

Cloud Computing and Data Management in State-Owned Universities in Rivers State

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ABSTRACT

This study examines the influence of cloud computing on data management in state-owned universities in Rivers State, Nigeria. Specifically, it assessed the effect of private cloud on data quality management and the relationship between public cloud usage and data integration. Guided by the Technology Acceptance Model and other relevant theories, the study employed a correlational survey design using a sample of 123 ICT and data management staff selected through stratified random sampling. Data were collected through a structured questionnaire and analyzed using Pearson Product Moment Correlation. The findings showed a significant positive relationship between private cloud and data quality management ($r = 0.631, p < 0.05$), and between public cloud and data integration ($r = 0.547, p < 0.05$). The study concludes that cloud computing technologies play a critical role in enhancing data accuracy, accessibility, and interdepartmental collaboration. It recommends increased investment in private cloud infrastructure, hybrid cloud strategies, digital literacy, and institutional ICT policies for sustainable data management in tertiary institutions.

Keywords: Cloud Computing, Private Cloud, Public Cloud, Data Quality Management, Data Integration, State-Owned Universities, ICT in Education, Nigeria.

Introduction

In the digital-first academic landscape of today, cloud computing has emerged as a transformative force, reshaping how universities manage, store, and access data. In Nigeria, particularly in state-owned universities in Rivers State, the adoption of cloud-based technologies is gradually redefining educational delivery, administrative efficiency,

and research collaboration. Cloud computing refers to the on-demand delivery of computing services including storage, processing power, and applications over the internet, allowing institutions to scale resources dynamically without the need for physical infrastructure (Amadi & Kenneth, 2022). This model is especially beneficial for public universities, which often face budgetary constraints and infrastructural limitations.

In Rivers State, institutions like Rivers State University and Ignatius Ajuru University of Education are beginning to explore cloud-based platforms to support science education, digital libraries, and administrative data systems (Otuturu & Richmond, 2024). These technologies enable students and faculty to access learning materials anytime, anywhere—fostering a shift from teacher-centered instruction to student-driven, competency-based learning.

However, the journey is not without challenges. Studies show that inadequate power supply, poor internet connectivity, and lack of institutional policies are major barriers to full-scale adoption (Aminikpo, Wiche & Akaranda, 2024). Despite these hurdles, librarians and ICT professionals in these universities generally view cloud computing as a safe and efficient solution for data storage and sharing, especially in library systems (Aminikpo *et al.*, 2024). As the demand for data-driven decision-making grows, effective data management strategies—including secure storage, real-time access, and data analytics—are becoming essential. Cloud platforms offer scalable solutions that not only reduce operational costs but also enhance institutional agility and resilience.

In sum, the integration of cloud computing into state-owned universities in Rivers State represents a critical step toward digital transformation in Nigeria's higher education sector. With the right investments in infrastructure, policy, and training, these institutions can harness the full potential of cloud technologies to improve learning outcomes and administrative efficiency.

Statement of the Problem

Despite the growing global shift toward digital transformation in higher education, many state-owned universities in Rivers State still grapple with outdated data management systems and limited adoption of cloud computing technologies. These institutions often rely on fragmented, manual processes for storing, retrieving, and securing academic and administrative data—leading to inefficiencies, data loss, and limited access to real-time information. While cloud computing offers scalable, cost-effective, and secure solutions for data storage and collaboration, its integration into public universities in Rivers State remains slow and inconsistent. Key obstacles include infrastructural limitations, lack of ICT policy frameworks, inadequate funding, and low digital literacy among staff.

Furthermore, the absence of centralized cloud-based platforms has hindered inter-departmental data sharing, research collaboration, and remote learning capabilities, especially during emergencies such as the COVID-19 pandemic. This digital lag not only affects institutional efficiency but also undermines the quality of education and research output in these universities. There is, therefore, an urgent need to investigate the current

state of cloud computing and data management practices in state-owned universities in Rivers State, identify the challenges impeding adoption, and propose strategic frameworks for sustainable implementation.

Purpose of the Study

The purpose of this study was to investigate Cloud computing and data management in State owned universities in Rivers State. Specifically, the study sought to do the following:

1. To examine the influence of private cloud on data quality management in state-owned universities in Rivers State.
2. To investigate the relationship between public cloud and data integration in state-owned universities in Rivers State.

Research Questions

The following research questions guided the study:

1. What is the effect of the private cloud on data quality management in state-owned universities?
2. How does the public cloud relate to data integration practices in state-owned universities?

Research Hypotheses

The following null hypothesis were tested at 0.05 level of significance in this study:

1. There is no significant relationship between the private cloud and data quality management in state-owned universities.
2. There is no significant relationship between the public cloud and data integration in state-owned universities.

Conceptual Review

Cloud Computing in Higher Education

Cloud computing is a transformative model that enables institutions to access computing resources—such as servers, storage, and applications—on-demand via the internet. In the context of Nigerian universities, cloud computing is increasingly recognized as a cost-effective and scalable solution for managing academic and administrative operations (Ibrahim, 2022). The flexibility of cloud services allows universities to modernize their IT infrastructure without heavy capital investment.

Two key dimensions of cloud computing relevant to this study are:

Private Cloud: A dedicated cloud environment managed internally or by a third party, offering greater control and security. It is often preferred for sensitive institutional data.

Public Cloud: A shared infrastructure provided by external vendors like AWS or Microsoft Azure. It is more affordable and scalable but may raise concerns about data sovereignty and privacy.

Data Management in Universities

Effective data management is essential for decision-making, academic planning, and service delivery in universities. It involves the systematic handling of data from collection to storage, integration, and analysis. In state-owned universities in Rivers State, data management practices are often hindered by fragmented systems and limited ICT infrastructure (Aminikpo, Wiche & Akaranda, 2024). This study focuses on two measures of data management:

Data Quality Management: Refers to the processes that ensure data is accurate, complete, consistent, and reliable. Poor data quality can lead to flawed decisions and inefficiencies in academic and administrative functions.

Data Integration: Involves combining data from various sources into a unified system, enabling seamless access and analysis across departments. Cloud platforms can facilitate this by centralizing data repositories and enabling real-time updates.

Linking Cloud Computing to Data Management

The integration of cloud computing into university systems has the potential to significantly enhance data management. Private clouds offer secure environments for managing sensitive academic records, while public clouds provide scalable platforms for collaborative tools and learning management systems. Both models can support data quality management by reducing redundancy and improving data accuracy through centralized systems (Ibrahim, 2022). Similarly, cloud-based platforms enable data integration by connecting disparate systems—such as student information systems, digital libraries, and research databases—into a cohesive digital ecosystem. This is particularly valuable in state-owned universities where legacy systems often operate in silos (Aminikpo *et al.*, 2024).

Despite these benefits, challenges such as inadequate funding, limited digital literacy, and policy gaps continue to affect the adoption of cloud computing in Rivers State universities. Addressing these barriers is crucial for leveraging cloud technologies to improve institutional data practices (Ibrahim, 2022; Rabiou & Muslim, 2023).

Theoretical Review

Technology Acceptance Model (TAM)- Davis (1989)

TAM explains how users form attitudes and intentions to use technology. In the context of cloud computing, TAM can help understand the factors influencing adoption and usage in universities. Understanding the factors that influence the adoption of cloud computing in universities can inform strategies to improve data management.

Resource-Based View (RBV) Theory- Barney (1991)

RBV theory posits that organizations can gain a competitive advantage by leveraging their unique resources and capabilities. In the context of cloud computing, RBV can help understand how universities can utilize cloud resources to improve data management. RBV can inform strategies for universities to leverage cloud computing to gain a competitive advantage in data management.

Information Systems Success Model (ISSM) - DeLone and McLean (1992, 2003)

ISSM explains the factors that contribute to the success of information systems. In the context of cloud computing, ISSM can help understand the factors that contribute to the success of cloud-based data management systems. ISSM can inform strategies to improve the success of cloud-based data management systems in universities.

Cloud Computing Adoption Model

Various studies have proposed cloud computing adoption models, including Sultan (2011) and Low *et al.* (2011). These models explain the factors that influence the adoption of cloud computing in organizations. In the context of universities, these models can help understand the factors that influence the adoption of cloud computing for data management. Understanding the factors that influence cloud computing adoption can inform strategies to improve data management in universities.

Empirical Studies

Several empirical studies have explored cloud computing and data management in higher education, particularly within Nigerian contexts and comparable developing systems.

Ibrahim and Muslim (2023) conducted a quantitative study titled “Determinants of Cloud Computing Adoption and Usage in Nigerian Universities”. The researchers found that factors such as institutional readiness, top management support, and perceived data sensitivity significantly influence whether universities prefer private or public cloud deployments. The study highlighted that while public cloud is often adopted for scalability and accessibility, private cloud is preferred for securing sensitive academic records.

In a preceding work, Ibrahim and Muslim (2022) offered a systematic literature review that analyzed 30 empirical studies on cloud computing adoption in universities. They identified a gap in localized research, particularly for state-owned universities in sub-national regions like Rivers State, and recommended context-specific models that incorporate hybrid cloud strategies.

Ibrahim (2022) developed a conceptual framework through a mixed-methods approach that included interviews with IT stakeholders across Nigerian universities. Her study, titled “Cloud Computing Adoption in Nigerian Universities: A Conceptualized Model Based on Stakeholder Perceptions”, emphasized that collaborative decision-making and policy alignment drive successful cloud implementation.

Broadening the lens globally, Behera *et al.* (2018) offered an empirical study on cloud computing architecture and implementation in academia. Though not Nigeria-specific, it provides comparative insights into deployment challenges and highlights data integration tools adopted in university environments.

Cano *et al.* (2016) investigated the efficiency and reliability of private cloud infrastructure across a large dataset of institutions in the U.S. While rooted in a different region, the study’s insights are useful for benchmarking performance expectations in African university settings exploring private cloud adoption.

Gopalakrishnan and Maheswari (2019) published a comparative study on public and private cloud services used by educational institutions. The researchers analyzed service models and costs, offering empirical data on why universities in resource-constrained environments lean toward public cloud to reduce infrastructure overhead.

When it comes to data management, Ehrlinger *et al.* (2022) conducted a study on data integration strategies and information lifecycle management. They argued that seamless integration of academic, financial, and personnel data systems is key to institutional analytics and planning. Their work is particularly relevant for universities consolidating legacy databases.

Cai and Zhu (2015) took a more theoretical yet evidence-based approach in discussing data quality challenges in big data environments. Their model addressed accuracy, completeness, and timeliness of data—all core dimensions of data quality management in universities.

Sadiq *et al.* (2017) explored how empirical methods can help measure and improve data quality in institutional databases. They introduced frameworks that universities can use to implement data governance policies.

A comparative study by the International Journal of Innovative Research in Computer Science and Technology (2020) investigated various cloud computing deployment models. The study provided empirical use cases from both public and private institutions and gave practical guidance on factors like scalability, compliance, and maintenance.

Methodology

The study adopted a correlational survey design. This design was deemed appropriate as the study aimed to examine the relationships and influences between aspects of cloud computing (private and public cloud) and data management components (data quality management and data integration) in state-owned universities. The correlational design enabled the researcher to statistically determine the degree of association between the variables without manipulating them.

The population of the study comprised ICT staff, data administrators, and university records managers in all the state-owned universities in Rivers State, which include Rivers State University (RSU), Ignatius Ajuru University of Education (IAUE), and Ken Saro-Wiwa Polytechnic (now upgraded to Ken Saro-Wiwa State University). The estimated population was approximately 185 staff, based on records obtained from the ICT and administrative units of the institutions.

A sample size of 123 respondents was selected from the total population using the stratified random sampling technique. The population was stratified based on the institutions, and proportional allocation was applied to ensure fair representation from each university. From each stratum, respondents were randomly selected to reduce bias and increase generalizability.

The primary instrument for data collection was a structured questionnaire titled *Cloud Computing and Data Management Questionnaire (CCDMQ)*. The questionnaire

was divided into three sections: Section A sought demographic information, Section B contained items on the influence of private cloud on data quality management, while Section C focused on the relationship between public cloud and data integration. The items were designed on a 4-point Likert scale ranging from Strongly Agree (4) to Strongly Disagree (1).

The instrument was subjected to face and content validity by three experts—one in Educational Technology, one in Measurement and Evaluation, and one in Computer Science—from the Faculty of Education, Rivers State University. Their corrections and suggestions were incorporated. To ensure the reliability of the instrument, a pilot test was conducted with 20 ICT staff from a public university in a neighboring state not included in the main study. The data collected from the pilot test was analyzed using Cronbach's Alpha, which yielded a reliability coefficient of 0.87, indicating high internal consistency.

The researcher personally administered the questionnaire with the assistance of trained research assistants to ensure a high rate of return and accurate completion. A total of 130 copies were distributed, and 123 were properly filled and returned, representing a 94.6% return rate.

Data collected were analyzed using both descriptive and inferential statistics. For the research questions, mean and standard deviation were used to summarize responses and determine levels of agreement. To test the hypotheses, Pearson Product Moment Correlation Coefficient (PPMCC) was used to establish the strength and direction of relationships between the independent (private and public cloud) and dependent variables (data quality management and data integration). All hypotheses were tested at 0.05 level of significance using SPSS version 25.

Results

Hypothesis 1: There is no significant relationship between the private cloud and data quality management in state-owned universities.

Table 1: Relationship between Private Cloud and Data Quality Management

		Private Cloud	Data Quality Management
Private Cloud	Pearson correlation	1.000	0.631
	Sig. (2-tailed)	.	.000
	N	123	123
Data Quality Management	Pearson correlation	0.631	1.000
	Sig. (2-tailed)	.000	.
	N	123	123

The result in Table 1 shows a Pearson correlation coefficient (r) of 0.631, which indicates a moderate to strong positive relationship between private cloud and data quality management. The p -value of 0.000 is less than the 0.05 significance level, hence the null hypothesis is rejected. This implies that there is a significant relationship between the use of private cloud and data quality management in state-owned universities in Rivers State. As private cloud usage increases, data quality management also improves.

Hypothesis 2: There is no significant relationship between the public cloud and data integration in state-owned universities.

Table 2: Relationship between Public Cloud and Data Integration

		Public Cloud	Data Integration
Public Cloud	Pearson correlation	1.000	0.547
	Sig. (2-tailed)	.	.000
	N	123	123
Data Integration	Pearson correlation	0.547	1.000
	Sig. (2-tailed)	.000	.
	N	123	123

Table 2 presents a correlation coefficient (r) of 0.547, indicating a moderate positive relationship between public cloud adoption and data integration. The p -value of 0.000 is below the 0.05 level of significance, leading to the rejection of the null hypothesis. This means that a significant relationship exists between public cloud usage and data integration in state-owned universities. The findings suggest that increased use of public cloud services is associated with better integration of data across university departments.

Discussion of Findings

Private Cloud and Data Quality Management

The result of the first hypothesis revealed a statistically significant and positive relationship between private cloud adoption and data quality management ($r = 0.631$, $p < 0.05$). This finding implies that increased use of private cloud infrastructure enhances the quality of data management processes in state-owned universities. Specifically, private cloud platforms offer more secure, customizable, and controlled environments for data storage, processing, and retrieval. These features help reduce data redundancy, ensure consistency, and improve data integrity and accuracy.

This result aligns with the findings of Nguyen and Simkin (2022) who reported that institutions using private cloud infrastructures experienced improved data quality assurance due to dedicated resources and restricted access control. Similarly, Olanrewaju and Adewumi (2021) found that private cloud solutions enhanced data accuracy and reduced duplication in Nigerian public universities. From a theoretical standpoint, this supports the Technology Acceptance Model (TAM) which posits that perceived usefulness and ease of use influence the acceptance of new technologies. In this context, the perceived ability of private cloud to ensure high data quality may be driving its adoption and utilization.

Furthermore, given the sensitive nature of academic and administrative data in universities, private cloud's ability to offer stronger security protocols and institutional autonomy appears to directly contribute to better data quality management. This suggests that investment in private cloud infrastructure could be a strategic move for improving institutional data reliability in state-owned universities.

Public Cloud and Data Integration

The result of the second hypothesis also showed a significant positive relationship between public cloud usage and data integration ($r = 0.547$, $p < 0.05$). This suggests that public cloud platforms contribute to enhancing the ability of state-owned universities to integrate data from various sources and departments into unified systems. Public cloud services such as Google Cloud, Microsoft Azure, and Amazon Web Services often offer interoperability, shared access, and multi-platform compatibility, which promote real-time data access and departmental collaboration. This finding supports the study by Ali, Al-Fuqaha, and Guizani (2023) who found that public cloud platforms facilitated effective data synchronization and sharing among higher institutions. It also aligns with Ibrahim and Nwachukwu (2020) who noted that the scalability and accessibility of public cloud systems enhanced cross-functional data flow in educational institutions.

From a practical standpoint, this implies that state-owned universities can leverage public cloud systems to eliminate data silos, reduce system fragmentation, and improve decision-making processes through comprehensive data integration. However, while public cloud platforms enhance integration, concerns around data security and privacy remain, particularly in the context of Nigerian public institutions with limited regulatory oversight.

Overall, the findings of this study emphasize the critical role of cloud computing in modernizing data management in tertiary education. While private clouds are more effective in enhancing data quality due to their controlled environment, public clouds offer superior support for data integration due to their scalability and accessibility. Strategic adoption of both systems—possibly through hybrid cloud models—could yield maximum benefits for data-driven governance in state-owned universities.

Conclusion

This study investigated the influence of cloud computing—specifically private and public cloud models—on data quality management and data integration in state-owned universities in Rivers State. The findings revealed that private cloud adoption has a significant positive effect on data quality management, while public cloud usage also significantly enhances data integration across university departments. These results underscore the potential of cloud computing to address long-standing inefficiencies in data storage, retrieval, and analysis within the context of higher education.

Despite infrastructural and policy challenges, the study establishes that cloud technologies can serve as critical enablers of digital transformation in Nigeria's tertiary institutions. The benefits observed include improved data accuracy, consistency, and seamless cross-functional collaboration. For state-owned universities aiming to modernize their academic and administrative functions, investing in cloud infrastructure and human capacity is essential for achieving long-term efficiency, agility, and innovation.

Recommendations

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

1. State-owned universities should prioritize the development and deployment of private cloud systems to manage sensitive academic and administrative data securely and efficiently.
2. Government and university leadership must establish clear cloud computing adoption frameworks and data governance policies that address ownership, access, and compliance.

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