

Harnessing Cloud Computing in Nigerian Educational Sector

Salim Ahmad

Department of Information Technology, Federal University Dutse

Corresponding Email: salim_mgr@yahoo.com

Abstract

Due to the rapid development of data generation today, lots of data are generated on every day basics at various level in educational sector. Information storage for individual and organizations including educational sector is taking another dimension. Harnessing cloud computing in educational sector will definitely lead to the adoption of Cloud Computing in the sector. Cloud Computing is everything that could answer the challenges of ICT in educational sector and the ability to make ICT resources cheaper that's what gives great flexibility for expansion, but suffered a lot of setbacks considering the security and privacy issues related to the technology. This paper considered the benefit of harnessing cloud computing in Educational Sector as objectives and recommended for adopting the new technology by educational sector in Nigeria. Descriptive Research Methods were used in the research.

Keywords: *Cloud Computing, Cloud Adoption, Cloud Architecture, Security, TOE Framework, Nigerian Educational Sector*

Introduction

The Nigeria Educational System is in the concurrent list of the Nigeria constitution (Okwuchukwu, 2019). In this situation federal, states and local governments have some statutory managerial responsibilities when it comes to Educational Sector in Nigeria. These Educational sector ranges from Universities, Polytechnics, Colleges of Education, Secondary Schools, Primary Schools and other related educational institutions be it private or public. The educational sector in Nigeria warrants more consideration not only because of the social, economic and political impact of the sector but also because of the role of education in human life and the important role it played in any country's economic development.

The Nigerian Education Sector has seen various changes and transformations in Information Technology. Institutions of higher learning, such as Universities, Polytechnics, Colleges and Research Institutions are the essential sector in terms of invention through their research and development. Consequently, Higher Institutions and other basics and post basic educational sector may benefit significantly by harnessing the cloud computing benefits including cost effectiveness of ICT services, resource sharing, data storage while fostering innovation, promoting agility as well as other cloud services (Gital and Zambuk, 2019).

So many reasons have influenced the growth and development of the Nigeria educational sector which are numerous to mention but among them are political, economic and international factors (Okwuchukwu, 2019). However, Harnessing Cloud Computing in educational sector will contribute in the sector positively despite the technological issues associated with cloud computing technology.

Related Work

Many organizations in Nigeria are making use of Cloud Technology in reducing cost and easy access to boarder services it offered critical evaluation of related literatures indicate low patronage in educational section due to difficulty in decision making process. As described by Odeh (2017) the innovation process model of knowledge, persuasion, decision, implementation and confirmation; knowledge serves as a major characteristics of decision making, this persuade thinking of the relative advantages, compatibility and complexibility of the new technology intended to implement. After that, followed by decision to adopt or reject prior to implementation as well as confirmation by the instition. Olanrewaju (2017) also discovered in their research where analysis was made and demonstrates that the adoption of Cloud Computing in establishments of higher learning can be realized through some factors that have an vital control on adoption methodologies similar to administrative bodies and governments, internal stakeholders, cloud suppliers, firm attributes, socio-political changes, IT framework, and the likes and also conclude Improvements in service delivery. However, *Cloud computing is fast gaining a significant ground as a solution to offer institutions with competitive advantage compared to the old traditional Technology. Although, the adoption level of cloud services is still very low in higher institutions of learning due to security issues, especially trust issues which remain a major concern over cloud solutions. Furthermore, studies shows that some selected public and private universities in sub Saharan Africa have low cloud adoption. That's why an adoption strategy was recommended with reference to the resources available, confidentiality, integrity and availability in their research. Ibrahim (2014) examines nine variables in adoption cloud computing at HEIs in Nigeria, that will make decision much more easier by HEIs management as relative advantage, compatibility, complexity, trailibility, top management, firm size, amount of information, pressure coercive and quality of internet connection and also recommended Innovation Diffusion Theory. However, Christopher (2014) revealed that the adoption of cloud computing technology has an important influence on cost effectiveness, enhanced availability, low environmental impact, reduced IT complexities, mobility, scalability, increased operability and reduced investment in physical asset However, the major challenges confronting the adoption of cloud are data insecurity, regulatory compliance concerns, lock-in and privacy concerns.*

Cloud Computing Adoption in Nigerian Educational Sector

According to National Institute for Standards and Technology (NIST) “Cloud Computing as a model that enables convenient on-demand network access to a shared pool of configurable computing resources like (network, server, storage, applications and services) that can be rapidly provisioned and released with minimal management effort of service provider interaction” (NIST, 2011). Moreover, Cloud computing is a technology that represents a shift from the traditional ownership of ICT infrastructure and other resources to a more scalable form in which Computer resources are hired online to organizations on either as a pay-as-you-use base or by subscription (Adeleke, 2020).

- Most of the educational sector use cloud computing all day long without realizing it. When using your PC and typing a query into Google, the computer on your desk isn't playing much part in finding the answers you need: it's no more than a messenger. The words you type are swiftly shuttled over the Net to one of Google's hundreds of thousands of clustered PCs, which dig out your results and send them promptly

back to you. When you do a Google search, the real work in finding your answers might be done by a computer sitting in California, Dublin, Tokyo, or Beijing; you don't know—and most likely you don't care!

- The same applies to Web-based email. Once upon a time, email was something you could only send and receive using a program running on your PC (sometimes called a mail client). But then Web-based services such as Hotmail came along and carried email off into the cloud.
- Preparing documents over the Net is a newer example of cloud computing. Simply log on to a web-based service such as Google Documents and you can create a document, spreadsheet, presentation, or whatever you like using Web-based software. Instead of typing your words into a program like Microsoft Word or OpenOffice, running on your computer, you're using similar software running on a PC at one of Google's world-wide data centers.

All these can be adopted in the Nigerian Educational Sector in order to harness the benefits associated with the technology as well as to foster growth and development of the sector. Cloud Computing can be used based on three (3) different models, that offers diverse services to users, these models allows users to run applications and store data online. But they all offer different level of user flexibility and control (Ahmad et al, 2017). These models are categorized as shown in the figure below:

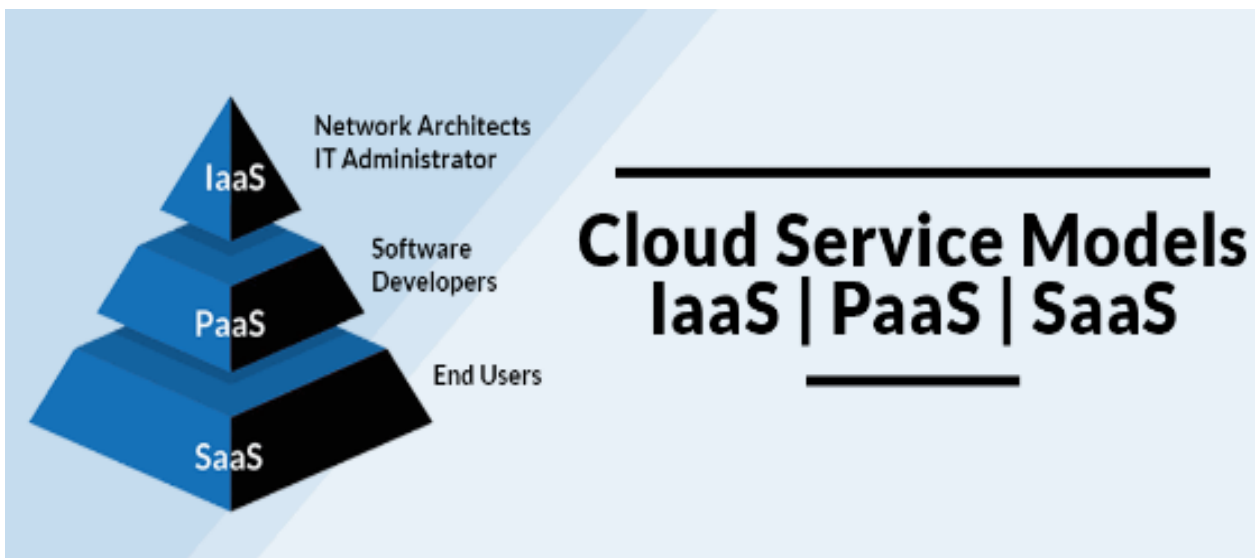


Figure 1: Cloud Computing Models (Ahmad et al, 2017)

From the figure 1 above, we have seen how cloud computing services model are classified and the different services they offered. Moreover, the models would be examined in such to give details on how each of the models works.

- Software as a service (SaaS) cloud computing users run existing online applications via internet by making use of interface like web browser as per requirement and pay per use. The cloud providers ensure hardware, applications, and operating system maintenance and security. Eg salesforce, Google Apps, gmail and Google Docs.

- Platform as a service (PaaS) users in this service create their own cloud applications using supplier – specific tools and languages which also offers Operating System and other tools for software development. Eg Microsoft Window Azure, Google App Engine and Amazon web services.
- Infrastructure as a service (IaaS) users of IaaS run any application they please on cloud hardware of their own choice, this is because user has direct access to CPU processing, servers, network, storage devices on virtual machines which are access via Internet Protocol (IP) address. Eg IBM Computing on demand, GoGrid, and Rackspace Cloud.

However, the models of are connected to the cloud computing architecture as a means of fully understanding how the general technology of cloud computing works. The essential components and sub-components that make the cloud work are broadly divided into two sections; the front end and back end which connect to each other via a network generally the INTERNET.

Front End: This is the visible interface that computer users or clients encounter through their web-enabled client devices. But it should be clear here that not all cloud computing systems will use the same user interface.

Back End: On the other hand, is the “cloud” part of a cloud computing architecture, comprising all the resources required to deliver cloud-computing services. A system’s back end can be made up of a number of bare metal servers, data storage facilities, virtual machines, a security mechanism, and services, all built in conformance with a deployment model, and all together responsible for providing a service. This can better be understood with the Figure 2 below.

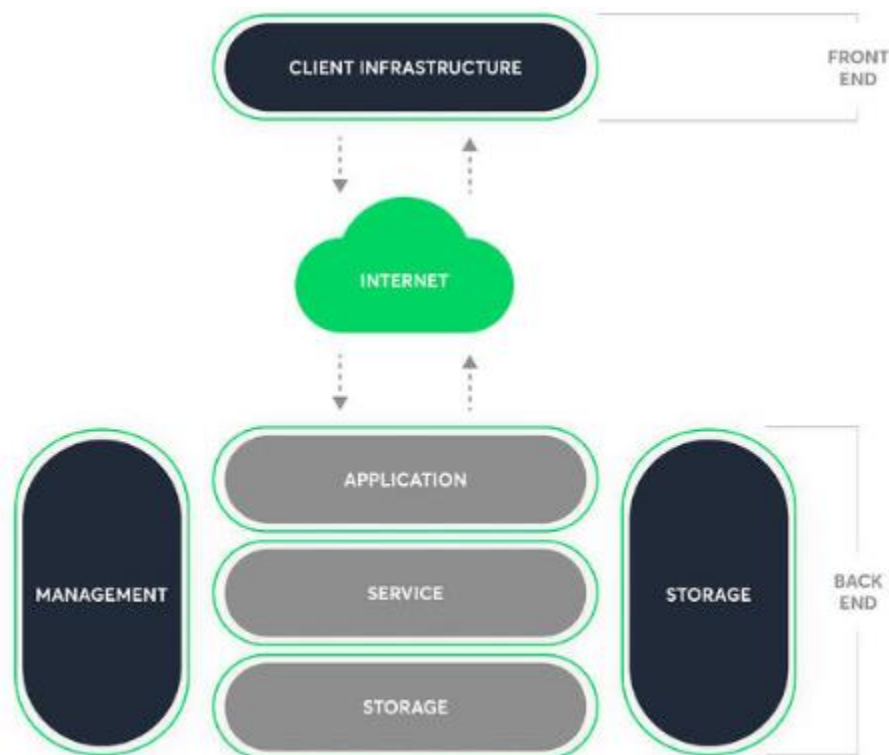


Figure 2: Architecture of Cloud Computing Adapted from (Ahmad et al, 2017).

Therefore, cloud computing adoption will the educational sector a means or a strategic move in order to reduce cost, risk and attaining scalability of data base capabilities by partly or fully deploying organization's digital assets, services, IT resources or applications to cloud (Hassan et al, 2016). Some of the factors that influence the Cloud Computing Adoption are the (TOE Framework) Technology; due to the new innovations in technology which is on the rise, Organization; the size of your organization which depends on the volume of data generated by that sector, and Environment; due to intense rivalry among competitors, in order for organization to be relevant in the market. The TOE frameworks are some of the factors that necessitate cloud computing adoption generally.

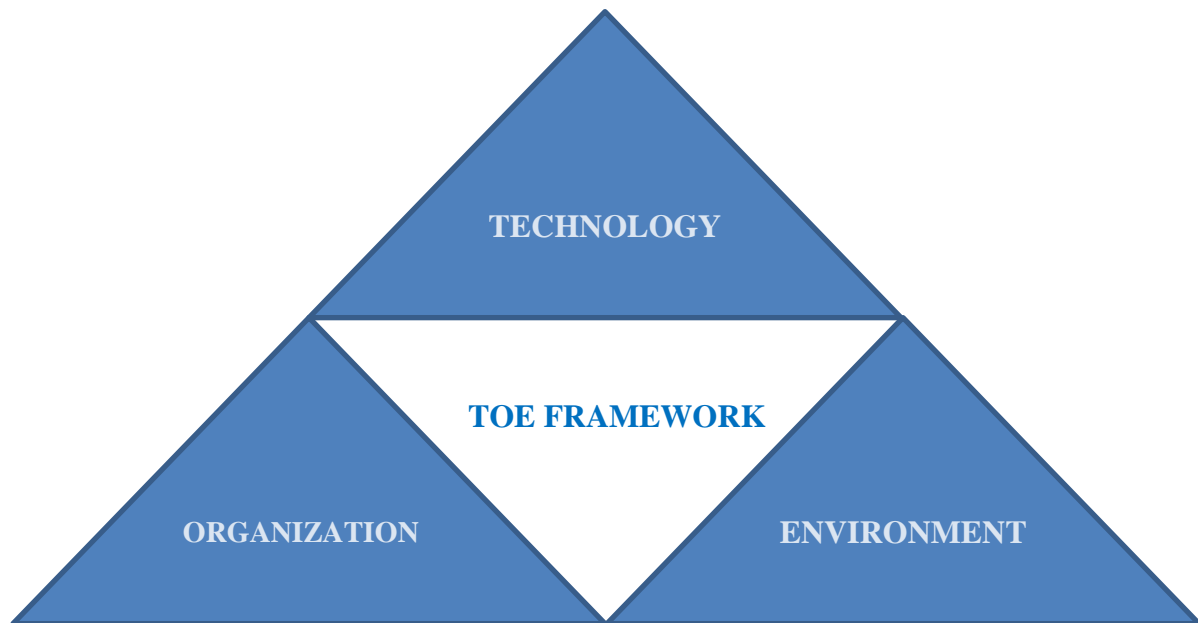


Figure 2: TOE Framework for Cloud Adoption. Adapted from (Hassan et al, 2016)

Security Issues in Cloud Computing Adoption in Nigerian Educational Sector

Nigerian Education Sector is a very diverse sector that generates numerous data volumes, and the amount of data generated depends on the size of the organization. Therefore, when using a cloud computing services, is essentially handing over all the data generated to a third party. The fact that the entities as well as users from all over the world are accessing the same server can cause a security issue (Malik & Chaturvedi, 2013). Companies handling confidential information might be particularly concerned about using cloud computing, as data could possibly be harmed by viruses and other malware. That said, some servers like Google Cloud Connect come with customizable spam filtering, email encryption, and SSL enforcement for secure HTTPS access, among other security measures. Cloud computing sometimes comes with the risk that unauthorized users might access your information. To protect against this happening, cloud computing services offer password protection and operate on secure servers with data encryption technology in order to improve the privacy related issues. Cloud computing entities control the users. This includes not only how much you have to pay to use the service, but also what information you can store, where you can access it from, and many other factors. You depend on the provider for updates and backups. If for some reason, their server ceases to operate, you run the risk of losing all your information, that's to say with cloud computing adoption by educational sector, the control of those

resources may be lost. While Internet access is increasingly widespread, it is not available everywhere in Nigeria yet. Therefore, Internet **Reliance is a major setback also** that hinders the cloud implementation by many users.

Harnessing the benefits of Cloud Computing in Nigerian Educational Sector

Cloud computing as a new technology drives lots of benefits when adopted and implemented in any organization (Ahmad et al, 2017). So, harnessing this technology in Nigerian educational sector will lead to so many growths in the entire sector. there are many potential opportunities and capabilities that cloud computing can open, it can lead to a whole new world of jobs, services, platforms, applications, and much more in the Nigerian educational sector which will organize the sector and give room for conducting learning and research much more affordable, easier and professional.

Nigerian Educational sector would be able to achieve great things when connecting with cloud computing in different ways, some of which are as follows:

1. Reduced Cost and Savings on Expensive and outdated Textbooks

Cloud computing is often inexpensive. The software is already installed online, so you won't need to install it yourself. There are numerous cloud computing applications available for free, such as Dropbox, and increasing storage size and memory is affordable. If you need to pay for a cloud computing service, it is paid for incrementally on a monthly or yearly basis. By choosing a plan that has no contract, you can terminate your use of the services at any time; therefore, you only pay for the services when you need them. Cloud-based textbooks are an effective solution to expensive text books. Digital contents are likely to be less expensive. Hence, allowing students to get access to the same quality of learning material. Costly textbooks force students to rely on older version of books, or even resort to second-hand editions that contain obsolete material. In such cases, Cloud-based material makes it easy to update content in real-time, enabling students and any user to have access to the latest learning resources as well as getting away with buying expensive text books particularly with the economic situation in Nigeria.

2. Easy Accesses to Expensive Software/Hardware

One of the main advantages of cloud computing is the development of the Software-as-a-Service (SaaS) model. It is common for software programs to now be available either free or at a low-cost depending on the type of subscription, which makes it easy for student/user to use high-quality academic applications without spending much. Therefore, the cost for the educational sector in providing the software is drastically reduced. However, Cloud computing applications run on web browsers and are compatible with most mobile devices. This means schools and students do not need to own specific computers or laptops to access materials online. Additionally, there is no need to invest in external storage devices since there are several platforms available that offer free cloud-based storage services. This benefits students and other cloud computing users.

3. Worldwide Access and Wider Target Audience

Cloud computing increases mobility, as you can access your documents from any device in any part of the world. The benefits of cloud computing applications in educational sector open new opportunities for students. Since education in developed nations had moved online, also help students to get access to materials remotely.

Education and training are currently becoming easier, making it easy to receive specific training in areas that may improve employability alternatively.

4. Easier to Set-Up

You can set up a cloud computing service in a matter of minutes. Adjusting your individual settings, such as choosing a password or selecting which devices you want to connect to the network. After that, you can immediately start using the resources, software and many other which is easier with cloud computing applications; all the tools that are used in teaching can be easily uploaded and accessed anytime by the students. This means, as long as there is internet connectivity, students have everything that is required in their studies conveniently. Whereas, teachers can receive assignments, grade test and monitor the academic activities of students

5. Scalability

Scalability in cloud computing refers to the ability to scale up or scale down IT resources as needed to meet the changing demand. Scalability is one of the promises of the cloud and the main driver of its exploding popularity with businesses. In education, this can be applied in cases where the student population reaches the point that exceeds the currently available resources, where much data are generated or otherwise. Cloud computing offers the authority to expand these resources to meet demand, to manage resources and also comprises of reducing capabilities to match requirements.

6. Data Security and Storage

In the past, memory was limited by the particular device in question. If you ran out of memory, you would need a USB drive to back up your data in external device. Cloud computing offers increased storage, so you won't have to worry about running out of space on your hard drive. However, Cloud computing applications offer strong authentication protocols for making sure that academic materials are made available only to authorized personnel with maximum data security.

Conclusion

Cloud Computing improved services delivery and growth in any sector of the economy in Nigeria not only Educational Sector, due to the incredible opportunities provided. The Educational Sector is one of the sectors that generated lots of data; this will help in making available a gigantic number of educational databases in Nigeria. Where all information related to the sector can be stored in the cloud. Since the technology provides mass data storage capability. But the poor state of ICT in the Nigerian educational system may limit its influence in the sector entirely. Funding and poor or inadequate ICT infrastructure in educational sector is characterized as a main obstacle to the effective use of ICT. However, with the adoption and harnessing some of the benefits associated with the cloud computing technology will influence the growth and development of the sector. Harnessing Cloud Computing Technology in Nigerian Educational Sector will make the sector more technologically active, most especially in the discharge of its responsibilities. This research examines some of the benefits the sector will attain when it adopts and implement the technology with little or no cost. Despite the challenges of Cloud Computing, in this regard Cloud Computing services have lots of prospects if properly managed and harnessed in Educational Sector in Nigeria.

References

- Ogwu Paul Okwuchukwu (2019) 'Overview of The Nigerian Educational Sector'. Available at: <http://isdfoundation.org.ng/2019/05/10/overview-of-the-nigerian-educational-sector/> (Accessed: on 17/5/2022)
- Abdulsalam Ya'u Gital and Fatima Umar Zambuk (2011) 'Cloud Computing: Solution to ICT in Higher Education in Nigeria'. Available at: <https://www.primescholars.com/articles/cloud-computing-solution-to-ict-in-higher-education-in-nigeria.pdf> (Accessed: on 16/5/2022)
- Abasiama G. Akpan and Shedrack Mmeah (2019) 'Harnessing Cloud Computing Paradigm for Virtual Library Adoption in Tertiary Institutions in Nigeria'. Available at: https://www.researchgate.net/publication/335813731_Harnessing_Cloud_Computing_Paradigm_for_Virtual_Library_Adoption_in_Tertiary_Institutions_in_Nigeria (Accessed: on 13/5/2022)
- Fagbola Tamitayo. M.(2015) 'Cloud Computing in Education – A Study of Trends, Challenges and an Archetype for Effective Adoption in Nigerian Universities' Available at: https://www.researchgate.net/publication/309430082_Cloud_Computing_in_Education_-_A_Study_of_Trends_Challenges_and_an_Archetype_for_Effective_Adoption_in_Nigerian_Universities (Accessed: on 13/5/2022)
- Ayeleye Christoper Akin, Fagbola Temitayo Matthew and Daramola Comfort Y. (2014) The Impact and Challenges of Cloud Computing Adoption on Public Universities in Southwestern Nigeria'. Available at: <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.678.3292&rep=rep1&type=pdf> (Accessed: on 16/5/2022)
- Salim Ahmad, Suleiman Ibrahim and Sanjeev Kumar (2017) 'Cloud Computing – A new Era of Information Technology: Opportunities and Challenges'. Published by *International Journal of Science Technology and Management*, Vol. No. 6, Issue No. 4, April 2017, pg 363-370 Available at: www.ijstm.com (Accessed: on 16/5/2022)
- Sapna Malik, MM Chaturvedi, (2013) 'Privacy and Security in Mobile Cloud Computing: Review'. Published by *International Journal of Computer Applications* (0975-8887) Volume-No11, October, 2013.
- NIST – National Institute of Standard and Technology, US Department of Commerce. 'Guidelines on Security and Privacy in Public Cloud Computing'. Special publication, 2011. Available at: <http://csrc.nist/specialpublication/nistpubs/800-144.pdf> (Accessed: on 02/08/2021)
- Shrinivas A (2016) 'An Overview of Cloud Deployment Models and Security Issues'. Published in *International Journal of Computer Application* (2250-1797), Volume 6, No. 4 July-August 2016.
- Haslinda Hassan, Mohd Herry Mohd Nasir, Norhaiza Khairudin and Iskandar Adon (2016) 'Factors Influencing Cloud Computing Adoption in Small Medium Enterprises'.. Published in *Journal of Information and Communication Technology* 16(1) June 2016. Available at: DOI:10.32890/jict2017.16.1.2. (Accessed: on 02/08/2021)
- Imran A. Adeleke, Ismail O. Muraina and Kazeem K. Adegbuyi (2020) 'Adoption of Cloud Computing Technology for Effective University Administration in Nigeria' *Current Journal of Applied Science and*

Technology, 39(40): 1-8, 2020. Available at: DOI: 10.9734/CJAST/2020/v39i4031106. (Accessed: on 17/5/2022)

Mahmoud Odeh, Alexeis Garcia-Perez and Kevin Warwick (2017) Cloud Computing Adoption at Higher Education Institutions in Developing Countries: A Qualitative Investigation of Main Enablers and Barriers. Published at International Journal of Information and Education Technology 7(12):921-927, Accessed online from

https://www.researchgate.net/publication/315591077_Cloud_Computing_Adoption_at_Higher_Education_Institutions_in_Developing_Countries_A_Qualitative_Investigation_of_Main_Enablers_and_Barriers

Rashidah Olanrewaju et al. (2017) Adoption of Cloud Computing in Higher Learning Institutions: A Systematic Review. Published at Indian Journal of Science and Technology 10(36):1-19. Accessed online from

https://www.researchgate.net/publication/321536067_Adoption_of_Cloud_Computing_in_Higher_Learning_Institutions_A_Systematic_Review

Oyeleye Christopher, Fagbola Temitayo M. and Daramola Comfort (2014) The Impact and Challenges of Cloud Computing Adoption on Public Universities in Southwestern Nigeria. Published at International Journal of Advanced Computer Science and Application. 5(8) Accessed online from

https://www.researchgate.net/publication/269524402_The_Impact_and_Challenges_of_Cloud_Computing_Adoption_on_Public_Universities_in_Southwestern_Nigeria