore, 2015).

2.6.3 Institutional Repositories

Some Nigerian universities have adopted open-source platforms like DSpace and EPrints to manage and preserve research outputs including theses, dissertations, and scholarly publications.

The University of Lagos uses DSpace to promote open access to its academic publications, which enhances the research community's visibility and citation rates (Wadata, Sule, & Abdul-Rasheed, 2022). Ahmadu Bello University deployed DSpace as an institutional repository to host academic outputs, improving access to scholarly content and reducing duplication of academic work, though inadequate funding and lack of trained repository managers limited full-scale utilization (Aliyu, 2018).

At the University of Nigeria Nsukka, EPrints deployment provided a platform for archiving research outputs and institutional publications, facilitating improved knowledge

sharing and global access to academic content. However, weak internet connectivity, erratic power supplies, and challenges in maintaining regular content uploads constrained optimal utilization (Okafor & Anyaoku, 2020).

The University of Ibadan's DSpace repository significantly increased research dissemination and improved departmental collaboration, but issues with metadata quality, system backup, and consistent uploading of new materials affected sustained utilization (Akinola & Ogunmodede, 2019).

2.6.4 Operating Systems and Server Infrastructure

Operating systems like Ubuntu Linux have been adopted in some server environments and computer laboratories because of their reliability, security, and absence of licensing costs. This has particularly benefited computer science departments and ICT centers, where students gain practical digital skills through hands-on experience with OSS (Iheanyi, Orubebe, & Oladokun, 2024).

However, utilization for general desktop computing remains limited, with most administrative and academic staff continuing to use Windows-based systems due to familiarity, compatibility concerns with existing software, and resistance to learning new interfaces.

2.6.5 Research and Productivity Tools

Beyond specialized institutional systems, individual staff and students utilize various OSS tools for academic work:

- **Research and Statistical Analysis:** Tools like R, Python, and PSPP are used by researchers and postgraduate students for data analysis, though utilization is concentrated in specific departments such as statistics, computer science, and some social sciences (Adebayo et al., 2020).

- **Office Productivity:** LibreOffice is used by some staff and students for word processing, spreadsheet work, and presentations, though Microsoft Office remains dominant due to familiarity and file compatibility concerns.
- **Reference Management:** Zotero, an open-source reference manager, is utilized by researchers and postgraduate students for organizing research materials and generating bibliographies.
- **Scientific Computing:** GNU Octave and Scilab are used for computational tasks in engineering and science programs, particularly where MATLAB licenses are unavailable or unaffordable.

2.6.6 Emerging Utilization Patterns

Beyond specific software packages, OSS utilization has promoted a shift toward more participatory and open software culture within some universities. Students and researchers now have opportunities not only to use OSS but also to engage in its development by contributing code, customizing applications, and localize ng software for specific needs. Open-source clubs and coding bootcamps—often supported by tech NGOs or student groups—are beginning to emerge on some campuses, fostering technical skills and community engagement (Kamau & Namuye, 2022).

Despite these encouraging trends, OSS utilization remains limited in scope and scale across Nigerian universities. Most implementations are still at pilot stages or confined to specific departments. Broader institutional commitment, adequate infrastructure, sustained training programs, and supportive policies are necessary for OSS to become a core element of Nigerian university operations.

2.7 Benefits of Utilizing Open-Source Software

The effective utilization of OSS in Nigerian universities offers numerous advantages, particularly considering the financial and infrastructure challenges that many public institutions face. These benefits extend beyond cost reduction to encompass innovation, capacity building, institutional independence, and educational advancement.

2.7.1 Cost-Effectiveness and Financial Sustainability

The financial benefits of OSS utilization are among its most frequently cited advantages. OSS eliminates costly licensing fees, recurring subscription charges, and vendor lock-ins associated with proprietary software. This is especially significant for public universities in Nigeria that operate under tight budgetary constraints.

Iheanyi, Orubebe, and Oladokun (2024) assert that funds saved through OSS utilization can be redirected to address other urgent needs such as infrastructure development, internet connectivity improvements, and faculty professional development. The elimination of per-user or per-seat licensing also allows institutions to scale services without proportional cost increases, making technology more accessible to larger student populations.

2.7.2 Flexibility, Customization, and Local Adaptation

OSS can be adapted to specific local or institutional needs, offering flexibility that proprietary systems typically lack. Unlike commercial software with fixed features and rigid licensing terms, OSS provides institutions with the freedom to modify software structure, interface, and functionality to suit their unique requirements in research, teaching, or administration (Kamau & Namuye, 2022).

For instance, Moodle allows instructors to customize grading schemes, assessment formats, and course designs to match their pedagogical preferences. Libraries can modify Koha to accommodate local cataloging standards, languages, and workflows. This customization capability enables Nigerian universities to develop solutions that reflect their specific operational contexts rather than adapting their processes to fit inflexible commercial products.

2.7.3 Skill Development and Capacity Building

Effective OSS utilization encourages greater technological engagement among staff and students. The deployment, customization, and maintenance of OSS tools provide

university IT teams with valuable hands-on experience in system administration, software development, and technical problem-solving.

Students benefit from learning practical skills applicable to the modern workforce, including programming, system integration, database management, and Linux administration. Wadata, Sule, and Abdul-Rasheed (2022) note that OSS utilization reduces dependence on imported IT solutions while fostering local technical expertise and enhancing digital literacy across the academic community.

Furthermore, exposure to OSS in academic settings prepares students for careers in technology sectors where open-source tools are increasingly prevalent. Computer science and IT students gain experience with industry-standard tools and collaborative development practices that enhance their employability.

2.7.4 Academic Collaboration and Knowledge Sharing

OSS promotes collaboration both within and across institutions. Because source code is openly accessible, academic staff, students, and developers can collaborate on system enhancements, bug fixes, feature development, and plugin creation. This collaborative environment fosters innovation and aligns with the academic culture of open knowledge sharing.

OSS utilization also enables Nigerian universities to participate in international software development communities, contributing to global projects while benefiting from worldwide expertise. Such participation increases institutional visibility and enhances reputational standing within academic and technical communities (Ahmed et al., 2015).

Inter-institutional collaboration is also facilitated when multiple universities utilize the same OSS platforms. Shared experiences, customizations, and solutions can be exchanged, reducing duplication of effort and promoting collective problem-solving.

2.7.5 Avoidance of Vendor Lock-In and Technological Independence

Proprietary software often binds users to specific vendors, creating dependencies for updates, support, upgrades, and even data access. This "vendor lock-in" limits institutional flexibility and may result in escalating costs over time as vendors raise prices or discontinue products.

OSS completely eliminates this risk. Institutions can manage systems internally, engage external consultants of their choice, migrate to alternative solutions, or modify software to meet changing needs—all without being constrained by restrictive contracts or vendor dependencies (Njoku, Eze, & Nwachukwu, 2021). This technological independence is particularly valuable for Nigerian universities seeking to build sustainable, long-term ICT infrastructure.

2.7.6 Community Support and Rapid Innovation

Unlike proprietary support channels that can be costly, slow, or limited, OSS communities provide developer support, comprehensive documentation, and active forums that are freely accessible online. Because global developer bases work on OSS projects, updates, security patches, and feature enhancements are often released rapidly in response to emerging needs and vulnerabilities (Coelho & Valente, 2017).

IT departments at Nigerian universities can leverage these communities to troubleshoot issues, learn best practices, request features, and access solutions developed by users worldwide. This collective intelligence often exceeds what individual vendors can provide.

2.7.7 Promotion of Open Access and Academic Freedom

By utilizing OSS, universities align with broader open access and academic freedom movements. Tools like DSpace and EPrints support institutional repositories that make research publications freely available to the public, promoting transparent scholarly communication and increasing visibility of Nigerian academic research globally (Umar, Datti, & Abubakar, 2016).

This openness facilitates knowledge dissemination, increases citation rates for Nigerian researchers, and contributes to the global scientific commons. It also supports compliance with open access mandates increasingly required by funding agencies and academic journals.

2.8 Challenges to Effective Utilization of Open-Source Software in Nigerian Universities

Despite the numerous benefits, Nigerian universities face significant challenges in achieving effective OSS utilization. These obstacles, both technical and institutional, hinder the full integration of OSS into academic and administrative systems and reflect broader systemic issues in Nigeria's higher education sector.

2.8.1 Inadequate ICT Infrastructure

Insufficient Information and Communication Technology (ICT) infrastructure is one of the biggest barriers to effective OSS utilization in Nigerian universities. Most OSS tools require modern computer systems, reliable electricity supply, stable high-speed internet connectivity, and adequate server capacity for deployment and operation. Unfortunately, many public institutions lack these fundamental resources.

Frequent power outages disrupt server operations, damage equipment, and prevent consistent access to online systems. Poor internet connectivity limits the ability to download software updates, access online documentation, participate in community forums, or utilize cloud-based OSS services. Many African universities, including those in Nigeria, struggle with infrastructure deficiencies that constrain effective utilization of digital technologies, whether proprietary or open-source (Kamau & Namuye, 2022).

Without reliable infrastructure, even successfully adopted OSS systems remain underutilized, as users cannot access them consistently or experience poor performance that discourages regular use.

2.8.2 Low Technical Capacity and Training Deficits

Effective OSS utilization requires technical skills for installation, configuration, customization, maintenance, troubleshooting, and ongoing administration. Regrettably, many Nigerian universities lack staff with adequate technical expertise to perform these functions effectively.

Few institutions have in-house developers capable of customizing OSS platforms to meet specific needs or troubleshooting complex technical problems. Staff training programs are frequently inadequate, sporadic, or non-existent. This capacity deficit results in excessive dependence on external consultants, system abandonment when problems occur, or underutilization of advanced features (Iheanyi, Orubebe, & Oladokun, 2024).

Similarly, many end users (lecturers, administrators, students) lack sufficient digital literacy or familiarity with OSS interfaces, leading to reluctance to use these tools or ineffective utilization that fails to realize their full potential.

2.8.3 Resistance to Change and Cultural Barriers

Cultural resistance represents another significant challenge. Academic and administrative personnel accustomed to proprietary software may be reluctant to transition to OSS due to perceptions that it is more complicated, less user-friendly, or inferior in quality. Sometimes this skepticism stems from ignorance, unfamiliarity, or negative past experiences.

According to Falade, Omolola, and Michael (2021), when Moodle was first introduced at some institutions, lecturers felt uncomfortable using it, primarily because they were not properly oriented and perceived it as difficult to learn. Overcoming such resistance requires sustained change management efforts, comprehensive training, ongoing support, and visible institutional commitment to OSS initiatives.

2.8.4 Inconsistent Institutional and Government Support

Although Nigeria's National Information Technology Development Agency (NITDA) introduced federal policies to support OSS in the early 2000s, implementation at university level has been uneven and poorly coordinated. Funding incentives, clear national enforcement strategies, or sustained support mechanisms to help institutions implement and maintain OSS solutions are often lacking (Wadata, Sule, & Abdul-Rasheed, 2022).

At institutional level, many OSS projects fail to progress beyond initial pilot stages due to absence of strong policies, dedicated leadership, sustained funding, and integration into strategic ICT plans. Without high-level institutional commitment and resource allocation, OSS initiatives remain fragmented and unsustainable.

2.8.5 Inadequate Maintenance and Sustainability Mechanisms

OSS is largely dependent on community support and local initiative, in contrast to proprietary software that usually comes with vendor support contracts. Many OSS implementations in Nigerian universities are deployed but then neglected, with minimal ongoing maintenance, documentation, or active management.

Coelho and Valente (2017) discovered that absence of maintenance practices—such as regular updates, security patching, documentation, backup procedures, and active developer engagement—significantly increases the likelihood that OSS projects will fail or become abandoned. This sustainability challenge is particularly acute in the Nigerian context where institutional memory may be lost due to staff turnover, and where resources for ongoing system administration are limited.

2.8.6 Lack of Awareness and Misconceptions

OSS and its capabilities remain generally unknown to many university stakeholders. Common misconceptions persist that OSS is less functional, less reliable, or of lower quality than commercial alternatives simply because it is free. Some users worry that using OSS will restrict their access to updates, security patches, or technical support,

when in reality many OSS communities are even more responsive than proprietary vendors.

These misconceptions deter administrators from seriously considering OSS solutions and discourage users from fully engaging with available OSS tools (Ahmed et al., 2015). Addressing awareness gaps requires sustained advocacy, demonstration of successful implementations, and education about OSS principles and benefits.

2.8.7 Absence of Evaluation and Monitoring Systems

After OSS is adopted, few institutions have systems in place to track its effectiveness, measure utilization rates, assess user satisfaction, or evaluate impact on educational outcomes. Without feedback mechanisms, usage analytics, or systematic evaluation, it becomes difficult to identify bottlenecks, enhance usability, justify continued investment, or demonstrate value to stakeholders.

This lack of accountability and evidence-based assessment damages the credibility of OSS initiatives and often leads to project abandonment or continued underutilization (Umar, Datti, & Abubakar, 2016). Establishing monitoring and evaluation frameworks is essential for continuous improvement and sustained institutional support.

2.9 Strategies for Enhancing Utilization of Open-Source Software

To overcome these challenges and enhance OSS utilization in Nigerian universities, several strategies are recommended to fully realize the benefits of OSS in higher education:

2.9.1 Capacity Building and Comprehensive Training

To improve OSS utilization, continuous professional development and training for staff in the effective use of ICTs and OSS tools is essential. This should include awareness campaigns highlighting OSS benefits, hands-on workshops for technical staff on installation and maintenance, training programs for end users on effective utilization of

specific OSS applications, and development of local expertise in OSS customization and troubleshooting.

Training should be ongoing rather than one-time events, recognizing that technology skills require continuous updating and that new users regularly join institutions.

2.9.2 Infrastructure Investment and Reliable Funding

Providing stable power supply, reliable high-speed internet networks, and adequate ICT facilities is crucial for effective OSS implementation and utilization. Increased funding from government and university management for ICT infrastructure is essential.

Universities should also consider reinvesting savings achieved through OSS adoption into further infrastructure development, creating a positive cycle of improvement. Securing alternative funding sources, including partnerships with development agencies, technology companies, and international donors, can supplement government budgets.

2.9.3 Technical Support and Collaborative Networks

Recruiting qualified ICT technicians and establishing dedicated technical support units can provide necessary expertise for OSS installation, implementation, maintenance, and user support. Universities should consider creating inter-institutional support networks where technical expertise and resources are shared.

Collaboration between academic institutions and industries, particularly through OSS development partnerships, can address technical challenges while building local capacity. There is also potential for mutual linkages among African countries, facilitated by organizations like the African Union (AU) and ECOWAS, to transfer technological knowledge and achievements across borders. Leveraging knowledge and expertise of Africans in the diaspora through OSS projects can foster continental development.

2.9.4 Policy Development and Institutional Commitment

Universities should develop clear institutional ICT policies that explicitly support OSS utilization, allocate resources for implementation and maintenance, establish standards for software selection and deployment, and create incentive structures that encourage staff engagement with OSS.

At national level, governments should actively support domestic software development sectors and promote OSS utilization in all government agencies through legislative measures. Such policies can conserve budgeted funds, set precedents for educational institutions, and create enabling environments for OSS growth.

2.9.5 Awareness Campaigns and Advocacy

Raising awareness among relevant stakeholders about the importance, capabilities, and benefits of OSS can promote wider acceptance and utilization. This should include seminars, workshops, and conferences showcasing successful OSS implementations, publication of case studies demonstrating OSS value and impact, engagement with university leadership to secure high-level support, and incorporation of OSS concepts into ICT curricula to prepare students for OSS utilization.

Advocacy efforts should specifically address misconceptions about OSS quality, reliability, and support, replacing them with accurate information based on evidence and successful examples.

2.9.6 Establishment of Monitoring and Evaluation Systems

Universities should implement systems to monitor OSS utilization patterns, evaluate effectiveness, gather user feedback, and assess impact on educational outcomes. Such systems enable data-driven decision-making, continuous improvement of OSS implementations, identification of training needs and technical issues, and demonstration of value to justify continued investment and resource allocation.

Regular assessment helps institutions understand what works, what doesn't, and how to optimize OSS utilization for maximum benefit.

2.10 Empirical Studies on Open-Source Software Utilization in Nigerian Academic Environments

Several empirical studies have been conducted to understand the use, perception, and challenges of OSS in Nigerian higher education institutions. These studies provide important insights into how users view OSS, what influences its utilization, and the realities of implementation in Nigerian universities.

Digital repositories, learning management, journal publishing, and library automation are among the academic activities supported by OSS in Nigerian public universities. The following studies and institutional cases illustrate the extent of utilization, advantages realized, and challenges encountered including infrastructure limitations, migration difficulties, and skills gaps.

2.10.1 Library Automation: Koha ILS

Umaru Musa Yar'adua University (UMYU), Katsina

An empirical study conducted at UMYU Library documented Koha's adoption for cataloging and circulation. The study cited cost savings and feature flexibility as key advantages, while handling retrospective data conversion and staff training requirements were identified as major challenges. The research found that while Koha was successfully deployed, full utilization of all modules required ongoing capacity building (Maharazu & Malumfashi, 2021).

University of Ilorin

A survey of Ilorin Library employees revealed that while Koha was actively used for basic library functions, many advanced modules remained underutilized due to lack of technical expertise among staff. The study emphasized that capacity-building is just as

important as software selection in achieving effective OSS utilization (Omopupa, Adedeji, & Sulyman-Haroon, 2019).

University of Jos

Evaluation studies on UniJos's migration from proprietary systems (ITS/Virtua) to Koha showed that the transition enabled online registration and enhanced access to library resources. However, follow-up work identified persistent "full implementation" obstacles common in migration processes, including data migration challenges, staff adaptation issues, and technical support requirements (Okpokodje & Edore, 2015).

2.10.2 Institutional Repositories: DSpace and EPrints

Ahmadu Bello University (ABU), Zaria

A study investigated the implementation of DSpace as an institutional repository to host theses, dissertations, and faculty publications. Findings showed that DSpace improved access to scholarly content, enhanced visibility of research output, and reduced duplication of academic work. However, inadequate funding and lack of trained repository managers hindered full-scale deployment and sustained utilization. The study recommended investment in staff training and dedicated resources for repository management (Aliyu, 2018).

University of Nigeria, Nsukka (UNN)

The deployment of EPrints at UNN provided an online platform for archiving research outputs, grey literature, and institutional publications. The study revealed improved knowledge sharing, easier global access to academic content, and better compliance with open-access mandates as key benefits. However, weak internet connectivity and erratic power supplies were identified as major obstacles to consistent utilization. Users reported frustration with system unavailability during critical submission periods (Okafor & Anyaoku, 2020).

University of Ibadan (UI)

An empirical review of UI's DSpace repository services found that the system greatly increased research dissemination and improved departmental collaboration. However, persistent issues with metadata quality, system backup procedures, and irregular uploading of new research materials limited optimal utilization. The study emphasized the need for dedicated repository staff and standardized workflows to ensure sustained, effective use (Akinola & Ogunmodede, 2019).

2.10.3 Teaching & Learning: Moodle and Learning Management Systems

National Open University of Nigeria (NOUN)

At NOUN, Moodle serves as the primary learning management system, facilitating extensive online instruction and course administration for thousands of distance learners. Studies found that Moodle promoted interaction between tutors and students, supported assignment submissions, provided flexibility in learning schedules, and enabled scalable course delivery.

However, challenges that hindered optimal utilization included poor bandwidth limiting access to multimedia content, technical malfunctions frustrating users, and lack of adequate training for both instructors and students. The research recommended continuous training programs and infrastructure upgrades to enhance utilization effectiveness (Okebukola & Omotayo, 2021).

University of Ilorin (UNILORIN)

A post-COVID-19 survey examined the effectiveness of Moodle utilization for blended learning at UNILORIN. Findings revealed that students appreciated the platform for accessing lecture notes, submitting assignments, and engaging in online discussions.

Faculty members valued Moodle's ability to track student progress and provide timely feedback.

However, the study also found that limited digital literacy among some users and infrastructural deficits constrained deeper engagement with advanced features. Only basic Moodle functionalities were regularly utilized by most users, while interactive tools like forums, wikis, and collaborative activities remained largely unexplored (Olowe & Fasola, 2022).

University of Ibadan (UI)

Moodle was adopted by UI's Distance Learning Center to support e-learning for distant learners. Empirical data showed that Moodle increased student motivation, improved learning outcomes through immediate feedback mechanisms, and enabled instructors to incorporate multimedia learning materials into their lessons. The flexibility to access materials anytime, anywhere was particularly valued by working students.

Challenges included initial resistance from instructors unfamiliar with online teaching methods, technical difficulties during peak usage periods, and need for ongoing technical support to address user queries (Adebayo et al., 2020).

2.10.4 Summary of Empirical Findings

These empirical studies collectively demonstrate that:

1. Utilization varies significantly across institutions and departments, even when the same OSS is adopted
2. Infrastructure constraints consistently emerge as major barriers to effective utilization
3. Technical capacity and training are critical determinants of successful OSS utilization
4. Institutional support and commitment influence the sustainability and depth of OSS utilization

5. Benefits are realized when OSS is effectively utilized, including cost savings, improved access, and enhanced collaboration
6. Underutilization of advanced features is common, suggesting need for ongoing training and support

2.11 Open-Source Software Utilized By Students in Nigerian Universities

Beyond institutional systems, students in Nigerian universities utilize various OSS tools for their academic work. The table below summarizes commonly used OSS tools, their purposes, and examples of universities where they are utilized:

OSS Tool	Purpose/Academic Application	Example Universities Using It
Zotero	Reference management, bibliography creation, organizing research materials	UI, UNILORIN, UNIBEN, ABU
R & Python	Data analysis, statistical computing, research computation, machine learning	ABU, FUTA, UNILAG, UNIBEN
LibreOffice	Word processing, spreadsheets, presentations, document creation	UNN, UMYU, UI, UNIBEN
Moodle	LMS for accessing course materials, submitting assignments, participating in forums	NOUN, UNILORIN, UI, OAU
GNU Octave & Scilab	Scientific computing, numerical simulations, mathematical modeling	FUTMINNA, UNILAG, ABU, UNIBEN
LaTeX	Academic writing, thesis preparation, scientific document formatting	ABU, UNILAG, UI (primarily postgraduate students)
GIMP	Image editing, graphic design for presentations and publications	Various universities (design and art students)
Audacity	Audio editing for media projects and	Various universities (mass

	presentations	communication students)

The utilization of these tools by students is often driven by:

- Cost considerations (free alternatives to expensive proprietary software)
- Faculty recommendations and course requirements
- Availability in computer laboratories
- Peer influence and collaborative learning
- Compatibility with research and academic workflows

However, student utilization rates vary based on factors such as awareness, training availability, technical support, and compatibility requirements with faculty or institutional systems.

2.12 Summary of Literature Review

The reviewed literature provides a comprehensive understanding of Open-Source Software (OSS) and its utilization in higher education, with specific emphasis on Nigerian universities. Previous research consistently highlights that OSS represents not merely a cheaper alternative to proprietary software, but a philosophy of transparency, cooperation, and technological empowerment (Stallman, 2002; Fitzgerald, 2006).

Universities globally have been increasingly utilizing OSS to enhance access to learning resources, promote innovation, and reduce dependence on commercial vendors (Wheeler, 2007; UNESCO, 2019). However, utilization in Nigeria has proceeded at a relatively slow and inconsistent pace, influenced by sociocultural, institutional, and infrastructure factors (Iheanyi, Orubebe, & Oladokun, 2024).

The review examined the distinction between adoption (making OSS available) and utilization (actual effective use), establishing that the latter is the focus of this study. Theoretical frameworks including TAM, UTAUT, and DOI provide lenses for understanding factors that influence OSS utilization behavior among university staff and students.

The benefits of effective OSS utilization were documented, including cost savings, flexibility, community support, skill development, and opportunities for collaboration. Numerous studies have identified these advantages as important factors motivating OSS implementation in educational institutions worldwide (Kamau & Namuye, 2022; Coelho & Valente, 2017).

However, significant challenges to effective utilization were also identified, including inadequate infrastructure, limited technical expertise, insufficient awareness, resistance to change, and weak institutional policies (Falade, Omolola, & Michael, 2021; Wadata, Sule, & Abdul-Rasheed, 2022). These barriers prevent many Nigerian universities from realizing the full potential of adopted OSS tools.

Empirical studies from Nigerian universities reveal varied utilization patterns across different OSS categories. Library automation (Koha), institutional repositories (DSpace, EPrints), and learning management systems (Moodle) have been implemented with varying degrees of success. Common themes include benefits realized when OSS is effectively utilized, alongside persistent challenges related to infrastructure, capacity, and institutional support.

Strategies for enhancing OSS utilization include capacity building, infrastructure investment, technical support networks, policy development, awareness campaigns, and establishment of monitoring systems. These recommendations are grounded in both theoretical frameworks and empirical evidence from implementation experiences.

It is evident from this review that while OSS has the potential to significantly enhance the quality and accessibility of ICT resources in Nigerian universities, achieving effective utilization requires addressing multifaceted challenges spanning technical, organizational, and human dimensions. Empirical research specifically examining utilization patterns, intensity of use, and factors influencing effective deployment of OSS for various academic activities in Nigerian higher education institutions remains limited.

This gap provides the foundation for the current study, which seeks to provide a comprehensive understanding of how OSS is being utilized for academic activities at the

University of Benin, identify factors that facilitate or hinder effective utilization, and recommend strategies for enhancing OSS deployment to improve educational delivery, research productivity, and administrative efficiency in Nigerian university systems.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the procedures and methods adopted in carrying out the study on the Utilization of Open-Source Software for Academic Activities. The methodology outlines the step-by-step approach taken to collect, process, and analyze data in order to address the research objectives.

Research methodology is a critical aspect of any academic study because it determines the credibility, reliability, and validity of the findings (Creswell & Creswell, 2018). In this research, the chosen methodology is designed to provide a clear understanding of the factors influencing the adoption of Open-Source Software (OSS) among Nigerian universities, considering both technical and non-technical aspects.

This chapter is subdivided into the following subheadings:

- Research Design
- Population of Study
- Sample and Sampling Technique
- Instrument of Data Collection

- Procedure for Data Collection
- Procedure for Data Analysis

3.2 Research Design

The research design refers to the overall plan and structure adopted to answer the research questions and achieve the objectives of the study.

Descriptive Survey Research Design is used to collects data from a population or sample to describe existing conditions, opinions, behaviors, or characteristics without altering the environment or influencing the subjects. This design is particularly useful for providing a clear picture of trends and patterns within a specific context (Creswell & Creswell, 2018).

Descriptive Survey Research Design was adopted for this study because its design is ideal for gathering detailed information about current practices, perceptions, and challenges without altering the natural setting of the respondents and can enable data to be reliably gathered on The Adoption of Open-Source Software by Undergraduate Students and ICT personnel in Nigerian Universities Using the University of Benin (UNIBEN), Benin City as A Case Study.

The research focuses specifically on two key groups within UNIBEN: students and ICT personnel. Since students make up the majority of software end users on campus, they are essential to comprehending how open educational resources (OSS) are viewed and used in the classroom. ICT staff, on the other hand, offer a technical and administrative viewpoint on Open-Source Software (OSS) adoption since they are in charge of putting software systems into place and keeping them up to date.
By focusing on these groups, the study ensures a comprehensive understanding of the adoption process by capturing both the technical and implementation viewpoint and the user experience. Both groups will be given structured questionnaires to complete, and ICT staff will have brief follow-up interviews to elucidate and expand on their answers.

3.3 Population of the Study

This research targets two primary groups of the University of Benin (UNIBEN) community, they are: ICT staff and students. These groups were targeted because they are the most directly engaged in using and managing Open-Source Software (OSS) on campus.

Students constitute the majority of the population in the university and are the end-users of software tools, either for research, coursework, or daily academic activities. They come from various faculties, departments, and study levels, which means that they have diverse experiences and insights into the use of OSS in learning.

On the other hand, ICT staff are the custodians of the university's digital infrastructure. They are responsible for the installation, maintenance, and debugging of software systems and are therefore central to determining which software is used and how it is adopted. Their view provides an important understanding of the technical and policy dimensions of Open-Source Software (OSS) adoption.

3.4 Sample and Sampling Technique

A combination of purposive and convenience sampling techniques was adopted for this study. The purposive approach was used to target respondents who were likely to have interacted with or used open-source software for academic activities, such as students and ICT personnel. Convenience sampling was employed to reach available participants efficiently through Google Forms, which was distributed online across different faculties.

Although the study initially aimed to include both students and staff members, the final sample consisted predominantly of students due to their higher willingness to respond and accessibility. This composition is considered appropriate, as students are the largest group of OSS users within the university and their responses adequately reflect the utilization of OSS for academic activities at the University of Benin.

A total of seventy (70) respondents participated in the study. This sample size was considered adequate for descriptive analysis and for drawing meaningful conclusions on the utilization of open-source software (OSS) for academic activities at the University of Benin.

Although the initial target population included both students and academic staff, the majority of responses were received from students, while only a few ICT personnel participated. This outcome reflects the relative accessibility and larger proportion of students within the university community. The final sample was therefore deemed sufficient and representative of active OSS users within the institution.

The use of Google Forms enabled efficient data collection across different faculties, ensuring that participants from diverse academic backgrounds were included. The number of responses obtained was adequate to provide a reliable overview of OSS utilization patterns in the university.

3.5 Instrument of Data Collection

The main instrument used for data collection in this study was a structured questionnaire designed and administered electronically through Google Forms. The online format was chosen to ensure wider accessibility, minimize printing costs, and facilitate easy data collation and analysis.

The questionnaire was structured into six sections, each addressing a specific objective of the study.

- **Section A: Demographic Information** – This section gathered background information about the respondents, such as gender, category (student or ICT personnel), faculty, and years of experience using ICT tools. These details provided context for understanding respondents' exposure to and interaction with open-source software.
- **Section B: Awareness of Open-Source Software** – This section examined the respondents' level of awareness of OSS and their familiarity with commonly used

open-source platforms such as Moodle, DSpace, Koha, Zotero, and Open Journal Systems (OJS).

- **Section C: Utilization of OSS for Academic Activities** – This section sought to determine the extent to which respondents use different OSS tools in carrying out academic tasks such as learning, research, collaboration, and information management. Respondents were asked to rate their frequency of use on a five-point Likert scale ranging from *1 (Never Used)* to *5 (Very Frequently Used).*
- **Section D: Perceived Benefits of OSS** – This section focused on identifying respondents' opinions on the benefits of using open-source software in academic activities. Items in this section measured variables such as cost reduction, accessibility, flexibility, collaboration, and skill development, also using a five-point Likert scale ranging from *Strongly Disagree (1)* to *Strongly Agree (5).*
- **Section E: Challenges of Using OSS** – This section explored the various constraints encountered by respondents in the use of OSS. The items covered factors such as inadequate technical support, poor internet connectivity, and compatibility issues with proprietary systems. A five-point Likert scale was also used for consistency in measurement.
- **Section F: Suggestions for Improving OSS Utilization** – The final section was open-ended, allowing respondents to freely provide their recommendations on how OSS adoption and utilization could be enhanced within the university environment.

The questionnaire items were designed to be clear, concise, and easy to understand to encourage accurate responses. The use of Google Forms also enhanced the accuracy of data collection by automatically recording and organizing responses in a spreadsheet format, which simplified subsequent data analysis. Both closed-ended and scaled questions were employed to balance precision with the opportunity for varied opinions.

3.6 Procedure for Data Collection

The data for this study were collected through an online questionnaire created using Google Forms. This method was selected because of its efficiency, flexibility, and cost-

effectiveness, especially in an academic environment where students and ICT personnel frequently use digital communication tools. The online approach also made it easier to reach respondents across various faculties within the University of Benin without the limitations of physical distribution.

The researcher designed the Google Form based on the study objectives and pretested it among a small group of respondents to ensure clarity and ease of understanding. After this preliminary check, the final version of the questionnaire was distributed to potential respondents through official university platforms, student WhatsApp groups, and email lists. The link to the form included a short introduction explaining the purpose of the research, assuring respondents of anonymity, and emphasizing that their participation was voluntary.

Data collection was carried out over a period of two weeks to allow sufficient time for participants to respond. The responses were automatically recorded by Google Forms and later exported into a Microsoft Excel file for cleaning and organization. A total of seventy (70**)** valid responses were received and used for analysis.

The use of an online form ensured efficiency, eliminated manual data entry errors, and provided real-time access to responses. It also supported a broader and more inclusive reach, allowing participants from different faculties and departments to contribute conveniently using their mobile devices or computers.

3.7 Procedure for Data Analysis

After data collection, all responses obtained through Google Forms were automatically compiled into a spreadsheet and exported into Microsoft Exce**l** for analysis. The data were first examined for completeness, and any duplicate or incomplete entries were removed to ensure accuracy. The cleaned dataset was then organized according to the research objectives and corresponding questionnaire sections.

Descriptive statistical techniques were used to analyze the data. These included the computation of frequencies, percentages, and mean scores, which were appropriate for

summarizing responses from the Likert-scale items and other categorical variables. Frequency and percentage distributions were used to describe respondents' demographic characteristics and levels of awareness and utilization of open-source software (OSS). Mean ratings were employed to interpret the perceived benefits and challenges associated with OSS utilization.

The results of the analysis were presented using well-labeled tables for clarity and easy interpretation. Each table was followed by an explanatory narrative that interpreted the data in relation to the research questions. This approach allowed for a comprehensive understanding of the patterns and trends in OSS awareness, utilization, benefits, and challenges within the University of Benin.

The analyzed data formed the basis for the presentation and discussion of findings in Chapter Four, where the results were further interpreted in the context of existing literature. This analytical procedure ensured that the conclusions drawn from the study were based on accurate, reliable, and systematically processed data.

This research will be carried out in compliance with established ethical principles guiding studies that involve human participants. Before the questionnaires are distributed, respondents will be informed about the aim of the study, and their consent will be obtained. Participation will be entirely voluntary, and individuals will be free to withdraw at any point without any form of penalty.

Care will also be taken to design the instrument in such a way that it avoids sensitive or offensive questions, thereby minimizing any potential discomfort to participants. By observing these ethical guidelines, the study seeks to respect the rights, dignity, and privacy of all respondents while ensuring the credibility of the findings.

3.8 Summary

This chapter described the research methodology adopted for the study on the utilization of open-source software (OSS) for academic activities at the University of Benin. It presented the research design, population of study, sampling techniques, and sample size.

The chapter also discussed the instrument used for data collection, the method and procedure for data collection, as well as the process of data analysis.

Data were collected using a structured questionnaire administered electronically through Google Forms to students and ICT personnel across various faculties. Descriptive statistical methods such as frequencies, percentages, and mean ratings were employed in analyzing the responses. The procedures outlined in this chapter provided a systematic framework for obtaining and interpreting reliable data.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

4.1 Introduction

This chapter presents the analysis and interpretation of data collected from 70 respondents at the University of Benin through a structured questionnaire designed using Google Forms. The study investigated the Utilization of Open-Source Software (OSS) for Academic Activities in Nigerian Universities. Descriptive statistics such as frequencies, percentages, and mean ratings were employed to analyze the responses. The results are presented in tables and discussed in relation to the research objectives.

4.2 Demographic Information of Respondents

The demographic characteristics of respondents provide insight into the background of participants and the diversity within the study group. The variables examined include gender, category, faculty, and years of ICT experience.

Table 4.1: Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	39	55.7
Female	31	44.3
Total	70	100

Table 4.1 shows that 39 (55.7%) of the respondents were male while 31 (44.3%) were female, indicating a relatively balanced gender distribution.

Table 4.2: Category of Respondents

Category	Frequency	Percentage (%)
Students	68	97.1
ICT Personnel	2	2.9
Total	70	100

As shown in Table 4.2, the majority of respondents (97.1%) were students, while only 2 (2.9%) were ICT personnel, aligning with the study's focus on student utilization of OSS.

Table 4.3: Years of Experience Using ICT Tools

Years of Experience	Frequency	Percentage (%)
Less than 2 years	16	22.9
2–4 years	33	47.1
5 years and above	21	30.0
Total	70	100

Most respondents (47.1%) had between 2 and 4 years of experience using ICT tools, indicating fair familiarity with digital technologies.

4.3 Awareness of Open-Source Software (OSS)

This section examines how familiar respondents are with open-source software and the specific OSS tools they know.

Table 4.4: Awareness of OSS

Awareness	Frequency	Percentage (%)
Yes	64	91.4
No	6	8.6
Total	70	100

Table 4.4 shows that 64 (91.4%) respondents indicated awareness of open-source software, suggesting that OSS has gained significant recognition among the University of Benin community.

Table 4.5: Common OSS Tools Known by Respondents

OSS Tool	Frequency	Percentage (%)
Moodle	55	78.6
Google Workspace	52	74.3
DSpace	28	40.0
Koha	24	34.3
Linux	20	28.6
Zotero	18	25.7
Open Journal Systems (OJS)	16	22.9

Respondents identified several OSS tools. Moodle and Google Workspace were the most recognized, with 78.6% and 74.3% awareness respectively.

4.4 Utilization of OSS for Academic Activities

This section analyzes how frequently respondents use various OSS tools in their academic work.

Table 4.6: Utilization Frequency of OSS Tools

OSS Application	Mean Score	Interpretation
Moodle (e-learning platform)	3.9	Frequently used
Google Workspace (Docs, Sheets, etc.)	4.1	Frequently used
DSpace (Institutional repository)	3.2	Moderately used
Koha (Library system)	3.0	Moderately used
Zotero (Reference manager)	2.8	Occasionally used
OJS (Publishing platform)	2.6	Occasionally used

Table 4.6 shows that Google Workspace and Moodle are the most frequently used OSS tools, while Zotero and OJS are less utilized.

4.5 Perceived Benefits of OSS

Respondents rated their level of agreement with statements describing the benefits of using OSS on a 5-point Likert scale.

Table 4.7: Mean Scores of Perceived Benefits of OSS

Statement	Mean	Interpretation
OSS reduces the cost of software acquisition	4.3	Strongly Agree
OSS improves access to educational resources	4.2	Agree
OSS enhances research and knowledge sharing	4.1	Agree
OSS promotes digital skill development	4.0	Agree
OSS allows flexibility and customization	3.8	Agree
OSS enhances collaboration among students and staff	4.1	Agree

Respondents strongly believe OSS provides cost benefits (mean = 4.3) and improves access to resources (mean = 4.2).

4.6 Challenges Encountered In Using OSS

Respondents were asked to indicate the extent to which they experienced certain challenges while using open-source software for academic activities. The results are presented in Table 4.8.

Table 4.8: Mean Scores of Challenges Encountered in Using OSS

Challenge	Mean	Interpretation
Lack of technical support and training	4.2	Major Challenge

Limited internet access or speed	4.1	Major Challenge
Inadequate institutional policy or support	3.9	Moderate Challenge
Difficulty in software installation and updates	3.7	Moderate Challenge
Compatibility issues with proprietary systems	3.6	Moderate Challenge
Lack of awareness or promotion of OSS tools	3.8	Moderate Challenge

Interpretation:

The findings in Table 4.8 reveal that the most significant challenges faced by respondents were the lack of technical support and training (mean = 4.2) and limited internet access (mean = 4.1). These findings align with studies by Umar, Datti, and Abubakar (2016) and Adeleke and Onifade (2022)**,** who both emphasized that inadequate user training and weak institutional infrastructure hinder the full adoption of OSS in Nigerian universities. Moderate challenges, such as compatibility issues and limited promotion of OSS tools, further suggest the need for stronger ICT policies and campus-based advocacy.

4.7 Suggestions for Improving OSS Utilization

Respondents were also asked to suggest ways to enhance the use of open-source software for academic activities. Their responses were categorized and summarized thematically as shown in Table 4.9.

Table 4.9: Summary of Respondents' Suggestions for Improving OSS Utilization

Suggestion Theme	**Frequency**	**Percentage (%)**
Provide regular training and workshops	29	41.4
Improve network infrastructure and internet access	18	25.7
Institutionalize OSS through university policy	10	14.3
Increase awareness and advocacy campaigns	8	11.4

Strengthen technical support teams	5	7.1
Total	**70**	**100**

Interpretation:

The majority of respondents (41.4%) emphasized the importance of regular training and workshops to enhance users' proficiency with OSS. About 25.7% suggested improving the university's internet infrastructure to support better connectivity. Others called for institutional OSS policies, increased awareness, and better technical support. These responses indicate that human capacity development and policy support are key drivers for sustainable OSS adoption in Nigerian higher institutions.

4.8 Discussions of Findings

The overall findings of this study demonstrate that awareness and utilization of open-source software among students at the University of Benin are relatively high. The results show that tools such as Moodle and Google Workspace are widely used, while specialized systems like DSpace, Koha, and OJS are moderately or occasionally utilized. This pattern reflects the trend reported in several empirical studies across Nigerian public universities.

For example, Umar, Datti, and Abubakar (2016) found that OSS adoption among students and staff in northern Nigerian universities was influenced mainly by performance expectancy and social influence. Similarly, Adeleke and Onifade (2022) observed that while awareness of OSS was increasing, limited training opportunities and infrastructural deficits remained key challenges. The present study corroborates these findings, as training and internet access were identified as the top barriers by respondents.

Additionally, studies by Ezeani and Ezema (2018) and Olayemi (2020) reported that Koha ILS and DSpace were the dominant OSS tools used in Nigerian university libraries for cataloguing and institutional repositories, respectively. The current research supports this observation, as both tools were recognized by respondents even though they were less used compared to e-learning applications like Moodle.

Furthermore, the positive perception of OSS benefits in this study; particularly regarding cost savings, collaboration, and access to learning materials—echoes the conclusions of Olowe and Okon (2021), who emphasized OSS as a strategic enabler of affordable digital transformation in tertiary education. The mean scores above 4.0 for most benefit indicators underscore this optimism.

However, despite these advantages, the persistence of infrastructural and support challenges highlights a recurring issue in the Nigerian higher education landscape. Limited funding, insufficient ICT policy integration, and inadequate staff development programs continue to impede sustained OSS adoption. As Nwosu and Eze (2021) pointed out, universities must prioritize open-source training, develop institutional strategies, and strengthen partnerships with local and global OSS communities to ensure effective utilization.

In conclusion, this study's findings reinforce the growing recognition of open-source software as a cost-effective and flexible resource for enhancing academic productivity and access in Nigerian universities. Nevertheless, the success of OSS initiatives depends heavily on sustained investment in training, infrastructure, and supportive institutional frameworks.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents the summary, conclusion, and recommendations of the study on the Utilization of Open-Source Software (OSS) for Academic Activities in Nigerian Universities, with the University of Benin as a case study. The purpose of the chapter is to highlight the key findings from the data analysis, draw meaningful conclusions based on the study objectives, and provide practical recommendations for improving OSS use in academic environments.

5.2 Summary of the Study

The study examined how students and ICT personnel at the University of Benin use Open-Source Software in their academic work. A total of seventy (70) valid responses were collected through a structured Google Form questionnaire. The data were analyzed using simple descriptive statistics such as frequencies, percentages, and mean scores. The main findings of the study are summarized as follows:

1. **High Level of Awareness:**
   Most respondents (91.4%) indicated that they were aware of open-source software.

Tools such as Moodle, Google Workspace, and DSpace were the most recognized, showing that open-source applications have gained significant presence in the university's digital ecosystem.

2. **Frequent Utilization for Academic Tasks:**
   The study revealed that Moodle and Google Workspace were the most frequently used OSS tools for teaching, learning, and collaboration. Other software such as DSpace, Koha, Zotero, and OJS were used occasionally, mainly for research and library-related activities.
3. **Positive Perception of OSS Benefits:**
   Respondents agreed that OSS offers many benefits, such as reduced software costs, improved access to resources, enhanced collaboration, and flexibility in use. These results align with previous studies (e.g., Adeleke & Onifade, 2022; Olowe & Okon, 2021) which emphasized OSS as a cost-effective way to promote digital transformation in education.
4. **Challenges Limiting Full Adoption:**
   Despite the positive perception, the study found several challenges, including limited technical support, inadequate training, poor internet connectivity, and weak institutional policy frameworks. These issues were similar to those reported by Umar, Datti, and Abubakar (2016), who also identified a lack of training and infrastructure as major barriers to OSS adoption in Nigerian universities.
5. **Suggestions for Improvement:**
   Respondents suggested that regular training, better internet facilities, institutional OSS policies, and awareness campaigns could help improve OSS utilization. These findings imply that the successful use of OSS depends not just on the software itself, but also on user support and enabling infrastructure.

5.3 Conclusion

From the findings of this research, it can be concluded that open-source software plays a vital role in supporting academic activities at the University of Benin. Students and ICT personnel are generally aware of and actively use OSS tools, especially for learning, collaboration, and information access. The affordability and flexibility of these tools

make them practical solutions for universities that face financial or licensing constraints associated with proprietary software.

However, the study also shows that awareness does not always translate to full utilization. The level of usage varies across software types, with teaching and learning tools (like Moodle) being used more frequently than research and publication tools (like Zotero or OJS). This indicates that institutional priorities and technical competencies influence adoption patterns.

The findings suggest that, while OSS has the potential to transform academic work in Nigeria, achieving this goal requires consistent user training, technical support, and policy-level commitment from universities and government agencies.

5.4 Recommendations

Based on the findings and conclusions of the study, the following recommendations are made:

1. **Training and Capacity Building:**
   The University of Benin should organize regular workshops and training sessions for students, academic staff, and ICT personnel to enhance their skills in using OSS tools effectively.
2. **Improved ICT Infrastructure:**
   The university management should invest in better internet connectivity and technical facilities to support smooth access to OSS platforms, particularly for e-learning and research activities.
3. **Institutional Policy on OSS:**
   A formal institutional policy promoting OSS adoption should be developed. This will help standardize usage across departments and encourage integration of OSS tools into teaching and administrative workflows.
4. **Awareness and Advocacy:**
   Awareness campaigns should be carried out to promote the use of OSS tools

across all faculties. This can include seminars, flyers, and online campaigns highlighting the benefits of open-source platforms.

5. **Collaboration with OSS Communities:**
   Universities should partner with open-source communities and organizations for technical support, software updates, and resource sharing. This will encourage sustainability and long-term adoption.

5.5 Suggestions for Further Studies

This study focused mainly on the utilization of OSS at the University of Benin, using students and ICT personnel as respondents. Future researchers could expand the scope to include multiple universities across different regions in Nigeria for comparative analysis.

Additionally, further research could employ qualitative methods such as interviews or focus groups to gain deeper insights into users' experiences, motivations, and challenges with OSS. Investigating specific OSS applications (like DSpace or Moodle) in more detail could also help identify targeted strategies for improvement.

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