

Cloud Computing Technology on Information User-friendliness and Serviceability by the University Librarian and IT Attendants Superintendents at the National Open University of Nigeria

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Abstract

This study explored the transformative impact of cloud computing technology on the National Open University of Nigeria (NOUN) Library, aiming to enhance access, efficiency, and collaboration in supporting distance learners. Employing a qualitative approach, data was collected through interviews with key library personnel, including the University Librarian and IT staff responsible for cloud services. Findings revealed that NOUN Library actively utilized cloud-based solutions to develop digital libraries, search scholarly content, automate processes, and facilitate data sharing across dispersed study centers. The library's adoption of cloud technology fostered improved user friendliness, operational efficiency, and cost savings. Notably, respondents expressed confidence in their knowledge of cloud computing, with minimal concerns about data privacy or staff redundancies; however, they highlighted high subscription costs as a significant challenge. The study underscored that cloud services enabled seamless resource sharing, centralized management, and broadened access for geographically dispersed students, aligning with global best practices in digital library management. The findings demonstrated the librarians' strong willingness to leverage cloud computing for enhancing service delivery and collaboration, regardless of age or technical proficiency. Cloud adoption empowered NOUN to disclose its vast collections online, streamline workflows, and foster innovative initiatives that responded effectively to the needs of distance learners. This technological shift positioned NOUN Library as a proactive institution in the digital age, capable of overcoming traditional resource limitations and expanding its reach across Nigeria's diverse student population. In conclusion, cloud computing presented a promising pathway for NOUN Library to revolutionize its operations, improve resource accessibility, and foster innovation in service delivery. The technology's scalability, cost-efficiency, and capacity for supporting collaborative ventures made it an invaluable asset for modern libraries seeking to meet the demands of a digital society. The study recommended that the university's leadership and IT department collaborate to incorporate cloud-based video services, software applications, and infrastructure from leading providers such as Google, Amazon, IBM, and Microsoft. Embracing these solutions would enable the library to redirect internal technical resources toward strategic initiatives, enhance user experiences, and sustain continuous innovation. Ultimately, adopting cloud computing positioned NOUN Library to deliver resilient, accessible, and efficient services for its diverse user base.

Keywords: *Cloud Computing, Information Users-Friendliness, Information Serviceability, Library, National Open University of Nigeria.*

I. Introduction

The inception of the National Open University of Nigeria (NOUN) signifies a strategic initiative by the Federal Ministry of Education and its affiliated bodies to incorporate Information and Communication Technology (ICT) into the Nigerian educational framework (Oyelekan, 2008). Established as an Open and Distance Learning (ODL) institution, NOUN was formally revitalized on April 12, 2001, with a primary focus on online service delivery. Notably, NOUN leverages the ILEARN Learning Management System for lecture and note management. Additionally, the university operates a digital library named INFORMATION GATEWAY, offering a wide array of multimedia tutorials to enhance the learning experience. Distance education learners exhibit distinct characteristics compared to traditional university students. Typically, they are

working adults with familial obligations, showcasing a high level of motivation and a proactive approach to their education. These learners are often self-directed, preferring independent study and utilizing various learning methods while maintaining control over their educational journey. However, they encounter challenges related to accessing and retrieving essential information from libraries. Vacca (2021) identifies key issues faced by distance learners, including: Limited library services provided by distance learning institutions, reluctance to travel long distances to access library resources, deficiencies in information literacy skills, inadequate familiarity with library and electronic information sources, leading to hesitancy in seeking assistance from library staff for information retrieval. Open and Distance Education institutions can form a consortium to plan, coordinate, and implement a national digital library for the benefit of distance learners. Individual member institutions of the association should share their learning resources. This way, a diverse collection of learning materials can be created. This should be made available to students and accessed via the Intranet and the Internet. Cloud computing adoption can be interlinked with the digital library to address the copyrights and other related issues.

The concept of cloud computing sparks ongoing discussions and varying perspectives. As per Shakor and Shafiq (2021), cloud computing represents a scalable computing model that harnesses virtualized resources accessible to users. Notably, users can engage with these resources without prior familiarity with the specific services. Moreover, individuals online can seamlessly interact with multiple servers simultaneously, facilitating data exchange among them. Fundamentally, cloud computing enables data storage and utilization through internet connectivity, ensuring accessibility from any location and on any internet-enabled device.

Essentially, cloud computing facilitates the availability of data and applications over the internet. Cloud services are accessible through a web browser on any device. The term 'cloud' encompasses a blend of servers, networks, connection applications, and resources. To grasp Cloud Computing better, the researchers compare it with local computing. In the traditional local computing setup, the library's applications operate on a server owned and managed by the library, typically housed in a rack within a computer center or room. This server is physically visible and touch accessible. Specific library staff is tasked with tasks like updating the operating system, configuring software, and handling technical and administrative duties. The library incurs expenses for the server, hardware, as well as electricity bills for power and ventilation (Vacca, 2021).

In contrast, cloud computing operates on a more abstract level, where the underlying hardware is not a direct concern for users of the service. Users are aware that servers and data exist somewhere in the cloud, but the specific physical location is inconsequential. Automation and virtualization play a crucial role in facilitating the swift delivery of services and resources. Cloud Computing serves as a highly scalable platform that grants rapid access to hardware and software via the internet, offering straightforward management and accessibility for users with varying levels of expertise. This technology relies on advanced techniques like virtualization, multi-tenancy, scalability, load balancing, and optimal performance to ensure the efficient and seamless provision of resources.

In the contemporary era, the quality of life, opportunities for social progress and economic advancement are increasingly intertwined with the utilization of information. The sourcing, organization, storage, dissemination, and retrieval of information serve as the cornerstone of modern society. Individuals, businesses, and communities heavily rely on information to make well-informed decisions. Kumar (2023) emphasizes the critical role of information in our intricate modern society, where a broad spectrum of decisions hinges on the judicious use of information. Furthermore, libraries can leverage cloud computing to circumvent technological challenges such as hardware malfunctions, software glitches, and staff training deficiencies, enabling them to concentrate on enhancing collection development, enhancing patron services, and fostering innovation. According to Wainaina (2021), the hurdles confronting library automation encompass issues like hardware failures, software complexities, erratic power supplies, inadequate funding, insufficient staff training, and the planned obsolescence of commercial software.

In response to the obstacles encountered in library resource automation, the National Open University of Nigeria Library adopted cloud computing for resource provisioning and management. Notably, the institution's focus is on Open and Distance Learning, indicating a primarily virtual and online learning environment.

Consequently, most resources are in electronic format and accessible online. Unlike conventional universities with centralized teaching and learning approaches, the National Open University of Nigeria operates through 128 Study Centers dispersed across the country, catering to its geographically diverse student body. Therefore, to ensure seamless services and user access, the library must establish a platform that offers unrestricted access and is not bound by specific locations.

The researchers tend to investigate cloud and their impact on Open and Distance Library. Specifically, the objectives are:

1. To identify the information services provider using cloud computing technology in NOUN Library
2. To identify the impact of the adoption of cloud computing technology for information user-friendliness and serviceability in National Open University of Nigeria Library.

The research delves into the consequences of cloud computing technology on the Open and Distance Library of the National Open University of Nigeria located at the Abuja Main Library. The study aims to explore the implications of cloud technology for the library's operations.

The key research inquiries include:

1. What are the Information services render using cloud computing in National Open University of Nigeria Library?
2. What concerns has the adoption of cloud computing had on information users- friendliness and serviceability in National Open University of Nigeria Library?

Hence, an investigation of this nature is significant to place Cloud Computing technology within the sphere of library computation to enhance improved productivity and efficiency in library services. This research employed a qualitative methodology. The study focused on a target population comprising five (5) individuals from the National Open University of Nigeria Library, including the University Librarian, and four (4) members of the Information Technology (IT) unit at the NOUN Headquarters Abuja Library responsible for overseeing the administration of cloud computing technology. While the IT department consists of 24 staff members, only four are directly involved in managing cloud computing operations, ensuring a focused and effective research approach. The researcher conducted Focus Group interviews, engaging with the IT unit members through a structured questionnaire prepared in advance. This methodology facilitated detailed explanations or clarifications on any questions that may have posed challenges to the respondents' understanding.

II. Literature Review

Cloud Computing Technology

In the contemporary landscape, organizations and businesses heavily rely on technology to effectively meet their strategic goals. As highlighted by Raza and Khan (2022), modern consumers seek rapid and seamless digital interactions, expecting immediate responses. The influence of industry giants like Amazon and Apple has raised the bar, setting a standard for swift product delivery and consistent user experiences across all sectors. However, navigating technology can be intricate, costly, and challenging to manage, posing significant hurdles for organizations. This complexity often leads to resource constraints, including a shortage of specialized personnel and insufficient funding to fully harness technological capabilities. Cloud computing emerges as a transformative solution, offering avenues to reduce costs and enhance expertise. Atanda (2021) notes that leveraging cloud technology enables organizations to streamline technology expenses, enhance service delivery, cater to geographically dispersed users, and bolster operational reliability.

Many organizations face high costs with local computing due to expenses for servers, hardware, maintenance, personnel, and software. They often buy servers with excess capacity for future needs, leading to unused resources. Atanda (2021) explained that cloud computing provides a cost-effective solution by shifting infrastructure to a service model, eliminating the need for on-site servers and hardware. Cloud environments use clustered and virtualized generic computers, allowing for scalable, fault-tolerant, and continuous operation. Libraries, vital in the Information Age, are adapting to this technology to manage, store, and disseminate information. With diverse storage formats, libraries preserve knowledge and improve access, while cloud technology further enhances their capacity to deliver seamless, global information services.

Cloud computing refers to a server interconnected through communication networks like the internet, intranet, Local Area Network (LAN), or Wide Area Network (WAN), enabling authorized users to leverage its processing capabilities and resources for running applications, storing data, or executing various computing tasks from any location worldwide. Notably, the utilization of Personal Computers (PCs) to run applications is no longer a prerequisite with cloud technology. Consequently, cloud-based services are universally accessible wherever internet connectivity is available. Users, regardless of their technical proficiency, can effortlessly access cloud-based applications via a web browser on diverse devices such as PCs, smartphones, iPhones, iPads, Blackberries, or Android devices. In this setup, business software and user data are securely stored on remote servers. Prominent examples of cloud service providers include Amazon Web Services, Google App Engine, among others (Kumar, 2021).

Cloud Computing technology enables the sharing of resources and services over the internet, eliminating the need for hosting these services and resources on local servers, nodes, or personal devices. Cloud-based services, which mimic real servers or hardware, are supported by virtual servers or hardware simulated by software operating on one or more physical machines. These virtual servers or automated systems do not have a physical existence, allowing them to be easily relocated and scaled up or down without impacting the user's experience or functionality.

Cloud computing technology can be conceptualized as a cutting-edge model that offers convenient, on-demand network access to a shared pool of configurable computing resources, which can be swiftly provisioned and released with minimal management effort or service provider interaction. Chun (2020) observed that one of the key advantages of cloud computing is its ability to streamline IT operations by leveraging the efficiency of

pooling on-demand self-managed virtual infrastructure delivered as a service. This versatile service is known by various names such as Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), among others. Moreover, these services can be deployed over public, private, or hybrid networks to cater to diverse organizational needs. Leading cloud providers, including Google, Amazon, IBM, Oracle Cloud, Rackspace, Salesforce, Zoho, and Microsoft, offer cutting-edge cloud solutions.

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A library's nature and function include the collection, organization, documentation, and dissemination of information. This information must be provided or made available as needed at a reasonable cost. In general, cloud computing technology enables libraries to devote less of their technology budget and personnel to activities that require routine support for library operations, allowing them to concentrate on developing strategic or innovative services. Cloud computing is an IT attempt to help libraries perform their tasks more quickly, accurately, and virtually.

According to Chun (2020), cloud infrastructure allows libraries to move away from owning and operating their own servers to power their core automation application and instead gain similar functionality through web-based services. Despite this, Raza and Khan (2022) lamented that, while the use of the cloud in the business environment has transformed the concept of data storage and resource management, its use in libraries is less common. With Cloud Computing, one pays for what one uses instead of paying for excess capacity never consumed. Although there may be some minimum base charge, what is used is referred to as pay- as-you-go. In addition, personnel costs related to technology can be greatly reduced through increased reliance on cloud computing. Again, rather than purchasing permanent licenses, many organizations can achieve substantial saving by shifting to soft-ware-as-service or other license. This is because software-as-a-service, for one, usually involves a set monthly or annual subscription fee rather than a large up- front investment for license purchase.

Furthermore, cloud computing improves the performance of high-volume services. The approach has been praised for its adaptability and device-location independence. While cloud infrastructure resources provide the opportunity to expand IT infrastructure during peak demand periods, it also allows users to access systems via a web browser regardless of their location or device. (Okwoli 2019). Cloud computing also allows widely distributed users. This is commonly referred to as multi-tenancy. This advantage allows for the sharing of resources and costs among many users, resulting in infrastructure centralization, peak loading capacity, utilization, and efficiency. Again, because libraries, like most organizations, have a low tolerance for service interruptions, cloud-based services have been designed to provide a much higher level of reliability than most organizations can achieve within their own data centers, as well as sophisticated security and software updates provided by the provider.

In essence, cloud computing offers simpler sharing, standardized IT, latest functionality, less in-house IT, low monthly payment, pay when used, easy/fast deployment.

Cloud Computing in Education Institutions

Cloud computing technology has recently received significant attention from academia, industry, government, and the military. It has become widely used in recent years to solve storage and computational problems across various domains. Educational institutions can benefit from cloud infrastructure by improving computing performance, storage capacity, universal accessibility, and cost savings. It can help institutions reduce fixed and maintenance costs associated with ICT investments in hardware, software, and computer services. According to Kumar (2023), cloud computing provides numerous benefits to e-learning solutions by directly providing infrastructure, platform, and educational services through cloud providers, as well as by utilizing virtualization, centralized data storage, and facilities for data access monitoring.

However, Atanda (2021) cautioned that the use of cloud computing in higher education should be evaluated not only in terms of benefits but also in terms of risks and limitations. Following analysis, one or more cloud computing models may be selected for use. Although cloud computing has both benefits and risks, the benefits can be enhanced, and the risks significantly reduced if educational institutions exercise caution and vigilance when selecting cloud computing providers and monitoring the relationship to ensure that the provider is adequately protecting the data.

Cloud computing technology provides libraries with a cost-effective infrastructure that supports storage, computing, and automation needs. Since 2011, library vendors have increasingly offered cloud-based Integrated

Library Systems (ILS) and discovery tools. This technology allows libraries to develop digital repositories, enhance search capabilities, host content, store data, and automate operations. Cloud computing is an adaptation of existing technologies that enables functional, efficient digital libraries, bridging the gap to virtual libraries. Libraries benefit from unified search services, accessible from any Internet-enabled device, and a collaborative platform exemplified by the Online Computer Library Center (OCLC), which supports data sharing across libraries.

Libraries can host websites on third-party servers, freeing them from maintaining local servers. Platforms like Google Sites enable multi-editor access from various locations. Cloud computing also supports social networking tools like Twitter and Facebook, fostering community engagement and cooperative intelligence. Library automation, transitioning from traditional to computerized libraries, is enhanced by cloud services like Polaris, which offers cataloging, acquisition, and digital content services while adhering to various library standards. This move to cloud-based services streamlines library management, encourages intellectual collaboration, and improves decision-making efficiency (Kumar, 2023).

Libraries will not see the physical hardware involved with IaaS but will be able to perform many of the same system administration tasks as they would on local servers. Operating an application via IaaS saves the library from purchasing its own hardware while retaining the tasks associated with installing and maintaining software applications. A library may use IaaS to run its integrated library service (ILS) rather than purchasing local hardware. IaaS examples, according to Kumar (2023), include Amazon Web Services, Rackspace, Savis, HP, IBM, Sun, and Google Base.

An Overview of Open and Distance Learning (ODL)

Open Distance Learning (ODL) is an effective strategy for broadening access and increasing participation in higher education while maintaining cost efficiency and quality. ODL is heavily reliant on technology, including bandwidth, hardware, software, and mobile applications, to manage academics and support students. Cloud computing technology in libraries addresses access challenges for distance learners by providing digital resources. By forming a consortium, ODL institutions can share resources nationally, enhancing learning material diversity and availability via the Internet and intranet. This model also supports cost-effectiveness, efficient resource sharing, easier access, continuous updates, and collaborative learning, improving the overall educational experience for distance learners.

III. Methodology

This study adopted a qualitative research approach to gain in-depth insights into the management and application of cloud computing technology within the NOUN Library system. The target population comprised five key individuals: the University Librarian and four members of the Information Technology (IT) unit at the National Open University of Nigeria Headquarters in Abuja. These four IT staff members were specifically responsible for overseeing cloud computing operations. Although the IT unit included a total of 24 personnel, only these four were directly involved in cloud technology administration. To ensure the collection of relevant and focused data, the researchers employed purposive sampling, selecting these four individuals based on their roles and expertise, as recommended by Setta (2019), who noted that purposive sampling is particularly effective for quickly reaching targeted respondents in specialized areas.

Data collection involved multiple methods to ensure comprehensive understanding. These included direct observations, semi-structured interviews, and unstructured discussions with the selected participants. The interviews were conducted with the aid of a digital recorder to accurately capture responses. The semi-structured interviews were guided by a predetermined set of questions, allowing the researcher to engage personally with each IT staff member. This format provided flexibility for clarifying or elaborating on responses, especially if certain questions were not initially clear to the respondents. This approach facilitated a rich collection of qualitative data, capturing the nuances of cloud computing administration within the library's operational context.

Method of Data Analysis

The decision rule for data analysis was established to promote clarity and consistency throughout the research process. According to this rule, all data collected from the various research instruments would first be organized and categorized based on their source, ensuring that each piece of information was properly labeled and distinguished.

Next, the data were accurately transcribed to preserve its original meaning and context. Once transcribed, the data was systematically tabulated, allowing for easier comparison and identification of emerging patterns or themes. This step facilitated a clear organization of the information, making it accessible for detailed analysis.

Finally, the organized data was discussed descriptively. This involved analyzing the tabulated information to interpret the findings, highlight key insights, and draw meaningful conclusions relevant to the research objectives. This structured approach ensured that the analysis was transparent, logical, and aligned with the research goals, guiding readers to understand both the origin of the data and the pathway to the final interpretations.

IV. Analysis and Interpretation

Response Rate

Table 1: Response Rate

S/N	National Open University of Nigeria Library	Category of Staff	Sample Size	Response Rate
1.		University Librarian	1	1
		Staff of Information Technology unit	4	4
Total			5	5

The study involved a total of five respondents, including four staff member from the Information Technology unit and the university librarian of NOUN library, who participated in both semi-structured and structured interviews. The response rate for both types of interviews was a hundred percent, which was attributed to the small population size. The researcher obtained formal permission from the University Librarian, who instructed the Information Technology unit staff to provide the necessary support and cooperation for the data collection exercise. This high response rate and the cooperation from the University Librarian and IT staff ensured the successful completion of the interviews and the collection of valuable data for the study.

Research Question 1. What are the Information services render using cloud computing in National Open University of Nigeria Library?

Table 2: Information Services render using cloud computing technology in NOUN Library

S/NO	Information services provided using cloud computing in NOUN Library	Indications
1	Building digital library	√
2	Searching scholarly content	√
3	File storage	√
4	Building community Power	√
5	Library Automation	√

Key: √ = Available

x = Not Available

Table 2 shows that the above information services are rendered using cloud computing in NOUN Library. The table displays information services provided using cloud computing in NOUN library: building digital library, searching scholarly content, file storage, building community power and of course library automation. It implies that NOUN library uses these services to create effective platform to build a functional and efficient digital library.

RESEARCH QUESTION2: What is the degree of adoption of cloud computing had on information users-friendliness and serviceability in National Open University of Nigeria Library

Table 3: Degree of the adoption of cloud computing technology

Degree of the adoption of cloud computing	Low Quality	Moderate	High quality
Web-mail services	X	√	X
Store personal photos	X	√	X

On line application	X	√	X
Store personal video	X	√	X
Pay to store computer file online	X	√	X
Back-up hard drive to an online site	X	X	√

Key: √ = Applicable

x = Not Applicable

Respondents revealed that the NOUN library uses cloud computing for web-mail services. It is also used to store personal photos, online applications, and personal video storage, as well as to pay for online computer file storage and backup. The responses were to a collective agreement between the University Librarian and the four (4) IT staff interviewed. This implies that data sharing in the NOUN library will be extremely efficient.

V. Discussion of the Findings

The findings of this study show that NOUN librarians are involved in a variety of cloud computing activities. They demonstrate a strong willingness to adopt cloud computing technology in libraries. Regardless of computer literacy or age, they are using a variety of devices to access cloud computing tools. According to the respondents, the reasons for NOUN library's move to cloud computing are to disclose their vast collections on the web, amplify the power of collaboration with other developed libraries, build a significant, unified presence on the web, save time, save money, simplify workflow, make work more effective and efficient, and eliminate local storage, maintenance, and backup. This findings is in agreement with the study of Atanda (2021), who states that the library community can use cloud computing to increase the power of collaboration and create a significant, unified presence on the web.

NOUN Library considers cloud computing to be the most recent technological trend. The National Open University of Nigeria (NOUN) library implemented cloud computing to efficiently meet the information needs of its students across the country. Through cloud services, NOUN provides digital libraries, scholarly content search, data sharing, community building, and library automation. This adoption allows NOUN to disclose its vast collections online, collaborate with other libraries, streamline workflows, and reduce costs associated with storage and maintenance. This findings supports Kumar (2021) who noted that centralizing libraries in the web presence enhances access, saves time, and improves the effectiveness of its services, viewing cloud computing as a valuable and modern trend in library management.

VI. Conclusion

The National Open University of Nigeria Library has the potential to improve its services and relevance in today's information society. Cloud computing technology is one potential path into the future. It has the potential to provide numerous benefits to libraries and change their future. According to the findings of this study, librarians at the National Open University of Nigeria engage in a variety of cloud computing activities. They demonstrate a strong willingness to implement cloud computing technology in libraries. Regardless of computer literacy or age, they use a variety of devices to access cloud computing tools and meet the information needs of their students, who are spread across the country. It indicates that information services will be extremely effective and efficient.

VII. Recommendations include:

1. University Librarian and IT staff to adopt cloud-based video and software services from providers like Google, Amazon, IBM, and Microsoft to improve library services. They should see cloud computing as a flexible system that can help the library focus more on innovation instead of maintaining software and servers.
2. The University Librarian and IT staff should recognize that cloud computing represents an open, service-oriented architecture that has the potential to revolutionize the future of NOUN libraries.
3. University librarian should adopt cloud computing services to improve efficiency, reduce costs, and enable the development of innovative services.

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